



ENVIRONMENTAL STANDARDS REPORT

39-41 RICHMOND STREET

PROPERTY ADDRESS

39-41 RICHMOND STREET,
MANCHESTER,
M1 3WB,

DATE

April 2023

PREPARED BY

EAL Consult



Quidos
Excellence in Efficiency

Contents

1. EXECUTIVE SUMMARY 3

2. INTRODUCTION..... 6

3. PLANNING POLICY CONTEXT..... 8

4. ENERGY STRATEGY 11

5. ENVIRONMENTAL PERFORMANCE 14

6. CIRCULAR ECONOMY 16

7. CONCLUSION..... 17

8. APPENDIX..... 18

1. EXECUTIVE SUMMARY

This Environmental Standards Statement has been prepared to support the planning application for the erection of 4 new flats at 39-41 Richmond Street in Manchester. The strategy highlights how the proposed development will promote sustainability through both design and operation and summarises the relevant regulatory and planning policies applicable and how the relevant policy targets will be addressed and achieved.

The strategy responds to the UK Planning and regulatory framework, the National Planning Policy Framework 2021, City Council's Guide to Development in Manchester SPD/SPG (chapter 4) and Manchester Core Strategy 2012-2027

In accordance with the policies above, this statement outlines an overall commitment to reducing energy consumption under occupancy through the adoption of a 'Fabric First' principle, which will seek enhanced insulation standards and improved heating and lighting efficiencies in comparison to the standard requirements of Approved Document Part L 2021. Further carbon emission reduction can be achieved by using renewables (Air source Heatpumps).

Energy Efficiency & Carbon Reduction:

- Passive design principles including the electric boiler and a high level of insulation and reduced air permeability to deliver Part L 2021 compliant Building in absence of renewable technologies. It will achieve **32.1%** reduction in carbon emissions over Part L2 baseline.
- Air source Heatpumps have been proposed for the specific scheme and will deliver a further **43.5%** reduction in regulated carbon emissions over Part L baseline when utilising the proposed carbon factor changes to building Regulations Part L.

Material and waste management:

- Minimising the use of virgin materials during construction by recycling and reusing where feasible.
- Low waste benchmark levels will be targeted during construction with requirements identifying that the diversion of waste from landfill is to be achieved by the contractor.

Recommendation and Results:

This report demonstrates that the proposed development by incorporating the measures above can achieve an average carbon emission reduction of **75.6% with the use of:**

- **Air source Heatpumps.**

The following tables demonstrate the carbon emissions and savings.

Table 1. Carbon Dioxide emissions after each stage of the Energy Hierarchy

	Regulated Carbon dioxide emissions (Tonnes CO ₂ per annum)	
	Regulated	Unregulated
Building Regs Notional Development	3.21	3.85
After Energy demand Reduction	2.18	2.61
After Renewables	0.78	0.94

Table 2. Carbon Dioxide Savings from each stage of the Energy Hierarchy

	Regulated Carbon dioxide savings (Tonnes CO ₂)	% Reduction
Savings from energy efficiency measures	1.03	32.1%
Savings from Renewables	1.39	43.5%
Total savings	2.42	75.6%

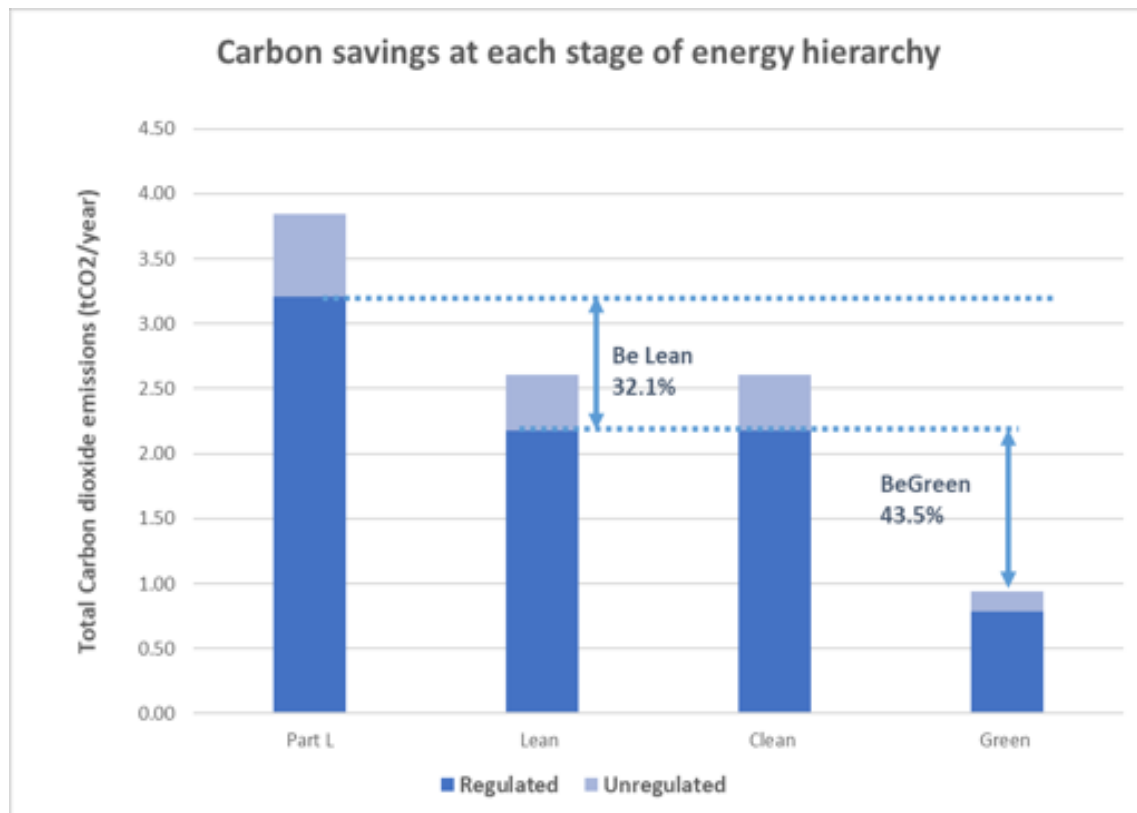


Figure 1. Carbon saving over energy hierarchy

The figure 1 summarises the carbon savings for each stage of the energy hierarchy. The overall carbon reduction for the project is **75.6%** which exceeds the 15% reduction outlined in the City Council's Guide to Development in Manchester SPD/SPG (chapter 4) and Manchester Core Strategy 2012-2027.

This reduction will allow to achieve a **Star 3 rating** as a minimum for the Code of sustainable homes.

2.INTRODUCTION

Site description

The development is located on 39-41 Richmond street. The development concerns the erection of 4 new flats.



Figure 2. Site location

Methodology

This energy assessment outlines the energy demand from the development together with the associated CO₂ emissions, using the present Building Regulations Part L as a baseline. It demonstrates how the emissions from energy use in the development will be reduced through energy efficiency measures.

The proposed scheme is required to achieve carbon emission reduction principles in accordance with the UK Planning and regulatory framework,

The methodology employed to determine the potential CO₂ savings is in accordance with the three-step Energy Hierarchy.

- **Be Lean** - Improve the energy efficiency of the scheme;
- **Be Clean** - Supply as much of the remaining energy requirement with low carbon technologies such as district heating if available or combined heat and power (CHP); and
- **Be Green** - Offset a proportion of the remaining carbon dioxide emissions by using renewable technologies.

The government approved Standard Assessment Procedure (SBEM) methodology software (2013) has been used to determine the CO₂ emissions and energy requirements. It compares CO₂ emissions from regulated energy use (BER) with those of an equivalent Building built to Part L2A 2013 (TER), a notional building of the same size and shape. These calculations do not include emissions from cooking or appliances.

Opportunities for incorporating features into the development that contribute to the objectives of sustainable development were explored during the design process, to ensure that where possible, the proposals achieve best practice.

3. PLANNING POLICY CONTEXT

National Planning Policy Framework 2021 – emphasised the concept of sustainable development by encouraging local authorities to adopt proactive strategies to mitigate and adapt to climate change. It recommends the move to a low carbon future by:

- Avoiding 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
- Contributing 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:
 - 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);
 - consider identifying suitable areas for renewable and low carbon energy sources, and supporting infrastructure, where this would help secure their development; and
 - identify opportunities for development to draw its energy supply from decentralised, renewable or low carbon energy supply systems and for colocating potential heat customers and suppliers.

Manchester, Core Strategy – 2012 to 2027.

Policy EN4 – Reducing CO2 emissions by enabling low and zero carbon development

The Council will seek to reduce fuel poverty and decouple growth in the economy, growth in CO2 emissions, and rising fossil fuel prices, through the following actions:

- All development must follow the principle of the Energy Hierarchy, being designed:
 - to reduce the need for energy through design features that provide passive heating, natural lighting and cooling
 - to reduce the need for energy through energy efficient features such as improved insulation and glazing
 - to meet residual energy requirements through the use of low or zero carbon energy generating technologies
- Wherever possible new development and retrofit projects, including energy generation plant, must be located and designed in a manner that allows advantage to be taken of opportunities for low and zero carbon energy supplies.
- Where possible new development and retrofit projects will be used as a mechanism to help improve energy efficiency and provide low and zero carbon energy supplies to existing buildings.
- Where appropriate new development and retrofit projects will be required to connect to and/or make contributions to low or zero carbon energy schemes and/or to incorporate provision to enable future connection to any existing / potential decentralised energy schemes.
- The use of building materials with low embodied carbon in new development and refurbishment schemes.

Policy EN6 – Target Framework for CO2 reductions from low or zero carbon energy supplies

Applications for residential development of 10 or more units and all other development over 1,000 sqm will be expected as a minimum to meet the target shown in Tables 12.1 or 12.2, unless this can be shown not to be viable. This should be demonstrated through an energy statement, submitted as part of the Design and Access Statement. Such a statement will be expected to set out the projected regulated energy demand and associated CO2 emissions for all phases of the development.

Developments smaller than the above threshold, but involving the erection of a building or substantial improvement to an existing building will also be expected to meet the minimum target, where viable, but will not be expected to submit an energy statement.

The target framework relates to three broad development locations and their potential for low and zero carbon, decentralised energy. The areas are defined as follows:

- Target 1 Network development areas: Locations where the proximity of new and existing buildings, the mix of uses and density of development provide the right conditions to support district heating (and cooling).
- Target 2 Electricity intense areas: Locations where the predominant building type has an all-electric fit-out such as retail units and leisure complexes.
- Target 3 Micro-generation areas: Locations where lower densities and a fragmented mix of uses tend to mean that only building scale solutions are practical.

Policy EN7 – Energy Infrastructure Opportunities

There will be a general presumption in favour of low and zero carbon decentralised energy schemes, subject to the following considerations:

- That any new generating plant capable of producing heat and cooling as well as electricity should be located in a way that facilitates future connection to a local distributed energy system.
- That any energy centre, including generating plant, standby/boiler plant and substations, shall be located and designed to a high quality so as to integrate with and contribute to the townscape.
- Biofuels should be obtained from sustainable sources and processes and in a way that minimises transport impacts, following a sequential approach in order to minimise CO2 emissions – firstly prioritising local and regional sources, followed by national, European and international.
- Consideration should be given to biofuel delivery by rail and waterways where possible. Where large-scale fuel or feedstock delivery is required by road the energy centre must be located in or adjacent to light industrial, industrial or leisure uses with any impact on local residential amenity minimised.
- The cumulative impact of energy schemes will be taken into account when considering applications, to include modelled impacts on air quality and landscape character, with reference to Policy EN16.
- Flood risk, through the Manchester-Salford-Trafford Strategic Flood Risk Assessment.

Policy EN8 – Adaptation to Climate Change

All new development will be expected to be adaptable to climate change in terms of the design, layout, siting and function of both buildings and associated external spaces. In achieving developments which are adaptable to climate change developers should have regard to the following, although this is not an exhaustive list:

- Minimisation of flood risk by appropriate siting, drainage, and treatment of surface areas to ensure rain water permeability
- Reduction in urban heat island effect through the use of Green Infrastructure such as green roofs, green walls, increased tree cover and waterways
- The need to control overheating of buildings through passive design
- The opportunity to provide linked and diverse green space to enhance natural habitats which will assist species adaptation

4. ENERGY STRATEGY

The Energy strategy for the proposed housing is based on the Building Regulations Part L2A; it adopts a set of principles to guide design and decisions regarding energy, balanced with the need to optimise environmental and economic benefits. It seeks to incorporate energy efficiency through the approach detailed below.

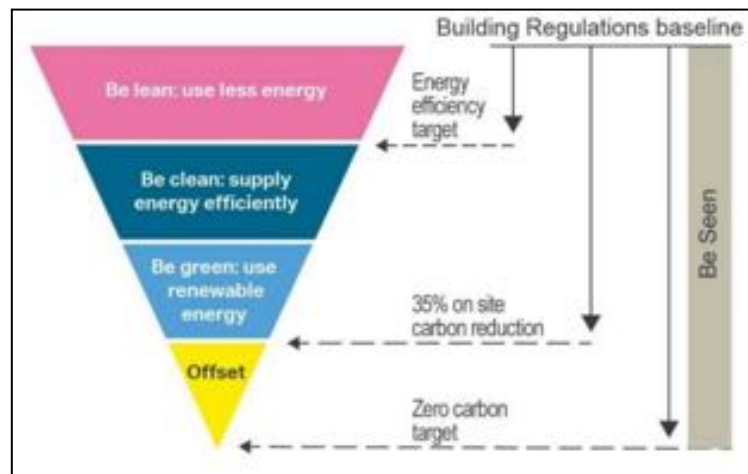


Figure 3. Energy Hierarchy

Be 'Lean' - Demand Reduction

The building fabric performance and engineering systems have been optimised in order to use less energy prior to the inclusion or consideration of Low and Zero Carbon (LZC) Technology.

Through passive design measures, efficient building fabric and engineering systems the building is estimated to achieve **32.1%** reduction in annual regulated CO₂ emissions over Part L2A benchmark, therefore demonstrating compliance with Building Regulations Through passive means alone without the utilisation of renewable technologies.

Passive Design Measures:

Fabric Performance - The fabric performance values aim to reduce unwanted heat loss and heat gains, whilst maintaining a comfortable internal environment.

Table 3. Fabric energy Efficiency Standard

Thermal element	Part L Minimum Standard
Wall	0.26W/m ² k
Roof	0.16 W/m ² k
Floor	0.18 W/m ² k
Glazing	1.6 W/m ² k
Doors	1.6 W/m ² k

The heat loss of different building elements is dependent upon their U –value. A building with low U values provides better levels of insulation and reduced heating demand.

The development will incorporate high levels of insulation and efficient glazing; thereby reduce demand for space heating. The table below shows the U values for the development and the associated improvements over Building Regulations.

Table 4. Energy Efficient design Specification

Element	Part L	Proposed
Wall	0.26 W/m ² k	0.12W/m ² k
Floor	0.16W/ m ² k	0.10W/m ² k
Roof	0.18 W/ m ² k	0.11 W/ m ² k
Glazing	1.6 W/ m ² k	1.2 W/ m ² k

Space Heating & Cooling - Space heating could be provided by underfloor heating

Efficient Lighting and Controls - Throughout the development natural lighting will be optimised. The development will also incorporate low energy light fittings throughout. All light fittings will be specified as low energy lighting and will accommodate compact LED luminaries only. Internal areas that are not frequently used will be fitted with occupant sensors.

Ventilation - The use of natural ventilation is proposed.

Domestic hot water (DHW) system – domestic hot water is supplied via the cylinder.

Be 'Clean' – Supply Energy Efficiently

The Be Clean step of the energy hierarchy refers to the use of 'Clean energy supply'. This includes, but is not limited to, the use of Combined Heat and Power (CHP) and District Heat Networks.

District Heating and Cooling

There is no existing or planned heat and energy network in the vicinity and the site does not fall into an opportunity area with decentralised energy potential.

Community heating and Combined Heat and Power (CHP system)

CHP systems are usually needed where there is a large heat demand (schemes with more than 100-150 dwellings), usually resulting from the building(s) being in continuous use, or through specific heating requirements such as a swimming pool. Community (or district) heating involves using a central boiler plant (or other heat sources) to heat a number of buildings through a network of well-insulated underground pipes. This system is not considered appropriate for this development

In light of the small scale of the proposed development, it is apparent that the use of CHP is also technically and financially unviable in this instance.

Be 'Green' - Renewable Energy

Once energy demand reduction measures have been applied, methods for generating low and zero carbon energy can be assessed. The following renewable technologies can be considered for the project: Biomass, Water source heat pump, air source heat pump, Wind energy and solar photovoltaic panels.

Renewable Technologies Feasibility Review Conclusion

The renewable energy sources that have been reviewed for this project are Biomass Heating, Ground Source Heat Pump, Air Source Heat Pump, Domestic Wind Turbine and Solar Photovoltaic Panels (PV).

On review of the above technologies as per the Appendix I, it has been concluded that the use of Air Source Heatpumps is to be incorporated in the design because it achieves a CO₂ percentage reduction of **43.5%** contributing to an overall reduction of **75.6%** in carbon emissions.

5. Environmental Performance

The proposed project incorporates sustainable design and construction measures capable of mitigating and adapting to climate change to meet future needs. This section details site-specific initiatives which demonstrate how the conversion helps to meet the sustainability objectives set out in the National Planning Framework 2021.

Energy Use and Pollution

The design of the development has taken into consideration day lighting to habitable spaces to improve the wellbeing of occupants. Good levels of daylight will offer occupants a pleasant and highly valued connection to the outdoors and plenty of natural light. It will also reduce the use of artificial lighting and therefore energy use. All light fittings will be specified as low energy lighting.

No external lighting is required. The location and orientation of windows help to create a design that avoids overheating in the summer.

Pollution: Air, Noise and Light

The layout of the development can provide good internal air quality for habitable areas but not too much so as to waste heat. The use of openable windows will create horizontal airflow. By achieving a good naturally ventilated building the energy demand for air conditioning and mechanical ventilation will thereby be eliminated within the development.

The development will not increase the air pollution of the area by reducing as a start, its energy consumption, which in turn will reduce emissions that lead to air pollution.

Other measures will include:

- a. Use of eco-friendly building materials
- b. Non-toxic paints
- c. Installation of energy efficient appliances and devices
- d. Use of renewable technologies

Light pollution can best be described as artificial light that is allowed to illuminate or intrude upon areas not intended to be lit. Light in the wrong place at the wrong time can be intrusive.

Intrusive light is over bright or poorly directed lights shining onto neighbouring property which affect the neighbours' right to enjoy their property. Therefore, the proposal will incorporate lighting measures in order to avoid causing a nuisance.

Water: Water Efficiency

In domestic and non-domestic buildings, the demand for water can be reduced as much as 50% using a variety of simple and innovative strategies that are integrated into the plumbing and mechanical systems. In order to reduce water consumption, the proposed development will include efficient fixtures with low flow rates. Total internal water consumption will not exceed 105 litres/person/day.

- A water efficiency strategy will be determined for the development. This will include 'A' rated appliances
- Specification of efficient water fixtures throughout the scheme (low flow taps and showers, dual flush WCs).
- The landscaped areas of the development will be irrigated solely by precipitation throughout all seasons of the year to reduce unregulated water consumption.

Pollution

All contractors would be required to sign up to the nationally recognised Considerate Constructors Scheme which requires, amongst other things that dust emissions, potential noise pollution, impacts

on water quality and the potential for ground contamination are minimised during demolition and construction. The Contractor would also be obliged to adhere to a site-specific Code of Construction Practice to reduce potential nuisance effects.

Waste

A space for reuse and recycling has been included at of the ground floor unit for the tenant's exclusive use.

Flood Risk

The development site is located in a Low Flood Risk Area on the Environment Agency Flood Risk Map.

Biodiversity

The proposed development will incorporate measures to support and enhance the environment through consideration of the existing site, including measures to mitigate the impact of the development and enhance site biodiversity.

6. Circular economy

Materials efficiency

Materials can have a significant impact on environmental performance, both in construction but also ongoing use. Materials used for the building will have lower environmental impacts over their lifecycle. This applies to the materials used in the external walls, roof and glazing. This extends to elements of the materials category such as the basic building materials (internal walls) and the finishing elements (fascia, skirting, and furniture).

It is expected that all timber used in the development will come from a legal Source (FSC Scheme). At least 80% of the building materials will be responsibly sourced and will use suppliers who can provide an EMS certificate or equivalent. Materials rated with an A or B in the BRE Green Guide to Specification will be preferred.

Other measures will be implemented:

- The reuse of existing materials from the demolition of existing buildings
- At least 20% of the total value of materials used should derive from recycled and reused content in the products and materials selected;
- Steel will have a high recycled content;
- Concrete will have a Ground Granulated Blast Furnace Slag (GGBS) value of 50%.

Resource efficiency

- Pre-demolition audit to be carried out and target benchmark of ≤ 11.1 tonnes of construction waste per 100m²;

Diversion of waste from landfill

- Where possible, segregation of recyclable and non-recyclable material will be employed for all waste generated throughout the construction process. Furthermore, material will be re-used on-site where feasible;
- Pre-fabrication of materials/elements such as bathroom pods, pipework and riser materials will be considered;
- Reusable packing solutions with key product manufacturers will be explored at the earliest opportunity. Solutions may include flat pallets, bulk bags, steel stillages and returnable cable drums;
- Construction waste – minimum 80% diversion from landfill rate;
- Demolition waste – minimum 90% diversion from landfill rate;
- Operational waste – Target diversion from landfill rate to be set.

7. CONCLUSION

The development has been designed to exceed Part L2A building regulations requirements. In line with the national and local policies, regulated CO₂ emissions from the development will be reduced by **76.6%** from the notional emissions once energy efficiency measures and green measures are taken into account. Furthermore, this assessment concludes that the use Air Source Heatpumps has been considered as the most suitable and appropriate solution for the specific proposed development.

In order to achieve the required carbon emissions reduction, the report concludes and proposes the use of energy efficient measures outlined in the section 4 of this report.

An appraisal of the proposed development has been undertaken against key sustainability objectives identified from relevant policy guidance. The framework for the appraisal was guided by the National Plan. This process has ensured that the development responds to the sustainable development objectives that are relevant to the area. Key sustainability initiatives in ecology, waste management, water, health and wellbeing, materials, pollution and Surface water management have been incorporated in the design of the proposed Development.

8.APPENDIX

- I. Renewable technologies review
- II. SAP Calculations

Appendix I

Technology		Pros	Cons
Biomass Heating A biomass system designed for wood pellets, which have a high-energy content, would fuel this development.		• Less volume of storage • Less maintenance and produce considerably less ash residue	• NOx Emissions which may impacts • High Costs • Not suitable for the project
Ground Source Heat Pump It circulates a mixture of water and antifreeze around a loop of pipe, called a ground loop, which is buried in the garden. Heat from the ground is absorbed into the fluid and passes through a heat exchanger into the heat pump		• Use all through the year	• High Costs • Not suitable for this project

Air Source Heat Pump They are an efficient and environmentally-friendly way of heating using air drawn freely from the atmosphere. They operate rather like a refrigerator in reverse, absorbing heat from the air into a working fluid which is passed into a compressor where its temperature is increased before it is transferred into the heating and hot water circuits of the building		• Can generate less CO₂ than conventional heating systems. • Cheaper • Provides heating and hot water • Less maintenance • Can be used as air-conditioning in the summer	• Needs electricity • Can be noisy
Wind Turbines Wind turbines are available in various sizes from large rotors able to supply whole communities to small roof or wall-mounted units for individual dwellings.		• Cheaper • Less CO₂	• Local wind speeds in the area are likely to be below the level generally required for investment in large wind turbines. • Noise and signal interference. • Detrimental aesthetic impact
Solar Photovoltaic Panels (PV) Photovoltaic panels extract the energy of the sun to generate electricity. They operate most efficiently when oriented to the south and are inclined to about 35 degrees.		• Cheaper • Less CO₂ • No input power in order to generate electricity.	• Not suitable for conservative areas

Appendix I

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Air Source Heat Pump They are an efficient and environmentally-friendly way of heating using air drawn freely from the atmosphere. They operate rather like a refrigerator in reverse, absorbing heat from the air into a working fluid which is passed into a compressor where its temperature is increased before it is transferred into the heating and hot water circuits of the building		• Can generate less CO₂ than conventional heating systems. • Cheaper • Provides heating and hot water • Less maintenance • Can be used as air-conditioning in the summer	• Needs electricity • Can be noisy
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Building Regulations England Part L (BREL) Compliance Report

Approved Document L1 2021 Edition, England assessed by Array SAP 10 program, Array

Date: Wed 12 Apr 2023 06:37:39

Project Information			
Assessed By	Mark Simons	Building Type	Flat, End-terrace
OCDEA Registration	EES/004083	Assessment Date	2023-04-12

Dwelling Details			
Assessment Type	As designed	Total Floor Area	45 m ²
Site Reference	39-41 Richmond	Plot Reference	Flat 1 - Electric
Address	39-41 Richmond Street, MANCHESTER, M1 3WB		

Client Details	
Name	Mark Simons
Company	EAL Consult
Address	17 Dobree Avenue, London, NW10 2AD

This report covers items included within the SAP calculations. It is not a complete report of regulations compliance.

1a Target emission rate and dwelling emission rate			
Fuel for main heating system	Electricity		
Target carbon dioxide emission rate	17.7 kgCO ₂ /m ²		
Dwelling carbon dioxide emission rate	12.31 kgCO ₂ /m ²		OK
1b Target primary energy rate and dwelling primary energy			
Target primary energy	94.6 kWh _{PE} /m ²		
Dwelling primary energy	129.05 kWh _{PE} /m ²		FAIL
1c Target fabric energy efficiency and dwelling fabric energy efficiency			
Target fabric energy efficiency	43.9 kWh/m ²		
Dwelling fabric energy efficiency	43.6 kWh/m ²		OK

2a Fabric U-values				
Element	Maximum permitted average U-Value [W/m ² K]	Dwelling average U-Value [W/m ² K]	Element with highest individual U-Value	
External walls	0.26	0.12	Walls (1) (0.12)	OK
Party walls	0.2	0	Party Wall (1) (0)	N/A
Curtain walls	1.6	0	N/A	N/A
Floors	0.18	0.1	UNHEATED (0.1)	OK
Roofs	0.16	N/A	N/A	N/A
Windows, doors, and roof windows	1.6	1.2	FRONT (1.2)	OK
Rooflights	2.2	N/A	N/A	N/A

2b Envelope elements (better than typically expected values are flagged with a subsequent (!))			
Name	Net area [m ²]	U-Value [W/m ² K]	
Exposed wall: Walls (1)	14.87	0.12 (!)	
Sheltered wall: Walls (2)	21.49	0.12 (!)	
Party wall: Party Wall (1)	24.81	0 (!)	
Ground floor: UNHEATED, UNHEATED	44.76	0.1 (!)	

2c Openings (better than typically expected values are flagged with a subsequent (!))				
Name	Area [m ²]	Orientation	Frame factor	U-Value [W/m ² K]
FRONT, WINDOWS	8.38	North West	0.7	1.2
REAR, WINDOWS	4.53	South East	0.7	1.2
ENTRANCE DOOR, CORRIDOR DOOR	1.89	North East	N/A	1.2

2d Thermal bridging (better than typically expected values are flagged with a subsequent (!))				
Building part 1 - Main Dwelling: Thermal bridging calculated from linear thermal transmittances for each junction				
Main element	Junction detail	Source	Psi value [W/mK]	Drawing / reference
External wall	E2: Other lintels (including other steel lintels)	Calculated by person with suitable expertise	0.16	
External wall	E3: Sill	Calculated by person with suitable expertise	0.16	

Main element	Junction detail	Source	Psi value [W/mK]	Drawing / reference
External wall	E4: Jamb	Calculated by person with suitable expertise	0.16	
External wall	E5: Ground floor (normal)	Calculated by person with suitable expertise	0.16	

3 Air permeability (better than typically expected values are flagged with a subsequent (!))

Maximum permitted air permeability at 50Pa	8 m ³ /hm ²	
Dwelling air permeability at 50Pa	3 m ³ /hm ² , Design value (!)	OK
Air permeability test certificate reference		

4 Space heating

Main heating system 1: Boiler with radiators or underfloor heating - Electricity

Efficiency	100.0%
Emitter type	Underfloor
Flow temperature	
System type	Direct acting electric boiler
Manufacturer	
Model	
Commissioning	

Secondary heating system: N/A

Fuel	N/A
Efficiency	N/A
Commissioning	

5 Hot water

Cylinder/store - type: Cylinder

Capacity	200 litres
Declared heat loss	2.1 kWh/day
Primary pipework insulated	N/A
Manufacturer	
Model	
Commissioning	

Waste water heat recovery system 1 - type: N/A

Efficiency	
Manufacturer	
Model	

6 Controls

Main heating 1 - type: Time and temperature zone control by arrangement of plumbing and electrical services

Function	
Ecodesign class	
Manufacturer	
Model	

Water heating - type: Cylinder thermostat and HW separately timed

Manufacturer	
Model	

7 Lighting

Minimum permitted light source efficacy	75 lm/W	
Lowest light source efficacy	100 lm/W	OK
External lights control	N/A	

8 Mechanical ventilation

System type: N/A

Maximum permitted specific fan power	N/A	
Specific fan power	N/A	N/A
Minimum permitted heat recovery efficiency	N/A	
Heat recovery efficiency	N/A	N/A
Manufacturer/Model		
Commissioning		

9 Local generation

N/A

10 Heat networks	
N/A	
11 Supporting documentary evidence	
N/A	
12 Declarations	
a. Assessor Declaration	
This declaration by the assessor is confirmation that the contents of this BREL Compliance Report are a true and accurate reflection based upon the design information submitted for this dwelling for the purpose of carrying out the "As designed" assessment, and that the supporting documentary evidence (SAP Conventions, Appendix 1 (documentary evidence) schedules the minimum documentary evidence required) has been reviewed in the course of preparing this BREL Compliance Report.	
Signed: Name:	Assessor ID: Date:
b. Client Declaration	
N/A	

Full SAP Calculation Printout



Property Reference	39-41 Richmond				Issued on Date	12/04/2023
Assessment Reference	Flat 1 - Electric		Prop Type Ref	39-41 Richmond		
Property	39-41 , Richmond Street, MANCHESTER, M1 3WB					
SAP Rating	61 D	DER	12.31	TER	17.70	
Environmental	92 A	% DER < TER				30.45
CO ₂ Emissions (t/year)	0.5	DFEE	43.58	TFEE	43.90	
Compliance Check	See BREL	% DFEE < TFEE				0.74
% DPER < TPER	-36.42	DPER	129.05	TPER	94.60	
Assessor Details	Mr. Mark Simons				Assessor ID	5542-0001
Client	EAL Consult, Mark Simons					

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	44.7600 (1b)	2.7500 (2b)	123.0900 (1b) - (4)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	44.7600		
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 123.0900 (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	2 * 10 = 20.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	Air changes per hour
Pressure test	20.0000 / (5) = 0.1625 (8)
Pressure Test Method	Yes
Measured/design AP50	Blower Door
Infiltration rate	3.0000 (17)
Number of sides sheltered	0.3125 (18)
	0 (19)

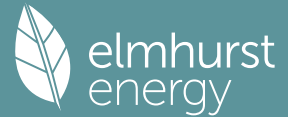
Shelter factor	(20) = 1 - [0.075 x (19)] = 1.0000 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.3125 (21)

	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	0.3984	0.3906	0.3828	0.3437	0.3359	0.2969	0.2969	0.2890	0.3125	0.3359	0.3515	0.3672 (22b)
Effective ac	0.5794	0.5763	0.5733	0.5591	0.5564	0.5441	0.5441	0.5418	0.5488	0.5564	0.5618	0.5674 (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
WINDOWS (Uw = 1.20)			12.9100	1.1450	14.7824		(27)
CORRIDOR DOOR			1.8900	1.2000	2.2680		(26)
UNHEATED			44.7600	0.1000	4.4760	110.0000	4923.6000 (28a)
EXTERNAL	27.7800	12.9100	14.8700	0.1200	1.7844	70.0000	1040.9000 (29a)
HALLWAY	23.3800	1.8900	21.4900	0.1100	2.3639	70.0000	1504.3000 (29a)
Total net area of external elements Aum(A, m ²)			95.9200				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		25.6747		(33)
SOLID			24.8100	0.0000	0.0000	180.0000	4465.8000 (32)

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CEILING 44.7600 30.0000 1342.8000 (32b)

Heat capacity $C_m = \text{Sum}(A \times k)$ (28)...(30) + (32) + (32a)...(32e) = 13277.4000 (34)
Thermal mass parameter (TMP = C_m / TFA) in kJ/m²K 296.6354 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element	5.0000	0.1600	0.8000
E2 Other lintels (including other steel lintels)	15.0000	0.1600	2.4000
E3 Sill	15.0000	0.1600	2.4000
E4 Jamb	25.0000	0.1600	4.0000
E5 Ground floor (normal)			

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 9.6000 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 35.2747 (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	23.5337	23.4085	23.2858	22.7095	22.6016	22.0997	22.0997	22.0067	22.2930	22.6016	22.8198	23.0479 (38)
Heat transfer coeff	58.8085	58.6833	58.5606	57.9842	57.8764	57.3744	57.3744	57.2814	57.5678	57.8764	58.0945	58.3226 (39)
Average = Sum(39)m / 12 =												57.9837

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.3139	1.3111	1.3083	1.2954	1.2930	1.2818	1.2818	1.2797	1.2861	1.2930	1.2979	1.3030 (40)
HLP (average)												1.2954
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

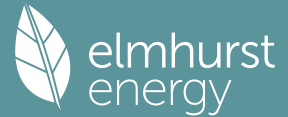
4. Water heating energy requirements (kWh/year)

Assumed occupancy												1.5378 (42)
Hot water usage for mixer showers	50.0033	49.2519	48.1569	46.0618	44.5156	42.7914	41.8113	42.8980	44.0893	45.9406	48.0807	49.8118 (42a)
Hot water usage for baths	22.7645	22.4264	21.9504	21.0725	20.4152	19.6864	19.2927	19.7654	20.2802	21.0601	21.9560	22.6876 (42b)
Hot water usage for other uses	31.9775	30.8147	29.6519	28.4891	27.3262	26.1634	26.1634	27.3262	28.4891	29.6519	30.8147	31.9775 (42c)
Average daily hot water use (litres/day)												96.2782 (43)
Daily hot water use	104.7454	102.4930	99.7591	95.6233	92.2571	88.6412	87.2674	89.9897	92.8585	96.6526	100.8514	104.4768 (44)
Energy conte	165.8911	145.9487	153.3260	130.9036	124.1958	108.9946	105.5424	111.4261	114.5039	131.1566	143.6813	163.5855 (45)
Energy content (annual)												Total = Sum(45)m = 1599.1556
Distribution loss (46)m = 0.15 x (45)m	24.8837	21.8923	22.9989	19.6355	18.6294	16.3492	15.8314	16.7139	17.1756	19.6735	21.5522	24.5378 (46)
Water storage loss:												
Store volume												200.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												2.1000 (48)
Temperature factor from Table 2b												0.6000 (49)
Enter (49) or (54) in (55)												1.2600 (55)
Total storage loss	39.0600	35.2800	39.0600	37.8000	39.0600	37.8000	39.0600	39.0600	37.8000	39.0600	37.8000	39.0600 (56)
If cylinder contains dedicated solar storage	39.0600	35.2800	39.0600	37.8000	39.0600	37.8000	39.0600	39.0600	37.8000	39.0600	37.8000	39.0600 (57)
Primary 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 (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	204.9511	181.2287	192.3860	168.7036	163.2558	146.7946	144.6024	150.4861	152.3039	170.2166	181.4813	202.6455 (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	204.9511	181.2287	192.3860	168.7036	163.2558	146.7946	144.6024	150.4861	152.3039	170.2166	181.4813	202.6455 (64)
12Total per year (kWh/year)												Total per year (kWh/year) = Sum(64)m = 2059.0556 (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	86.4068	76.7519	82.2289	73.7654	72.5431	66.4807	66.3408	68.2972	68.3125	74.8576	78.0140	85.6402 (65)

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

Metabolic gains (Table 5), Watts												
(66)m	76.8902	76.8902	76.8902	76.8902	76.8902	76.8902	76.8902	76.8902	76.8902	76.8902	76.8902	76.8902 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	67.4175	74.6408	67.4175	69.6647	67.4175	69.6647	67.4175	67.4175	69.6647	67.4175	69.6647	67.4175 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	133.6626	135.0496	131.5545	124.1136	114.7208	105.8930	99.9954	98.6084	102.1036	109.5445	118.9372	127.7651 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	30.6890	30.6890	30.6890	30.6890	30.6890	30.6890	30.6890	30.6890	30.6890	30.6890	30.6890	30.6890 (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)	-61.5121	-61.5121	-61.5121	-61.5121	-61.5121	-61.5121	-61.5121	-61.5121	-61.5121	-61.5121	-61.5121	-61.5121 (71)
Water heating gains (Table 5)	116.1382	114.2142	110.5227	102.4520	97.5041	92.3343	89.1678	91.7973	94.8785	100.6150	108.3528	115.1078 (72)
Total internal gains												

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366.2853 372.9717 358.5617 345.2973 328.7095 313.9591 302.6477 303.8902 312.7139 326.6440 346.0218 359.3574 (73)

6. Solar gains

[Jan]			Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	Specific data or Table 6c	FF	Access factor Table 6d	Gains W			
Southeast			4.5300	36.7938	0.6300		0.7000	0.7700	50.9384 (77)			
Northwest			8.3800	11.2829	0.6300		0.7000	0.7700	28.8960 (81)			
Solar gains	79.8344	145.5856	224.6908	321.1351	398.7021	412.9755	391.0126	330.5212	257.6760	167.7770	97.3711	67.1906 (83)
Total gains	446.1197	518.5573	583.2525	666.4324	727.4116	726.9346	693.6604	634.4115	570.3899	494.4210	443.3929	426.5479 (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	62.7149	62.8487	62.9804	63.6064	63.7249	64.2824	64.2824	64.3868	64.0665	63.7249	63.4856	63.2374
alpha	5.1810	5.1899	5.1987	5.2404	5.2483	5.2855	5.2855	5.2925	5.2711	5.2483	5.2324	5.2158
util living area	0.9908	0.9794	0.9508	0.8605	0.6932	0.4983	0.3628	0.4130	0.6614	0.9101	0.9799	0.9926 (86)
MIT	20.1162	20.2734	20.4906	20.7448	20.8889	20.9337	20.9402	20.9392	20.9106	20.7084	20.3703	20.0902 (87)
Th 2	19.8300	19.8322	19.8343	19.8444	19.8463	19.8551	19.8551	19.8567	19.8517	19.8463	19.8425	19.8385 (88)
util rest of house	0.9874	0.9721	0.9336	0.8185	0.6231	0.4124	0.2690	0.3117	0.5662	0.8713	0.9714	0.9898 (89)
MIT 2	18.8276	19.0266	19.2947	19.5935	19.7347	19.7765	19.7796	19.7810	19.7602	19.5655	19.1589	18.8016 (90)
Living area fraction										fLA = Living area / (4) =		0.5987 (91)
MIT	19.5991	19.7731	20.0107	20.2829	20.4258	20.4694	20.4745	20.4745	20.4490	20.2498	19.8842	19.5731 (92)
Temperature adjustment												0.0000
adjusted MIT	19.5991	19.7731	20.0107	20.2829	20.4258	20.4694	20.4745	20.4745	20.4490	20.2498	19.8842	19.5731 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	0.9865	0.9717	0.9366	0.8357	0.6594	0.4590	0.3199	0.3667	0.6173	0.8865	0.9718	0.9890 (94)
Useful gains	440.1035	503.8579	546.2538	556.9190	479.6775	333.6320	221.9270	232.6470	352.1034	438.2797	430.8693	421.8594 (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	899.7185	872.8049	791.1960	660.0274	505.0160	336.7524	222.2962	233.3905	365.4970	558.4959	742.6926	896.6016 (97)
Space heating kWh	341.9536	247.9324	182.2370	74.2380	18.8519	0.0000	0.0000	0.0000	0.0000	89.4408	224.5128	353.2082 (98a)
Space heating requirement - total per year (kWh/year)												1532.3746
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	341.9536	247.9324	182.2370	74.2380	18.8519	0.0000	0.0000	0.0000	0.0000	89.4408	224.5128	353.2082 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1532.3746
Space heating per m2										(98c) / (4) =		34.2354 (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 %)												100.0000 (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	341.9536	247.9324	182.2370	74.2380	18.8519	0.0000	0.0000	0.0000	0.0000	89.4408	224.5128	353.2082 (98)
Space heating efficiency (main heating system 1)	100.0000	100.0000	100.0000	100.0000	100.0000	0.0000	0.0000	0.0000	0.0000	100.0000	100.0000	100.0000 (210)
Space heating fuel (main heating system)	341.9536	247.9324	182.2370	74.2380	18.8519	0.0000	0.0000	0.0000	0.0000	89.4408	224.5128	353.2082 (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	204.9511	181.2287	192.3860	168.7036	163.2558	146.7946	144.6024	150.4861	152.3039	170.2166	181.4813	202.6455 (64)
Efficiency of water heater	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000 (216)
(217)m	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000 (217)

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Fuel for water heating, kWh/month	204.9511	181.2287	192.3860	168.7036	163.2558	146.7946	144.6024	150.4861	152.3039	170.2166	181.4813	202.6455	(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	3.4822	3.1452	3.4822	3.3699	3.4822	3.3699	3.4822	3.3699	3.3699	3.4822	3.3699	3.4822	(231)
Lighting	13.0345	10.4568	9.4152	6.8980	5.3282	4.3532	4.8605	6.3179	8.2064	10.7672	12.1615	13.3968	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)
Annual totals kWh/year													
Space heating fuel - main system 1												1532.3746	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												100.0000	
Water heating fuel used												2059.0556	(219)
Space cooling fuel												0.0000	(221)
Electricity for pumps and fans:													
central heating pump												41.0000	(230c)
Total electricity for the above, kWh/year												41.0000	(231)
Electricity for lighting (calculated in Appendix L)												105.1962	(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												3737.6264	(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	1532.3746	0.1566	240.0327 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	2059.0556	0.1409	290.1991 (264)
Space and water heating			530.2318 (265)
Pumps, fans and electric keep-hot	41.0000	0.1387	5.6872 (267)
Energy for lighting	105.1962	0.1443	15.1831 (268)
Total CO2, kg/year			551.1021 (272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			12.3100 (273)

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

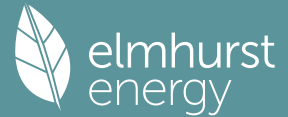
	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Space heating - main system 1	1532.3746	1.5799	2420.9862 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	2059.0556	1.5211	3132.1107 (278)
Space and water heating			5553.0970 (279)
Pumps, fans and electric keep-hot	41.0000	1.5128	62.0248 (281)
Energy for lighting	105.1962	1.5338	161.3534 (282)
Total Primary energy kWh/year			5776.4752 (286)
Dwelling Primary energy Rate (DPER)			129.0500 (287)

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

1. Overall dwelling characteristics

Area Storey height Volume

Full SAP Calculation Printout



Ground floor
 Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 44.7600 (m2) (1b) x 2.7500 (m) (2b) = 123.0900 (1b) - (4)
 Dwelling volume (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 123.0900 (5)

2. Ventilation rate

Number of open chimneys 0 * 80 = 0.0000 (6a)
 Number of open flues 0 * 20 = 0.0000 (6b)
 Number of chimneys / flues attached to closed fire 0 * 10 = 0.0000 (6c)
 Number of flues attached to solid fuel boiler 0 * 20 = 0.0000 (6d)
 Number of flues attached to other heater 0 * 35 = 0.0000 (6e)
 Number of blocked chimneys 0 * 20 = 0.0000 (6f)
 Number of intermittent extract fans 2 * 10 = 20.0000 (7a)
 Number of passive vents 0 * 10 = 0.0000 (7b)
 Number of flueless gas fires 0 * 40 = 0.0000 (7c)
 Air changes per hour 20.0000 / (5) = 0.1625 (8)
 Pressure test Yes
 Pressure Test Method Blower Door
 Measured/design AP50 5.0000 (17)
 Infiltration rate 0.4125 (18)
 Number of sides sheltered 0 (19)
 Shelter factor (20) = 1 - [0.075 x (19)] = 1.0000 (20)
 Infiltration rate adjusted to include shelter factor (21) = (18) x (20) = 0.4125 (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	0.5259	0.5156	0.5053	0.4537	0.4434	0.3919	0.3919	0.3815	0.4125	0.4434	0.4640	0.4847 (22b)
Effective ac	0.6383	0.6329	0.6277	0.6029	0.5983	0.5768	0.5768	0.5728	0.5851	0.5983	0.6077	0.6175 (25)

3. Heat losses and heat loss parameter

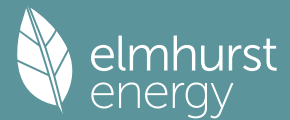
Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K
TER Opaque door			1.8900	1.0000	1.8900		(26)
TER Opening Type (Uw = 1.20)			9.3000	1.1450	10.6489		(27)
UNHEATED			44.7600	0.1300	5.8188		(28a)
EXTERNAL	27.7800	9.3000	18.4800	0.1800	3.3264		(29a)
HALLWAY	23.3800	1.8900	21.4900	0.1800	3.8682		(29a)
Total net area of external elements Aum(A, m2)			95.9200				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	25.5523		(33)
SOLID			24.8100	0.0000	0.0000		(32)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							306.6354 (35)
List of Thermal Bridges							
K1 Element				Length	Psi-value	Total	
E2 Other lintels (including other steel lintels)				5.0000	0.0500	0.2500	
E3 Sill				15.0000	0.0500	0.7500	
E4 Jamb				15.0000	0.0500	0.7500	
E5 Ground floor (normal)				25.0000	0.1600	4.0000	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							5.7500 (36)
Point Thermal bridges						(36a) =	0.0000
Total fabric heat loss						(33) + (36) + (36a) =	31.3023 (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	25.9273	25.7092	25.4953	24.4911	24.3032	23.4285	23.4285	23.2665	23.7654	24.3032	24.6833	25.0807 (38)
Average = Sum(39)m / 12 =	57.2295	57.0114	56.7976	55.7933	55.6054	54.7307	54.7307	54.5688	55.0677	55.6054	55.9855	56.3829 (39)
												55.7924
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.2786	1.2737	1.2689	1.2465	1.2423	1.2228	1.2228	1.2191	1.2303	1.2423	1.2508	1.2597 (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												1.5378 (42)
Hot water usage for mixer showers												
	50.0033	49.2519	48.1569	46.0618	44.5156	42.7914	41.8113	42.8980	44.0893	45.9406	48.0807	49.8118 (42a)
Hot water usage for baths												
	21.6263	21.3051	20.8528	20.0189	19.3944	18.7020	18.3280	18.7772	19.2662	20.0071	20.8582	21.5532 (42b)
Hot water usage for other uses												
	30.3786	29.2740	28.1693	27.0646	25.9599	24.8553	24.8553	25.9599	27.0646	28.1693	29.2740	30.3786 (42c)

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Average daily hot water use (litres/day)												93.7693 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	102.0083	99.8310	97.1790	93.1453	89.8700	86.3487	84.9946	87.6351	90.4201	94.1170	98.2129	101.7436 (44)
Energy content (annual)	161.5562	142.1580	149.3605	127.5112	120.9823	106.1758	102.7936	108.5106	111.4970	127.7159	139.9223	159.3059 (45)
Distribution loss (46) _m = 0.15 x (45) _m										Total = Sum(45) _m =		1557.4892
	24.2334	21.3237	22.4041	19.1267	18.1473	15.9264	15.4190	16.2766	16.7246	19.1574	20.9883	23.8959 (46)
Water storage loss:												
Store volume												200.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.6525 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.8924 (55)
Total storage loss	27.6637	24.9865	27.6637	26.7713	27.6637	26.7713	27.6637	27.6637	26.7713	27.6637	26.7713	27.6637 (56)
If cylinder contains dedicated solar storage	27.6637	24.9865	27.6637	26.7713	27.6637	26.7713	27.6637	27.6637	26.7713	27.6637	26.7713	27.6637 (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	212.4823	188.1557	200.2866	176.7945	171.9084	155.4591	153.7197	159.4367	160.7803	178.6419	189.2056	210.2320 (62)
WWHRS	-22.8594	-20.2171	-21.1702	-17.5297	-16.3371	-13.9798	-13.1038	-13.9346	-14.4640	-17.0514	-19.3172	-22.4361 (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	189.6228	167.9386	179.1164	159.2648	155.5713	141.4793	140.6159	145.5021	146.3163	161.5905	169.8883	187.7958 (64)
										Total per year (kWh/year) = Sum(64) _m =		1944.7022 (64)
12Total per year (kWh/year)												1945 (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)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a) _m =												
Heat gains from water heating, kWh/month	94.4583	84.0657	90.4032	81.8241	80.9675	74.7301	74.9197	76.8206	76.4994	83.2064	85.9508	93.7101 (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	76.8902	76.8902	76.8902	76.8902	76.8902	76.8902	76.8902	76.8902	76.8902	76.8902	76.8902	76.8902 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	67.6558	74.9046	67.6558	69.9110	67.6558	69.9110	67.6558	67.6558	69.9110	67.6558	69.9110	67.6558 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	133.6626	135.0496	131.5545	124.1136	114.7208	105.8930	99.9954	98.6084	102.1036	109.5445	118.9372	127.7651 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	30.6890	30.6890	30.6890	30.6890	30.6890	30.6890	30.6890	30.6890	30.6890	30.6890	30.6890	30.6890 (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)	-61.5121	-61.5121	-61.5121	-61.5121	-61.5121	-61.5121	-61.5121	-61.5121	-61.5121	-61.5121	-61.5121	-61.5121 (71)
Water heating gains (Table 5)	126.9601	125.0978	121.5097	113.6446	108.8272	103.7918	100.6986	103.2535	106.2492	111.8365	119.3761	125.9544 (72)
Total internal gains	377.3456	384.1191	369.7870	356.7362	340.2709	325.6628	314.4168	315.5848	324.3308	338.1039	357.2914	370.4423 (73)

6. Solar gains

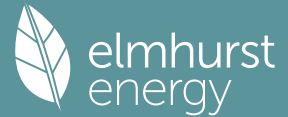
[Jan]	Area m ²	Solar flux Table 6a W/m ²	Specific data or Table 6b	Specific data or Table 6c	Access factor Table 6d	Gains W
Southeast	3.2600	36.7938	0.6300	0.7000	0.7700	36.6576 (77)
Northwest	6.0400	11.2829	0.6300	0.7000	0.7700	20.8272 (81)

Solar gains	57.4848	104.8359	161.8164	231.2982	287.1860	297.4750	281.6516	238.0663	185.5799	120.8205	70.1134	48.3798 (83)
Total gains	434.8304	488.9550	531.6034	588.0345	627.4569	623.1378	596.0684	553.6511	509.9108	458.9243	427.4048	418.8222 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil _m (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	66.6177	66.8726	67.1243	68.3325	68.5634	69.6592	69.6592	69.8660	69.2330	68.5634	68.0979	67.6180
alpha	5.4412	5.4582	5.4750	5.5555	5.5709	5.6439	5.6439	5.6577	5.6155	5.5709	5.5399	5.5079
util living area	0.9924	0.9847	0.9657	0.8994	0.7556	0.5524	0.4026	0.4505	0.7027	0.9271	0.9834	0.9937 (86)
MIT	19.9560	20.1302	20.3813	20.7074	20.9138	20.9878	20.9983	20.9968	20.9566	20.6940	20.2842	19.9394 (87)
Th 2	19.8576	19.8615	19.8652	19.8830	19.8863	19.9018	19.9018	19.9047	19.8958	19.8863	19.8796	19.8726 (88)
util rest of house	0.9895	0.9790	0.9527	0.8644	0.6875	0.4623	0.3029	0.3449	0.6083	0.8931	0.9760	0.9913 (89)
MIT 2	18.6819	18.9042	19.2186	19.6146	19.8252	19.8965	19.9014	19.9039	19.8727	19.6126	19.1139	18.6719 (90)
Living area fraction									fLA = Living area / (4) =			0.5987 (91)
MIT	19.4448	19.6383	19.9148	20.2689	20.4770	20.5499	20.5582	20.5583	20.5216	20.2600	19.8146	19.4308 (92)

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Temperature adjustment adjusted MIT	19.4448	19.6383	19.9148	20.2689	20.4770	20.5499	20.5582	20.5583	20.5216	20.2600	19.8146	0.0000 19.4308 (93)

8. Space heating requirement												

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9882	0.9776	0.9533	0.8776	0.7251	0.5161	0.3627	0.4083	0.6636	0.9060	0.9755	0.9901 (94)
Useful gains	429.6902	477.9786	506.7972	516.0791	454.9519	321.5985	216.1772	226.0503	338.3927	415.7746	416.9126	414.6721 (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	866.7282	840.2496	761.9266	634.3098	488.0480	325.6423	216.6334	226.9139	353.6249	537.1512	711.8350	858.7559 (97)
Space heating kwh	325.1563	243.4462	189.8163	85.1261	24.6235	0.0000	0.0000	0.0000	0.0000	90.3042	212.3442	330.3983 (98a)
Space heating requirement - total per year (kWh/year)												1501.2151
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	325.1563	243.4462	189.8163	85.1261	24.6235	0.0000	0.0000	0.0000	0.0000	90.3042	212.3442	330.3983 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1501.2151
Space heating per m2										(98c) / (4) =		33.5392 (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	325.1563	243.4462	189.8163	85.1261	24.6235	0.0000	0.0000	0.0000	0.0000	90.3042	212.3442	330.3983 (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)	352.2820	263.7553	205.6515	92.2276	26.6776	0.0000	0.0000	0.0000	0.0000	97.8377	230.0587	357.9613 (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	189.6228	167.9386	179.1164	159.2648	155.5713	141.4793	140.6159	145.5021	146.3163	161.5905	169.8883	187.7958 (64)
Efficiency of water heater (217)m	85.2580	84.8915	84.1901	82.7202	80.9207	79.8000	79.8000	79.8000	79.8000	82.8088	84.5612	79.8000 (216)
Fuel for water heating, kWh/month	222.4105	197.8273	212.7523	192.5342	192.2515	177.2924	176.2104	182.3335	183.3538	195.1368	200.9059	220.1256 (219)
Space cooling fuel requirement (221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041 (231)
Lighting	14.0575	11.2775	10.1541	7.4393	5.7464	4.6948	5.2420	6.8138	8.8504	11.6122	13.1160	14.4482 (232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-12.1681	-18.1239	-27.5152	-32.7495	-36.9407	-35.1075	-34.7066	-31.9656	-27.4013	-21.5327	-13.7260	-10.4119 (233a)
Electricity generated by wind turbines (Appendix M) (negative quantity) (234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity) (235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) (235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235c)
Electricity generated by PVs (Appendix M) (negative quantity) (233b)m	-4.2163	-9.0795	-18.4353	-28.2587	-37.9131	-38.2691	-37.7922	-31.7254	-22.9155	-13.1415	-5.6815	-3.3169 (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												1626.4518 (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												2353.1341 (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)												113.4524 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV generation												-553.0938 (233)
Wind generation												0.0000 (234)
Hydro-electric generation (Appendix N)												0.0000 (235a)
Electricity generated - Micro CHP (Appendix N)												0.0000 (235)

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Appendix Q - special features

Energy saved or generated	-0.0000 (236)
Energy used	0.0000 (237)
Total delivered energy for all uses	3625.9446 (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	1626.4518	0.2100	341.5549 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	2353.1341	0.2100	494.1582 (264)
Space and water heating			835.7131 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	113.4524	0.1443	16.3747 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-302.3490	0.1334	-40.3391
PV Unit electricity exported	-250.7448	0.1253	-31.4237
Total			-71.7628 (269)
Total CO2, kg/year			792.2542 (272)
EPC Target Carbon Dioxide Emission Rate (TER)			17.7000 (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	1626.4518	1.1300	1837.8906 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	2353.1341	1.1300	2659.0416 (278)
Space and water heating			4496.9322 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	113.4524	1.5338	174.0171 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-302.3490	1.4930	-451.4151
PV Unit electricity exported	-250.7448	0.4600	-115.3402
Total			-566.7553 (283)
Total Primary energy kWh/year			4234.2947 (286)
Target Primary Energy Rate (TPER)			94.6000 (287)

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022) CALCULATION OF FABRIC ENERGY EFFICIENCY

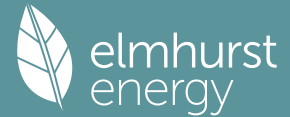
1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	44.7600 (1b)	2.7500 (2b)	123.0900 (1b) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	44.7600		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	123.0900 (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	2 * 10 = 20.0000 (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) =	20.0000 / (5) = 0.1625 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	3.0000 (17)
Infiltration rate	0.3125 (18)
Number of sides sheltered	0 (19)

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Shelter factor
Infiltration rate adjusted to include shelter factor

$$(20) = 1 - [0.075 \times (19)] = 1.0000 \quad (20)$$

$$(21) = (18) \times (20) = 0.3125 \quad (21)$$

	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	0.3984	0.3906	0.3828	0.3437	0.3359	0.2969	0.2969	0.2890	0.3125	0.3359	0.3515	0.3672	(22b)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)													(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =													(23c)
Effective ac	0.5794	0.5763	0.5733	0.5591	0.5564	0.5441	0.5441	0.5418	0.5488	0.5564	0.5618	0.5674	(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	
WINDOWS (Uw = 1.20)			12.9100	1.1450	14.7824			(27)
CORRIDOR DOOR			1.8900	1.2000	2.2680			(26)
UNHEATED			44.7600	0.1000	4.4760	110.0000	4923.6000	(28a)
EXTERNAL	27.7800	12.9100	14.8700	0.1200	1.7844	70.0000	1040.9000	(29a)
HALLWAY	23.3800	1.8900	21.4900	0.1100	2.3639	70.0000	1504.3000	(29a)
Total net area of external elements Aum(A, m2)			95.9200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	25.6747			(33)
SOLID			24.8100	0.0000	0.0000	180.0000	4465.8000	(32)
CEILING			44.7600			40.0000	1790.4000	(32b)

$$\text{Heat capacity } C_m = \text{Sum}(A \times k) \quad (28)...(30) + (32) + (32a)...(32e) = 13725.0000 \quad (34)$$

$$\text{Thermal mass parameter (TMP} = C_m / \text{TFA) in kJ/m2K} \quad 306.6354 \quad (35)$$

List of Thermal Bridges

K1 Element	Length	Psi-value	Total	
E2 Other lintels (including other steel lintels)	5.0000	0.1600	0.8000	
E3 Sill	15.0000	0.1600	2.4000	
E4 Jamb	15.0000	0.1600	2.4000	
E5 Ground floor (normal)	25.0000	0.1600	4.0000	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)				9.6000 (36)
Point Thermal bridges				0.0000 (36a) =
Total fabric heat loss				(33) + (36) + (36a) = 35.2747 (37)

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

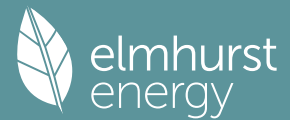
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	23.5337	23.4085	23.2858	22.7095	22.6016	22.0997	22.0997	22.0067	22.2930	22.6016	22.8198	23.0479	(38)
Heat transfer coeff	58.8085	58.6833	58.5606	57.9842	57.8764	57.3744	57.3744	57.2814	57.5678	57.8764	58.0945	58.3226	(39)
Average = Sum(39)m / 12 =												57.9837	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3139	1.3111	1.3083	1.2954	1.2930	1.2818	1.2818	1.2797	1.2861	1.2930	1.2979	1.3030	(40)
HLP (average)												1.2954	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy													1.5378 (42)
Hot water usage for mixer showers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42a)
Hot water usage for baths	21.6263	21.3051	20.8528	20.0189	19.3944	18.7020	18.3280	18.7772	19.2662	20.0071	20.8582	21.5532	(42b)
Hot water usage for other uses	30.3786	29.2740	28.1693	27.0646	25.9599	24.8553	24.8553	25.9599	27.0646	28.1693	29.2740	30.3786	(42c)
Average daily hot water use (litres/day)												47.6679	(43)
Daily hot water use	52.0049	50.5791	49.0221	47.0835	45.3544	43.5573	43.1833	44.7371	46.3308	48.1764	50.1322	51.9318	(44)
Energy conte	82.3631	72.0239	75.3452	64.4550	61.0557	53.5588	52.2264	55.3939	57.1305	65.3749	71.4224	81.3127	(45)
Energy content (annual)										Total = Sum(45)m =		791.6625	
Distribution loss (46)m = 0.15 x (45)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	(46)
Water storage loss:													
Total storage 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	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary 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	(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	70.0087	61.2204	64.0434	54.7867	51.8974	45.5250	44.3925	47.0848	48.5609	55.5686	60.7091	69.1158	(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	70.0087	61.2204	64.0434	54.7867	51.8974	45.5250	44.3925	47.0848	48.5609	55.5686	60.7091	69.1158	(64)
Total per year (kWh/year) = Sum(64)m =												672.9131	(64)
12Total per year (kWh/year)												673	(64)

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Electric shower(s)	40.0443	35.6798	38.9610	37.1800	37.8777	36.1316	37.3360	37.8777	37.1800	38.9610	38.2284	40.0443 (64a)
Heat gains from water heating, kWh/month	27.5132	24.2250	25.7511	22.9917	22.4438	20.4141	20.4321	21.2406	21.4352	23.6324	24.7344	27.2900 (65)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 455.5021 (64a)												

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	76.8902	76.8902	76.8902	76.8902	76.8902	76.8902	76.8902	76.8902	76.8902	76.8902	76.8902	76.8902 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	67.4175	74.6408	67.4175	69.6647	67.4175	69.6647	67.4175	67.4175	69.6647	67.4175	69.6647	67.4175 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	133.6626	135.0496	131.5545	124.1136	114.7208	105.8930	99.9954	98.6084	102.1036	109.5445	118.9372	127.7651 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	30.6890	30.6890	30.6890	30.6890	30.6890	30.6890	30.6890	30.6890	30.6890	30.6890	30.6890	30.6890 (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)	-61.5121	-61.5121	-61.5121	-61.5121	-61.5121	-61.5121	-61.5121	-61.5121	-61.5121	-61.5121	-61.5121	-61.5121 (71)
Water heating gains (Table 5)	36.9802	36.0492	34.6117	31.9329	30.1663	28.3530	27.4625	28.5492	29.7712	31.7640	34.3533	36.6802 (72)
Total internal gains	284.1273	291.8066	279.6507	271.7782	258.3717	249.9777	240.9425	240.6422	247.6065	254.7930	269.0223	277.9298 (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	
Southeast		4.5300		36.7938		0.6300		0.7000		0.7700		50.9384 (77)	
Northwest		8.3800		11.2829		0.6300		0.7000		0.7700		28.8960 (81)	
Solar gains		79.8344	145.5856	224.6908	321.1351	398.7021	412.9755	391.0126	330.5212	257.6760	167.7770	97.3711	67.1906 (83)
Total gains		363.9617	437.3922	504.3415	592.9133	657.0738	662.9532	631.9551	571.1634	505.2826	422.5700	366.3934	345.1203 (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	64.8291	64.9674	65.1035	65.7506	65.8732	66.4495	66.4495	66.5573	66.2263	65.8732	65.6258	65.3692
alpha	5.3219	5.3312	5.3402	5.3834	5.3915	5.4300	5.4300	5.4372	5.4151	5.3915	5.3751	5.3579
util living area	0.9968	0.9911	0.9739	0.9049	0.7490	0.5437	0.3978	0.4576	0.7280	0.9506	0.9921	0.9976 (86)
MIT	19.7731	19.9867	20.2903	20.6721	20.9084	20.9865	20.9979	20.9958	20.9416	20.6021	20.1183	19.7389 (87)
Th 2	19.8300	19.8322	19.8343	19.8444	19.8463	19.8551	19.8551	19.8567	19.8517	19.8463	19.8425	19.8385 (88)
util rest of house	0.9955	0.9875	0.9634	0.8705	0.6791	0.4513	0.2952	0.3460	0.6308	0.9244	0.9883	0.9966 (89)
MIT 2	18.7385	18.9516	19.2495	19.6091	19.7961	19.8505	19.8547	19.8559	19.8270	19.5591	19.0916	18.7111 (90)
Living area fraction	fLA = Living area / (4) = 0.5987 (91)											
MIT	19.3580	19.5713	19.8727	20.2456	20.4621	20.5307	20.5392	20.5384	20.4944	20.1836	19.7063	19.3265 (92)
Temperature adjustment	0.0000											
adjusted MIT	19.3580	19.5713	19.8727	20.2456	20.4621	20.5307	20.5392	20.5384	20.4944	20.1836	19.7063	19.3265 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	0.9948	0.9865	0.9638	0.8837	0.7179	0.5065	0.3568	0.4130	0.6876	0.9333	0.9878	0.9960 (94)
Ext temp.	362.0665	431.4921	486.0954	523.9398	471.7259	335.7800	225.4640	235.8867	347.4161	394.3996	361.9136	343.7411 (95)
Heat loss rate W	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)
Space heating kWh	885.5374	860.9616	783.1112	657.8638	507.1180	340.2703	226.0107	237.0534	368.1107	554.6649	732.3582	882.2186 (97)
Space heating requirement - total per year (kWh/year)	389.4624	288.6035	220.9797	96.4252	26.3317	0.0000	0.0000	0.0000	0.0000	119.2374	266.7202	400.6272 (98a)
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)
Space heating contribution - total per year (kWh/year)	389.4624	288.6035	220.9797	96.4252	26.3317	0.0000	0.0000	0.0000	0.0000	119.2374	266.7202	400.6272 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)	1808.3873											
Space heating per m ²	(98c) / (4) = 40.4019 (99)											

8c. Space cooling requirement

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Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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
Heat loss rate W												
	0.0000	0.0000	0.0000	0.0000	0.0000	539.3193	424.5706	435.3389	0.0000	0.0000	0.0000	0.0000 (100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9471	0.9754	0.9588	0.0000	0.0000	0.0000	0.0000 (101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	510.8112	414.1256	417.4071	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	751.5203	716.6317	646.8552	0.0000	0.0000	0.0000	0.0000 (103)
Space cooling kwh												
	0.0000	0.0000	0.0000	0.0000	0.0000	173.3105	225.0646	170.7094	0.0000	0.0000	0.0000	0.0000 (104)
Cooled fraction									fC = cooled area / (4) =			1.0000 (105)
Intermittency factor (Table 10b)												
	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500 (106)
Space cooling kwh												
	0.0000	0.0000	0.0000	0.0000	0.0000	43.3276	56.2661	42.6773	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling requirement												142.2711 (107)
Energy for space heating												40.4019 (99)
Energy for space cooling												3.1785 (108)
Total												43.5804 (109)
Fabric Energy Efficiency (DFEE)												43.6 (109)

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

1. Overall dwelling characteristics

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	44.7600 (1b)	x 2.7500 (2b)	= 123.0900 (1b) - (4)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	44.7600		
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 123.0900 (5)

2. Ventilation rate

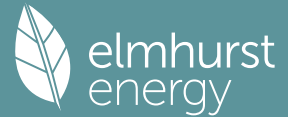
	m ³ per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	2 * 10 = 20.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	Air changes per hour 20.0000 / (5) = 0.1625 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	5.0000 (17)
Infiltration rate	0.4125 (18)
Number of sides sheltered	0 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] = 1.0000 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.4125 (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	0.5259	0.5156	0.5053	0.4537	0.4434	0.3919	0.3919	0.3815	0.4125	0.4434	0.4640	0.4847 (22b)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.0000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												0.0000 (23c)
Effective ac	0.6383	0.6329	0.6277	0.6029	0.5983	0.5768	0.5768	0.5728	0.5851	0.5983	0.6077	0.6175 (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
TER Opaque door			1.8900	1.0000	1.8900		(26)
TER Opening Type (Uw = 1.20)			9.3000	1.1450	10.6489		(27)
UNHEATED			44.7600	0.1300	5.8188		(28a)

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EXTERNAL	27.7800	9.3000	18.4800	0.1800	3.3264	(29a)
HALLWAY	23.3800	1.8900	21.4900	0.1800	3.8682	(29a)
Total net area of external elements Aum(A, m2)			95.9200			(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		25.5523	(33)
SOLID			24.8100	0.0000	0.0000	(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 306.6354 (35)

List of Thermal Bridges						
K1 Element	Length	Psi-value	Total			
E2 Other lintels (including other steel lintels)	5.0000	0.0500	0.2500			
E3 Sill	15.0000	0.0500	0.7500			
E4 Jamb	15.0000	0.0500	0.7500			
E5 Ground floor (normal)	25.0000	0.1600	4.0000			
Thermal bridges (Sum(L x Psi) calculated using Appendix K)						5.7500 (36)
Point Thermal bridges					(36a) =	0.0000
Total fabric heat loss					(33) + (36) + (36a) =	31.3023 (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	25.9273	25.7092	25.4953	24.4911	24.3032	23.4285	23.4285	23.2665	23.7654	24.3032	24.6833	25.0807 (38)
Average = Sum(39)m / 12 =	57.2295	57.0114	56.7976	55.7933	55.6054	54.7307	54.7307	54.5688	55.0677	55.6054	55.9855	56.3829 (39)
												55.7924
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.2786	1.2737	1.2689	1.2465	1.2423	1.2228	1.2228	1.2191	1.2303	1.2423	1.2508	1.2597 (40)
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

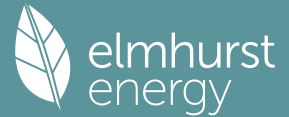
4. Water heating energy requirements (kWh/year)

Assumed occupancy													1.5378 (42)
Hot water usage for mixer showers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42a)
Hot water usage for baths	21.6263	21.3051	20.8528	20.0189	19.3944	18.7020	18.3280	18.7772	19.2662	20.0071	20.8582	21.5532	(42b)
Hot water usage for other uses	30.3786	29.2740	28.1693	27.0646	25.9599	24.8553	24.8553	25.9599	27.0646	28.1693	29.2740	30.3786	(42c)
Average daily hot water use (litres/day)													47.6679 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Energy conte	52.0049	50.5791	49.0221	47.0835	45.3544	43.5573	43.1833	44.7371	46.3308	48.1764	50.1322	51.9318	(44)
Energy content (annual)	82.3631	72.0239	75.3452	64.4550	61.0557	53.5588	52.2264	55.3939	57.1305	65.3749	71.4224	81.3127	(45)
Distribution loss (46)m = 0.15 x (45)m													791.6625
Distribution 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	(46)
Water storage loss:													
Total storage 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	(56)
If cylinder contains dedicated solar storage													
Primary 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	(57)
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	(59)
Total heat required for water heating calculated for each month													(61)
WWHRS	70.0087	61.2204	64.0434	54.7867	51.8974	45.5250	44.3925	47.0848	48.5609	55.5686	60.7091	69.1158	(62)
PV diverter	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63b)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
Output from w/h	70.0087	61.2204	64.0434	54.7867	51.8974	45.5250	44.3925	47.0848	48.5609	55.5686	60.7091	69.1158	(64)
12Total per year (kWh/year)													672.9131 (64)
Electric shower(s)	40.0443	35.6798	38.9610	37.1800	37.8777	36.1316	37.3360	37.8777	37.1800	38.9610	38.2284	40.0443	(64a)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =													455.5021 (64a)
Heat gains from water heating, kWh/month	27.5132	24.2250	25.7511	22.9917	22.4438	20.4141	20.4321	21.2406	21.4352	23.6324	24.7344	27.2900	(65)

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

Metabolic gains (Table 5), Watts													
(66)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	76.8902	76.8902	76.8902	76.8902	76.8902	76.8902	76.8902	76.8902	76.8902	76.8902	76.8902	76.8902	(66)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	67.6558	74.9046	67.6558	69.9110	67.6558	69.9110	67.6558	67.6558	69.9110	67.6558	69.9110	67.6558	(67)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	133.6626	135.0496	131.5545	124.1136	114.7208	105.8930	99.9954	98.6084	102.1036	109.5445	118.9372	127.7651	(68)
Pumps, fans	30.6890	30.6890	30.6890	30.6890	30.6890	30.6890	30.6890	30.6890	30.6890	30.6890	30.6890	30.6890	(69)
Losses e.g. evaporation (negative values) (Table 5)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Water heating gains (Table 5)	-61.5121	-61.5121	-61.5121	-61.5121	-61.5121	-61.5121	-61.5121	-61.5121	-61.5121	-61.5121	-61.5121	-61.5121	(71)
Total internal gains	36.9802	36.0492	34.6117	31.9329	30.1663	28.3530	27.4625	28.5492	29.7712	31.7640	34.3533	36.6802	(72)
	284.3657	292.0705	279.8890	272.0245	258.6100	250.2240	241.1808	240.8805	247.8528	255.0313	269.2686	278.1681	(73)

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6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b		Specific data or Table 6c		FF	Access factor Table 6d		Gains W

Southeast				3.2600	36.7938	0.6300		0.7000			0.7700		36.6576 (77)
Northwest				6.0400	11.2829	0.6300		0.7000			0.7700		20.8272 (81)

Solar gains	57.4848	104.8359	161.8164	231.2982	287.1860	297.4750	281.6516	238.0663	185.5799	120.8205	70.1134		48.3798 (83)
Total gains	341.8505	396.9064	441.7054	503.3228	545.7960	547.6991	522.8324	478.9468	433.4328	375.8518	339.3820		326.5479 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)	
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	66.6177	66.8726	67.1243	68.3325	68.5634	69.6592	69.6592	69.8660	69.2330	68.5634	68.0979	67.6180	
alpha	5.4412	5.4582	5.4750	5.5555	5.5709	5.6439	5.6439	5.6577	5.6155	5.5709	5.5399	5.5079	
util living area	0.9976	0.9941	0.9844	0.9417	0.8240	0.6200	0.4575	0.5176	0.7878	0.9663	0.9943	0.9981 (86)	
MIT	19.7758	19.9570	20.2246	20.5975	20.8651	20.9786	20.9967	20.9937	20.9228	20.5692	20.1185	19.7591 (87)	
Th 2	19.8576	19.8615	19.8652	19.8830	19.8863	19.9018	19.9018	19.9047	19.8958	19.8863	19.8796	19.8726 (88)	
util rest of house	0.9966	0.9917	0.9778	0.9174	0.7617	0.5228	0.3451	0.3980	0.6963	0.9471	0.9915	0.9974 (89)	
MIT 2	18.7629	18.9460	19.2126	19.5807	19.8073	19.8941	19.9012	19.9034	19.8610	19.5651	19.1216	18.7581 (90)	
Living area fraction									fLA = Living area / (4) =				0.5987 (91)
MIT	19.3694	19.5513	19.8186	20.1895	20.4406	20.5434	20.5571	20.5562	20.4967	20.1663	19.7185	19.3574 (92)	
Temperature adjustment												0.0000	
adjusted MIT	19.3694	19.5513	19.8186	20.1895	20.4406	20.5434	20.5571	20.5562	20.4967	20.1663	19.7185	19.3574 (93)	

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9961	0.9909	0.9774	0.9250	0.7947	0.5808	0.4126	0.4699	0.7491	0.9528	0.9910	0.9969 (94)
Useful gains	340.5046	393.2884	431.7373	465.5546	433.7251	318.0828	215.6978	225.0496	324.6702	358.1127	336.3193	325.5378 (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	862.4127	835.2926	756.4619	629.8794	486.0268	325.2880	216.5775	226.8006	352.2529	531.9372	706.4529	854.6205 (97)
Space heating kWh	388.2997	297.0268	241.5951	118.3139	38.9125	0.0000	0.0000	0.0000	0.0000	129.3255	266.4962	393.6375 (98a)
Space heating requirement - total per year (kWh/year)												1873.6071
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	388.2997	297.0268	241.5951	118.3139	38.9125	0.0000	0.0000	0.0000	0.0000	129.3255	266.4962	393.6375 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1873.6071
Space heating per m2										(98c) / (4) =		41.8590 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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
Heat loss rate W												
	0.0000	0.0000	0.0000	0.0000	0.0000	514.4690	405.0075	414.7226	0.0000	0.0000	0.0000	0.0000 (100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9148	0.9588	0.9365	0.0000	0.0000	0.0000	0.0000 (101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	470.6307	388.3231	388.3938	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	616.5406	588.8297	538.8202	0.0000	0.0000	0.0000	0.0000 (103)
Space cooling kWh												
	0.0000	0.0000	0.0000	0.0000	0.0000	105.0552	149.1769	111.9173	0.0000	0.0000	0.0000	0.0000 (104)
Cooled fraction									fC = cooled area / (4) =			1.0000 (105)
Intermittency factor (Table 10b)	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500 (106)
Space cooling kWh												
	0.0000	0.0000	0.0000	0.0000	0.0000	26.2638	37.2942	27.9793	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling requirement												91.5373 (107)
Energy for space heating												41.8590 (99)
Energy for space cooling												2.0451 (108)
Total												43.9040 (109)
Fabric Energy Efficiency (TFEE)												43.9 (109)

Building Regulations England Part L (BREL) Compliance Report

Approved Document L1 2021 Edition, England assessed by Array SAP 10 program, Array

Date: Wed 12 Apr 2023 06:38:05

Project Information			
Assessed By	Mark Simons	Building Type	Flat, End-terrace
OCDEA Registration	EES/004083	Assessment Date	2023-04-12

Dwelling Details			
Assessment Type	As designed	Total Floor Area	54 m ²
Site Reference	39-41 Richmond	Plot Reference	Flat 2 - Electric
Address	39-41 Richmond Street, MANCHESTER, M1 3WB		

Client Details	
Name	Mark Simons
Company	EAL Consult
Address	17 Dobree Avenue, London, NW10 2AD

This report covers items included within the SAP calculations. It is not a complete report of regulations compliance.

1a Target emission rate and dwelling emission rate			
Fuel for main heating system	Electricity		
Target carbon dioxide emission rate	13.91 kgCO ₂ /m ²		
Dwelling carbon dioxide emission rate	9.73 kgCO ₂ /m ²		OK
1b Target primary energy rate and dwelling primary energy			
Target primary energy	74.0 kWh _{PE} /m ²		
Dwelling primary energy	102.31 kWh _{PE} /m ²		FAIL
1c Target fabric energy efficiency and dwelling fabric energy efficiency			
Target fabric energy efficiency	31.7 kWh/m ²		
Dwelling fabric energy efficiency	31.2 kWh/m ²		OK

2a Fabric U-values				
Element	Maximum permitted average U-Value [W/m ² K]	Dwelling average U-Value [W/m ² K]	Element with highest individual U-Value	
External walls	0.26	0.12	Walls (1) (0.12)	OK
Party walls	0.2	0	Party Wall (1) (0)	N/A
Curtain walls	1.6	0	N/A	N/A
Floors	0.18	N/A	N/A	N/A
Roofs	0.16	N/A	N/A	N/A
Windows, doors, and roof windows	1.6	1.2	FRONT (1.2)	OK
Rooflights	2.2	N/A	N/A	N/A

2b Envelope elements (better than typically expected values are flagged with a subsequent (!))			
Name	Net area [m ²]	U-Value [W/m ² K]	
Exposed wall: Walls (1)	24.67	0.12 (!)	
Sheltered wall: Walls (2)	24.57	0.12 (!)	
Party wall: Party Wall (1)	24.81	0 (!)	

2c Openings (better than typically expected values are flagged with a subsequent (!))				
Name	Area [m ²]	Orientation	Frame factor	U-Value [W/m ² K]
FRONT, WINDOWS	8.38	North West	0.7	1.2
REAR, WINDOWS	8.34	South East	0.7	1.2
ENTRANCE DOOR, CORRIDOR DOOR	1.89	North East	N/A	1.2

2d Thermal bridging (better than typically expected values are flagged with a subsequent (!))				
Building part 1 - Main Dwelling: Thermal bridging calculated from linear thermal transmittances for each junction				
Main element	Junction detail	Source	Psi value [W/mK]	Drawing / reference
External wall	E2: Other lintels (including other steel lintels)	Calculated by person with suitable expertise	0.16	
External wall	E3: Sill	Calculated by person with suitable expertise	0.16	

Main element	Junction detail	Source	Psi value [W/mK]	Drawing / reference
External wall	E4: Jamb	Calculated by person with suitable expertise	0.16	
External wall	E5: Ground floor (normal)	Calculated by person with suitable expertise	0.16	

3 Air permeability (better than typically expected values are flagged with a subsequent (!))

Maximum permitted air permeability at 50Pa	8 m ³ /hm ²	
Dwelling air permeability at 50Pa	3 m ³ /hm ² , Design value (!)	OK
Air permeability test certificate reference		

4 Space heating

Main heating system 1: Boiler with radiators or underfloor heating - Electricity

Efficiency	100.0%
Emitter type	Underfloor
Flow temperature	
System type	Direct acting electric boiler
Manufacturer	
Model	
Commissioning	

Secondary heating system: N/A

Fuel	N/A
Efficiency	N/A
Commissioning	

5 Hot water

Cylinder/store - type: Cylinder

Capacity	200 litres
Declared heat loss	2.1 kWh/day
Primary pipework insulated	N/A
Manufacturer	
Model	
Commissioning	

Waste water heat recovery system 1 - type: N/A

Efficiency	
Manufacturer	
Model	

6 Controls

Main heating 1 - type: Time and temperature zone control by arrangement of plumbing and electrical services

Function	
Ecodesign class	
Manufacturer	
Model	

Water heating - type: Cylinder thermostat and HW separately timed

Manufacturer	
Model	

7 Lighting

Minimum permitted light source efficacy	75 lm/W	
Lowest light source efficacy	100 lm/W	OK
External lights control	N/A	

8 Mechanical ventilation

System type: N/A

Maximum permitted specific fan power	N/A	
Specific fan power	N/A	N/A
Minimum permitted heat recovery efficiency	N/A	
Heat recovery efficiency	N/A	N/A
Manufacturer/Model		
Commissioning		

9 Local generation

N/A

10 Heat networks	
N/A	
11 Supporting documentary evidence	
N/A	
12 Declarations	
a. Assessor Declaration	
This declaration by the assessor is confirmation that the contents of this BREL Compliance Report are a true and accurate reflection based upon the design information submitted for this dwelling for the purpose of carrying out the "As designed" assessment, and that the supporting documentary evidence (SAP Conventions, Appendix 1 (documentary evidence) schedules the minimum documentary evidence required) has been reviewed in the course of preparing this BREL Compliance Report.	
Signed: Name:	Assessor ID: Date:
b. Client Declaration	
N/A	

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Property Reference	39-41 Richmond				Issued on Date	12/04/2023
Assessment Reference	Flat 2 - Electric		Prop Type Ref	39-41 Richmond		
Property	39-41 , Richmond Street, MANCHESTER, M1 3WB					
SAP Rating	66 D	DER	9.73	TER	13.91	
Environmental	93 A	% DER < TER				30.05
CO ₂ Emissions (t/year)	0.49	DFEE	31.24	TFEE	31.71	
Compliance Check	See BREL	% DFEE < TFEE				1.50
% DPER < TPER	-38.26	DPER	102.31	TPER	74.00	
Assessor Details	Mr. Mark Simons				Assessor ID	5542-0001
Client	EAI Consult, Mark Simons					

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	54.2300 (1b)	x 2.7500 (2b)	= 149.1325 (1b) - (4)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	54.2300		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 149.1325 (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	2 * 10 = 20.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	Air changes per hour
Pressure test	20.0000 / (5) = 0.1341 (8)
Pressure Test Method	Yes
Measured/design AP50	Blower Door
Infiltration rate	3.0000 (17)
Number of sides sheltered	0.2841 (18)
	0 (19)

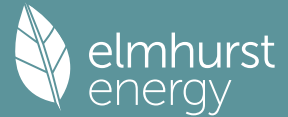
Shelter factor	(20) = 1 - [0.075 x (19)] = 1.0000 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.2841 (21)

	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	0.3622	0.3551	0.3480	0.3125	0.3054	0.2699	0.2699	0.2628	0.2841	0.3054	0.3196	0.3338 (22b)
Effective ac	0.5656	0.5631	0.5606	0.5488	0.5466	0.5364	0.5364	0.5345	0.5404	0.5466	0.5511	0.5557 (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
WINDOWS (U _w = 1.20)			16.7200	1.1450	19.1450		(27)
CORRIDOR DOOR			1.8900	1.2000	2.2680		(26)
EXTERNAL	41.3900	16.7200	24.6700	0.1200	2.9604	70.0000	1726.9000 (29a)
HALLWAY	26.4600	1.8900	24.5700	0.1100	2.7027	70.0000	1719.9000 (29a)
Total net area of external elements A _{um} (A, m ²)			67.8500				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		27.0761		(33)
SOLID			24.8100	0.0000	0.0000	180.0000	4465.8000 (32)
FLOORS			54.2300			40.0000	2169.2000 (32a)

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CEILING 54.2300 30.0000 1626.9000 (32b)

Heat capacity $C_m = \text{Sum}(A \times k)$ (28)...(30) + (32) + (32a)...(32e) = 11708.7000 (34)
Thermal mass parameter (TMP = C_m / TFA) in kJ/m²K 215.9082 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element	5.0000	0.1600	0.8000
E2 Other lintels (including other steel lintels)	7.5000	0.1600	1.2000
E3 Sill	7.5000	0.1600	1.2000
E4 Jamb	9.0000	0.1600	1.4400
E5 Ground floor (normal)			
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			4.6400 (36)
Point Thermal bridges			0.0000
Total fabric heat loss		(33) + (36) + (36a) =	31.7161 (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	27.8357	27.7103	27.5874	27.0102	26.9022	26.3994	26.3994	26.3063	26.5931	26.9022	27.1207	27.3491 (38)
Heat transfer coeff	59.5518	59.4265	59.3036	58.7263	58.6183	58.1156	58.1156	58.0225	58.3092	58.6183	58.8368	59.0652 (39)
Average = Sum(39)m / 12 =												58.7258
HLP	1.0981	1.0958	1.0936	1.0829	1.0809	1.0716	1.0716	1.0699	1.0752	1.0809	1.0849	1.0892 (40)
HLP (average)												1.0829
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

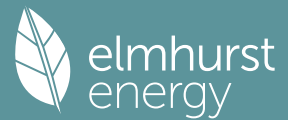
4. Water heating energy requirements (kWh/year)

Assumed occupancy												1.8148 (42)
Hot water usage for mixer showers	54.6471	53.8259	52.6292	50.3395	48.6498	46.7654	45.6943	46.8820	48.1839	50.2071	52.5460	54.4378 (42a)
Hot water usage for baths	24.8666	24.4973	23.9773	23.0184	22.3004	21.5042	21.0742	21.5906	22.1529	23.0048	23.9834	24.7826 (42b)
Hot water usage for other uses	34.9632	33.6918	32.4204	31.1490	29.8776	28.6062	28.6062	29.8776	31.1490	32.4204	33.6918	34.9632 (42c)
Average daily hot water use (litres/day)												105.2228 (43)
Daily hot water use	114.4769	112.0150	109.0268	104.5069	100.8277	96.8758	95.3747	98.3502	101.4857	105.6323	110.2212	114.1835 (44)
Energy conte	181.3035	159.5079	167.5702	143.0647	135.7335	119.1201	115.3475	121.7781	125.1421	143.3420	157.0303	178.7837 (45)
Energy content (annual)										Total = Sum(45)m =		1747.7235
Distribution loss (46)m = 0.15 x (45)m	27.1955	23.9262	25.1355	21.4597	20.3600	17.8680	17.3021	18.2667	18.7713	21.5013	23.5545	26.8176 (46)
Water storage loss:												
Store volume												200.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												2.1000 (48)
Temperature factor from Table 2b												0.6000 (49)
Enter (49) or (54) in (55)												1.2600 (55)
Total storage loss	39.0600	35.2800	39.0600	37.8000	39.0600	37.8000	39.0600	39.0600	37.8000	39.0600	37.8000	39.0600 (56)
If cylinder contains dedicated solar storage	39.0600	35.2800	39.0600	37.8000	39.0600	37.8000	39.0600	39.0600	37.8000	39.0600	37.8000	39.0600 (57)
Primary 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 (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	220.3635	194.7879	206.6302	180.8647	174.7935	156.9201	154.4075	160.8381	162.9421	182.4020	194.8303	217.8437 (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	220.3635	194.7879	206.6302	180.8647	174.7935	156.9201	154.4075	160.8381	162.9421	182.4020	194.8303	217.8437 (64)
12Total per year (kWh/year)										Total per year (kWh/year) = Sum(64)m =		2207.6235 (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	91.5314	81.2604	86.9651	77.8090	76.3794	69.8474	69.6010	71.7392	71.8497	78.9092	82.4526	90.6936 (65)

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

Metabolic gains (Table 5), Watts												
(66)m	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	79.7932	88.3425	79.7932	82.4530	79.7932	82.4530	79.7932	79.7932	82.4530	79.7932	82.4530	79.7932 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	158.1990	159.8407	155.7038	146.8971	135.7801	125.3317	118.3516	116.7100	120.8468	129.6535	140.7705	151.2189 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738 (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)	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906 (71)
Water heating gains (Table 5)	123.0261	120.9232	116.8886	108.0681	102.6605	97.0103	93.5498	96.4237	99.7913	106.0608	114.5174	121.9000 (72)
Total internal gains												

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414.2398 422.3278 405.6071 390.6396 371.4553 355.0166 341.9160 343.1483 353.3125 368.7290 390.9624 406.1336 (73)

6. Solar gains

[Jan]			Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	Specific data or Table 6c	FF	Access factor Table 6d	Gains W			

Southeast			8.3400	36.7938	0.6300		0.7000	0.7700	93.7806 (77)			
Northwest			8.3800	11.2829	0.6300		0.7000	0.7700	28.8960 (81)			

Solar gains	122.6766	218.5617	324.5400	444.8530	537.2765	550.5477	523.6470	452.0720	365.7915	248.4312	148.6862	103.8546 (83)
Total gains	536.9164	640.8895	730.1471	835.4926	908.7318	905.5643	865.5630	795.2203	719.1040	617.1602	539.6486	509.9882 (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	54.6149	54.7301	54.8435	55.3826	55.4846	55.9646	55.9646	56.0544	55.7788	55.4846	55.2786	55.0648
alpha	4.6410	4.6487	4.6562	4.6922	4.6990	4.7310	4.7310	4.7370	4.7186	4.6990	4.6852	4.6710
util living area	0.9728	0.9428	0.8833	0.7517	0.5769	0.4071	0.2948	0.3344	0.5430	0.8194	0.9465	0.9778 (86)
MIT	20.1403	20.3411	20.5721	20.7950	20.8989	20.9290	20.9336	20.9330	20.9144	20.7590	20.4168	20.1032 (87)
Th 2	20.0024	20.0042	20.0061	20.0148	20.0164	20.0241	20.0241	20.0255	20.0211	20.0164	20.0131	20.0097 (88)
util rest of house	0.9661	0.9298	0.8590	0.7101	0.5227	0.3466	0.2297	0.2642	0.4722	0.7756	0.9319	0.9722 (89)
MIT 2	19.0194	19.2683	19.5461	19.8017	19.9050	19.9371	19.9398	19.9410	19.9246	19.7734	19.3733	18.9790 (90)
Living area fraction									fLA = Living area / (4) =			0.4955 (91)
MIT	19.5748	19.7999	20.0545	20.2939	20.3974	20.4286	20.4322	20.4325	20.4150	20.2617	19.8904	19.5360 (92)
Temperature adjustment												0.0000
adjusted MIT	19.5748	19.7999	20.0545	20.2939	20.3974	20.4286	20.4322	20.4325	20.4150	20.2617	19.8904	19.5360 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	0.9626	0.9267	0.8603	0.7225	0.5441	0.3718	0.2570	0.2936	0.5012	0.7873	0.9298	0.9689 (94)
Useful gains	516.8448	593.9321	628.1690	603.6074	494.4556	336.7009	222.4423	233.4724	360.4168	485.9210	501.7885	494.1490 (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	909.6432	885.4461	803.8281	669.1211	509.8296	338.7309	222.7112	233.9752	368.2229	566.3549	752.5446	905.8255 (97)
Space heating kWh	292.2420	195.8974	130.6904	47.1698	11.4382	0.0000	0.0000	0.0000	0.0000	59.8428	180.5444	306.2873 (98a)
Space heating requirement - total per year (kWh/year)												1224.1124
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	292.2420	195.8974	130.6904	47.1698	11.4382	0.0000	0.0000	0.0000	0.0000	59.8428	180.5444	306.2873 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1224.1124
Space heating per m2										(98c) / (4) =		22.5726 (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 %)												100.0000 (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	292.2420	195.8974	130.6904	47.1698	11.4382	0.0000	0.0000	0.0000	0.0000	59.8428	180.5444	306.2873 (98)
Space heating efficiency (main heating system 1)	100.0000	100.0000	100.0000	100.0000	100.0000	0.0000	0.0000	0.0000	0.0000	100.0000	100.0000	100.0000 (210)
Space heating fuel (main heating system)	292.2420	195.8974	130.6904	47.1698	11.4382	0.0000	0.0000	0.0000	0.0000	59.8428	180.5444	306.2873 (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	220.3635	194.7879	206.6302	180.8647	174.7935	156.9201	154.4075	160.8381	162.9421	182.4020	194.8303	217.8437 (64)
Efficiency of water heater	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000 (216)
(217)m	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000 (217)

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Fuel for water heating, kWh/month	220.3635	194.7879	206.6302	180.8647	174.7935	156.9201	154.4075	160.8381	162.9421	182.4020	194.8303	217.8437	(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	3.4822	3.1452	3.4822	3.3699	3.4822	3.3699	3.4822	3.4822	3.3699	3.4822	3.3699	3.4822	(231)
Lighting	15.4273	12.3763	11.1435	8.1642	6.3063	5.1523	5.7528	7.4777	9.7128	12.7437	14.3940	15.8561	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)
Annual totals kWh/year													
Space heating fuel - main system 1												1224.1124	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												100.0000	
Water heating fuel used												2207.6235	(219)
Space cooling fuel												0.0000	(221)
Electricity for pumps and fans:													
central heating pump												41.0000	(230c)
Total electricity for the above, kWh/year												41.0000	(231)
Electricity for lighting (calculated in Appendix L)												124.5070	(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												3597.2428	(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	1224.1124	0.1573	192.5554 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	2207.6235	0.1410	311.2331 (264)
Space and water heating			503.7886 (265)
Pumps, fans and electric keep-hot	41.0000	0.1387	5.6872 (267)
Energy for lighting	124.5070	0.1443	17.9702 (268)
Total CO2, kg/year			527.4460 (272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			9.7300 (273)

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

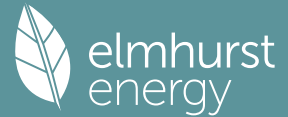
	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Space heating - main system 1	1224.1124	1.5823	1936.9138 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	2207.6235	1.5213	3358.4596 (278)
Space and water heating			5295.3735 (279)
Pumps, fans and electric keep-hot	41.0000	1.5128	62.0248 (281)
Energy for lighting	124.5070	1.5338	190.9730 (282)
Total Primary energy kWh/year			5548.3713 (286)
Dwelling Primary energy Rate (DPER)			102.3100 (287)

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

1. Overall dwelling characteristics

Area Storey height Volume

Full SAP Calculation Printout



Ground floor
 Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 54.2300
 Dwelling volume (m2) 54.2300 (1b) x (m) 2.7500 (2b) = (m3) 149.1325 (1b) - (4)
 (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 149.1325 (5)

2. Ventilation rate

Number of open chimneys 0 * 80 = 0.0000 (6a)
 Number of open flues 0 * 20 = 0.0000 (6b)
 Number of chimneys / flues attached to closed fire 0 * 10 = 0.0000 (6c)
 Number of flues attached to solid fuel boiler 0 * 20 = 0.0000 (6d)
 Number of flues attached to other heater 0 * 35 = 0.0000 (6e)
 Number of blocked chimneys 0 * 20 = 0.0000 (6f)
 Number of intermittent extract fans 2 * 10 = 20.0000 (7a)
 Number of passive vents 0 * 10 = 0.0000 (7b)
 Number of flueless gas fires 0 * 40 = 0.0000 (7c)
 Air changes per hour 20.0000 / (5) = 0.1341 (8)
 Pressure test Yes
 Pressure Test Method Blower Door
 Measured/design AP50 5.0000 (17)
 Infiltration rate 0.3841 (18)
 Number of sides sheltered 0 (19)
 Shelter factor (20) = 1 - [0.075 x (19)] = 1.0000 (20)
 Infiltration rate adjusted to include shelter factor (21) = (18) x (20) = 0.3841 (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	0.4897	0.4801	0.4705	0.4225	0.4129	0.3649	0.3649	0.3553	0.3841	0.4129	0.4321	0.4513 (22b)
Effective ac	0.6199	0.6153	0.6107	0.5893	0.5853	0.5666	0.5666	0.5631	0.5738	0.5853	0.5934	0.6018 (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 Opaque door			1.8900	1.0000	1.8900		(26)
TER Opening Type (Uw = 1.20)			11.6700	1.1450	13.3626		(27)
EXTERNAL	41.3900	11.6700	29.7200	0.1800	5.3496		(29a)
HALLWAY	26.4600	1.8900	24.5700	0.1800	4.4226		(29a)
Total net area of external elements Aum(A, m2)			67.8500				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		25.0248		(33)
SOLID			24.8100	0.0000	0.0000		(32)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							225.9082 (35)
List of Thermal Bridges							
K1 Element				Length	Psi-value	Total	
E2 Other lintels (including other steel lintels)				5.0000	0.0500	0.2500	
E3 Sill				7.5000	0.0500	0.3750	
E4 Jamb				7.5000	0.0500	0.3750	
E5 Ground floor (normal)				9.0000	0.1600	1.4400	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							2.4400 (36)
Point Thermal bridges						(36a) =	0.0000
Total fabric heat loss						(33) + (36) + (36a) =	27.4648 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)
 (38)m Jan 30.5087 Feb 30.2795 Mar 30.0549 Apr 28.9998 May 28.8023 Jun 27.8834 Jul 27.8834 Aug 27.7132 Sep 28.2374 Oct 28.8023 Nov 29.2017 Dec 29.6192 (38)
 Heat transfer coeff 57.9735 57.7443 57.5197 56.4645 56.2671 55.3482 55.3482 55.1780 55.7021 56.2671 56.6665 57.0840 (39)
 Average = Sum(39)m / 12 = 56.4636
 HLP Jan 1.0690 Feb 1.0648 Mar 1.0607 Apr 1.0412 May 1.0376 Jun 1.0206 Jul 1.0206 Aug 1.0175 Sep 1.0271 Oct 1.0376 Nov 1.0449 Dec 1.0526 (40)
 HLP (average) 1.0412
 Days in mont 31 28 31 30 31 30 31 31 30 31 30 31

4. Water heating energy requirements (kWh/year)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Assumed occupancy												1.8148 (42)
Hot water usage for mixer showers	54.6471	53.8259	52.6292	50.3395	48.6498	46.7654	45.6943	46.8820	48.1839	50.2071	52.5460	54.4378 (42a)
Hot water usage for baths	23.6233	23.2725	22.7784	21.8674	21.1853	20.4290	20.0205	20.5110	21.0452	21.8545	22.7842	23.5434 (42b)
Hot water usage for other uses	33.2150	32.0072	30.7994	29.5915	28.3837	27.1759	27.1759	28.3837	29.5915	30.7994	32.0072	33.2150 (42c)
Average daily hot water use (litres/day)												102.4808 (43)

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.4854	109.1055	106.2070	101.7985	98.2189	94.3703	92.8907	95.7768	98.8206	102.8610	107.3374	111.1962	(44)
Energy content (annual)	176.5657	155.3648	163.2361	139.3571	132.2215	116.0393	112.3432	118.5916	121.8557	139.5814	152.9218	174.1064	(45)
Distribution loss (46)m = 0.15 x (45)m	26.4849	23.3047	24.4854	20.9036	19.8332	17.4059	16.8515	17.7887	18.2784	20.9372	22.9383	26.1160	(46)
Water storage loss:													
Store volume													200.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):													1.6525 (48)
Temperature factor from Table 2b													0.5400 (49)
Enter (49) or (54) in (55)													0.8924 (55)
Total storage loss	27.6637	24.9865	27.6637	26.7713	27.6637	26.7713	27.6637	27.6637	26.7713	27.6637	26.7713	27.6637	(56)
If cylinder contains dedicated solar storage	27.6637	24.9865	27.6637	26.7713	27.6637	26.7713	27.6637	27.6637	26.7713	27.6637	26.7713	27.6637	(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	227.4918	201.3626	214.1622	188.6404	183.1475	165.3226	163.2693	169.5177	171.1390	190.5075	202.2051	225.0325	(62)
WWHRS	-24.9824	-22.0946	-23.1362	-19.1577	-17.8543	-15.2780	-14.3207	-15.2287	-15.8073	-18.6350	-21.1112	-24.5198	(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	202.5094	179.2679	191.0260	169.4827	165.2932	150.0446	148.9486	154.2890	155.3318	171.8725	181.0939	200.5127	(64)
12Total per year (kWh/year)													2069.6722 (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 =													2070 (64a)
Heat gains from water heating, kWh/month	99.4489	88.4570	95.0169	85.7629	84.7045	78.0097	78.0950	80.1726	79.9437	87.1517	90.2731	98.6312	(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	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	79.8937	88.4538	79.8937	82.5569	79.8937	82.5569	79.8937	79.8937	82.5569	79.8937	82.5569	79.8937	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	158.1990	159.8407	155.7038	146.8971	135.7801	125.3317	118.3516	116.7100	120.8468	129.6535	140.7705	151.2189	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	(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)	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	(71)
Water heating gains (Table 5)	133.6679	131.6324	127.7109	119.1151	113.8501	108.3468	104.9664	107.7588	111.0329	117.1394	125.3794	132.5689	(72)
Total internal gains	424.9822	433.1483	416.5299	401.7905	382.7454	366.4569	353.4331	354.5840	364.6580	379.9081	401.9282	416.9029	(73)

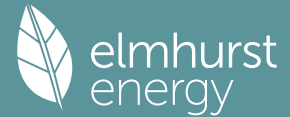
6. Solar gains

[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
Southeast				5.8200	36.7938		0.6300		0.7000		0.7700		65.4440 (77)
Northwest				5.8500	11.2829		0.6300		0.7000		0.7700		20.1720 (81)
Solar gains	85.6160	152.5361	226.5039	310.4803	374.9922	384.2573	365.4808	315.5210	255.2967	173.3835	103.7685	72.4799	(83)
Total gains	510.5982	585.6845	643.0338	712.2708	757.7376	750.7141	718.9140	670.1050	619.9547	553.2916	505.6967	489.3829	(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, n1,m (see Table 9a)													
Jan	58.7002	58.9332	59.1633	60.2689	60.4803	61.4845	61.4845	61.6741	61.0938	60.4803	60.0541	59.6149	
Feb	4.9133	4.9289	4.9442	5.0179	5.0320	5.0990	5.0990	5.1116	5.0729	5.0320	5.0036	4.9743	
util living area	0.9791	0.9594	0.9196	0.8160	0.6534	0.4664	0.3379	0.3771	0.5979	0.8567	0.9581	0.9824	(86)
MIT	19.9819	20.1997	20.4713	20.7769	20.9384	20.9910	20.9986	20.9976	20.9700	20.7567	20.3376	19.9567	(87)
Th 2	20.0262	20.0297	20.0331	20.0491	20.0521	20.0662	20.0662	20.0688	20.0608	20.0521	20.0461	20.0397	(88)
util rest of house	0.9737	0.9494	0.9004	0.7785	0.5977	0.4007	0.2666	0.3016	0.5249	0.8173	0.9459	0.9778	(89)
MIT 2	18.8695	19.1427	19.4757	19.8386	20.0042	20.0612	20.0657	20.0679	20.0421	19.8285	19.3304	18.8481	(90)
Living area fraction													fLA = Living area / (4) =
MIT	19.4207	19.6664	19.9690	20.3035	20.4671	20.5219	20.5279	20.5285	20.5019	20.2884	19.8294	19.3974	(92)
Temperature adjustment													0.0000

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adjusted MIT 19.4207 19.6664 19.9690 20.3035 20.4671 20.5219 20.5279 20.5285 20.5019 20.2884 19.8294 19.3974 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9694	0.9449	0.8990	0.7891	0.6227	0.4330	0.3019	0.3390	0.5599	0.8280	0.9426	0.9739	(94)
Useful gains	494.9797	553.4034	578.0575	562.0613	471.8293	325.0502	217.0630	227.1986	347.1064	458.1066	476.6896	476.5986	(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	876.5987	852.6749	774.7321	643.8942	493.2976	327.7666	217.4040	227.8047	356.5975	545.1399	721.3323	867.5270	(97)
Space heating kWh	283.9245	201.1104	146.3259	58.9197	15.9725	0.0000	0.0000	0.0000	0.0000	64.7528	176.1427	290.8507	(98a)
Space heating requirement - total per year (kWh/year)												1237.9992	
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	283.9245	201.1104	146.3259	58.9197	15.9725	0.0000	0.0000	0.0000	0.0000	64.7528	176.1427	290.8507	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1237.9992	
Space heating per m2										(98c) / (4) =		22.8287	(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	283.9245	201.1104	146.3259	58.9197	15.9725	0.0000	0.0000	0.0000	0.0000	64.7528	176.1427	290.8507	(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)	307.6105	217.8878	158.5329	63.8350	17.3049	0.0000	0.0000	0.0000	0.0000	70.1547	190.8372	315.1145	(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	202.5094	179.2679	191.0260	169.4827	165.2932	150.0446	148.9486	154.2890	155.3318	171.8725	181.0939	200.5127	(64)
Efficiency of water heater	84.8176	84.3182	83.4694	81.9424	80.5191	79.8000	79.8000	79.8000	79.8000	82.0764	83.9976	84.8929	(216)
Fuel for water heating, kWh/month	238.7587	212.6087	228.8575	206.8315	205.2845	188.0258	186.6524	193.3447	194.6513	209.4055	215.5940	236.1948	(217)
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	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting	16.6003	13.3174	11.9909	8.7850	6.7858	5.5441	6.1902	8.0463	10.4513	13.7127	15.4885	17.0617	(232)
Electricity generated by PVs (Appendix M) (negative quantity)	-14.6530	-21.7766	-32.9837	-39.1560	-44.0652	-41.8269	-41.3350	-38.1121	-32.7416	-25.8155	-16.5075	-12.5425	(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)	-5.1979	-11.1823	-22.6887	-34.7599	-46.6256	-47.0741	-46.5026	-39.0542	-28.2208	-16.1949	-7.0060	-4.0909	(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												1341.2776	(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												2516.2094	(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)												133.9743	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-670.1134	(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													

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Energy saved or generated	-0.0000 (236)
Energy used	0.0000 (237)
Total delivered energy for all uses	3407.3479 (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	1341.2776	0.2100	281.6683 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	2516.2094	0.2100	528.4040 (264)
Space and water heating			810.0723 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	133.9743	0.1443	19.3366 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-361.5156	0.1335	-48.2535
PV Unit electricity exported	-308.5978	0.1253	-38.6761
Total			-86.9297 (269)
Total CO2, kg/year			754.4085 (272)
EPC Target Carbon Dioxide Emission Rate (TER)			13.9100 (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	1341.2776	1.1300	1515.6437 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	2516.2094	1.1300	2843.3166 (278)
Space and water heating			4358.9603 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	133.9743	1.5338	205.4942 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-361.5156	1.4932	-539.8295
PV Unit electricity exported	-308.5978	0.4600	-141.9599
Total			-681.7895 (283)
Total Primary energy kWh/year			4012.7659 (286)
Target Primary Energy Rate (TPER)			74.0000 (287)

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022) CALCULATION OF FABRIC ENERGY EFFICIENCY

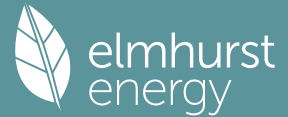
1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	54.2300 (1b)	x 2.7500 (2b)	= 149.1325 (1b) - (4)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	54.2300		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	149.1325 (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	2 * 10 = 20.0000 (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) =	20.0000 / (5) = 0.1341 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	3.0000 (17)
Infiltration rate	0.2841 (18)
Number of sides sheltered	0 (19)

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Shelter factor													(20) = 1 - [0.075 x (19)] = 1.0000 (20)
Infiltration rate adjusted to include shelter factor													(21) = (18) x (20) = 0.2841 (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	0.3622	0.3551	0.3480	0.3125	0.3054	0.2699	0.2699	0.2628	0.2841	0.3054	0.3196	0.3338	(22b)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)													0.0000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =													0.0000 (23c)
Effective ac	0.5656	0.5631	0.5606	0.5488	0.5466	0.5364	0.5364	0.5345	0.5404	0.5466	0.5511	0.5557	(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	
WINDOWS (Uw = 1.20)			16.7200	1.1450	19.1450			(27)
CORRIDOR DOOR			1.8900	1.2000	2.2680			(26)
EXTERNAL	41.3900	16.7200	24.6700	0.1200	2.9604	70.0000	1726.9000	(29a)
HALLWAY	26.4600	1.8900	24.5700	0.1100	2.7027	70.0000	1719.9000	(29a)
Total net area of external elements Aum(A, m2)			67.8500					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =					(33)
SOLID			24.8100	0.0000	0.0000	180.0000	4465.8000	(32)
FLOORS			54.2300			40.0000	2169.2000	(32d)
CEILING			54.2300			40.0000	2169.2000	(32b)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 12251.0000 (34)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 225.9082 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total	
E2 Other lintels (including other steel lintels)	5.0000	0.1600	0.8000	
E3 Sill	7.5000	0.1600	1.2000	
E4 Jamb	7.5000	0.1600	1.2000	
E5 Ground floor (normal)	9.0000	0.1600	1.4400	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)				4.6400 (36)
Point Thermal bridges				(36a) = 0.0000
Total fabric heat loss				(33) + (36) + (36a) = 31.7161 (37)

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

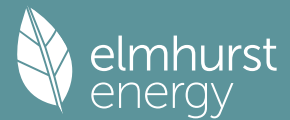
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	27.8357	27.7103	27.5874	27.0102	26.9022	26.3994	26.3994	26.3063	26.5931	26.9022	27.1207	27.3491	(38)
Heat transfer coeff	59.5518	59.4265	59.3036	58.7263	58.6183	58.1156	58.1156	58.0225	58.3092	58.6183	58.8368	59.0652	(39)
Average = Sum(39)m / 12 =													58.7258

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0981	1.0958	1.0936	1.0829	1.0809	1.0716	1.0716	1.0699	1.0752	1.0809	1.0849	1.0892	(40)
HLP (average)													1.0829
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy													1.8148 (42)
Hot water usage for mixer showers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42a)
Hot water usage for baths	23.6233	23.2725	22.7784	21.8674	21.1853	20.4290	20.0205	20.5110	21.0452	21.8545	22.7842	23.5434	(42b)
Hot water usage for other uses	33.2150	32.0072	30.7994	29.5915	28.3837	27.1759	27.1759	28.3837	29.5915	30.7994	32.0072	33.2150	(42c)
Average daily hot water use (litres/day)													52.0980 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	56.8383	55.2796	53.5778	51.4590	49.5691	47.6049	47.1964	48.8948	50.6368	52.6539	54.7914	56.7584	(44)
Energy conte	90.0180	78.7175	82.3470	70.4448	66.7295	58.5358	57.0799	60.5419	62.4402	71.4509	78.0604	88.8700	(45)
Energy content (annual)													865.2358
Distribution loss (46)m = 0.15 x (45)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	(46)
Water storage loss:													
Total storage 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	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary 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	(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	76.5153	66.9098	69.9950	59.8781	56.7201	49.7554	48.5179	51.4607	53.0742	60.7332	66.3514	75.5395	(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	76.5153	66.9098	69.9950	59.8781	56.7201	49.7554	48.5179	51.4607	53.0742	60.7332	66.3514	75.5395	(64)
12Total per year (kWh/year)													735.4504 (64)
Electric shower(s)													735 (64)

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43.7633	38.9934	42.5793	40.6329	41.3954	39.4872	40.8034	41.3954	40.6329	42.5793	41.7787	43.7633 (64a)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =											497.8045 (64a)
Heat gains from water heating, kWh/month	30.0696	26.4758	28.1436	25.1277	24.5289	22.3106	22.3303	23.2140	23.4268	25.8281	29.8257 (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	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	79.7932	88.3425	79.7932	82.4530	79.7932	82.4530	79.7932	79.7932	82.4530	79.7932	82.4530	79.7932 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	158.1990	159.8407	155.7038	146.8971	135.7801	125.3317	118.3516	116.7100	120.8468	129.6535	140.7705	151.2189 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738 (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)	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906 (71)
Water heating gains (Table 5)	40.4162	39.3985	37.8274	34.8997	32.9689	30.9870	30.0139	31.2016	32.5372	34.7152	37.5452	40.0883 (72)
Total internal gains	328.6299	337.8032	323.5459	314.4712	298.7637	288.9932	278.3802	277.9263	286.0584	294.3835	310.9901	321.3219 (73)

6. Solar gains

[Jan]			Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	Specific data or Table 6c	FF Access factor Table 6d	Gains W				
Southeast			8.3400	36.7938	0.6300	0.7000	0.7700	93.7806 (77)				
Northwest			8.3800	11.2829	0.6300	0.7000	0.7700	28.8960 (81)				
Solar gains	122.6766	218.5617	324.5400	444.8530	537.2765	550.5477	523.6470	452.0720	365.7915	248.4312	148.6862	103.8546 (83)
Total gains	451.3065	556.3649	648.0859	759.3242	836.0402	839.5410	802.0272	729.9983	651.8499	542.8147	459.6763	425.1765 (84)

7. Mean internal temperature (heating season)

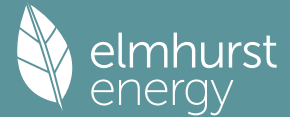
Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	57.1444	57.2650	57.3837	57.9477	58.0545	58.5567	58.5567	58.6507	58.3622	58.0545	57.8389	57.6152
alpha	4.8096	4.8177	4.8256	4.8632	4.8703	4.9038	4.9038	4.9100	4.8908	4.8703	4.8559	4.8410
util living area	0.9877	0.9679	0.9221	0.8008	0.6213	0.4384	0.3180	0.3640	0.5935	0.8740	0.9724	0.9905 (86)
MIT	19.8136	20.0954	20.4324	20.7777	20.9442	20.9916	20.9986	20.9974	20.9665	20.7067	20.1962	19.7630 (87)
Th 2	20.0024	20.0042	20.0061	20.0148	20.0164	20.0241	20.0241	20.0255	20.0211	20.0164	20.0131	20.0097 (88)
util rest of house	0.9842	0.9595	0.9031	0.7613	0.5648	0.3735	0.2479	0.2877	0.5183	0.8365	0.9637	0.9878 (89)
MIT 2	18.9411	19.2176	19.5394	19.8529	19.9832	20.0205	20.0237	20.0247	20.0050	19.8041	19.3265	18.8969 (90)
Living area fraction	19.3734	19.6525	19.9819	20.3111	20.4593	20.5017	20.5068	20.5067	20.4814	20.2513	19.7574	19.3261 (92)
MIT	19.3734	19.6525	19.9819	20.3111	20.4593	20.5017	20.5068	20.5067	20.4814	20.2513	19.7574	19.3261 (93)
Temperature adjustment												0.0000
adjusted MIT	19.3734	19.6525	19.9819	20.3111	20.4593	20.5017	20.5068	20.5067	20.4814	20.2513	19.7574	19.3261 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	0.9815	0.9560	0.9026	0.7738	0.5908	0.4055	0.2827	0.3255	0.5544	0.8463	0.9609	0.9854 (94)
Useful gains	442.9355	531.8938	584.9468	587.5889	493.8995	340.4511	226.7087	237.6197	361.4109	459.4076	441.7126	418.9745 (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	897.6491	876.6892	799.5227	670.1335	513.4579	342.9800	227.0430	238.2783	372.0932	565.7425	744.7202	893.4244 (97)
Space heating kWh	338.3069	231.7025	159.6445	59.4321	14.5514	0.0000	0.0000	0.0000	0.0000	79.1131	218.1655	352.9908 (98a)
Space heating requirement - total per year (kWh/year)												1453.9069
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	338.3069	231.7025	159.6445	59.4321	14.5514	0.0000	0.0000	0.0000	0.0000	79.1131	218.1655	352.9908 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1453.9069
Space heating per m ²										(98c) / (4) =		26.8100 (99)

8c. Space cooling requirement

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Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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
Heat loss rate W												
	0.0000	0.0000	0.0000	0.0000	0.0000	546.2863	430.0551	440.9707	0.0000	0.0000	0.0000	0.0000 (100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9710	0.9865	0.9782	0.0000	0.0000	0.0000	0.0000 (101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	530.4413	424.2456	431.3749	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	952.5269	910.2554	827.5959	0.0000	0.0000	0.0000	0.0000 (103)
Space cooling kWh												
	0.0000	0.0000	0.0000	0.0000	0.0000	303.9016	361.5913	294.7884	0.0000	0.0000	0.0000	0.0000 (104)
Cooled fraction									fC = cooled area / (4) =			1.0000 (105)
Intermittency factor (Table 10b)												
	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500 (106)
Space cooling kWh												
	0.0000	0.0000	0.0000	0.0000	0.0000	75.9754	90.3978	73.6971	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling requirement												240.0703 (107)
Energy for space heating												26.8100 (99)
Energy for space cooling												4.4269 (108)
Total												31.2369 (109)
Fabric Energy Efficiency (DFEE)												31.2 (109)

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

1. Overall dwelling characteristics

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	54.2300 (1b)	x 2.7500 (2b)	= 149.1325 (1b) - (4)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	54.2300		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	149.1325 (5)

2. Ventilation rate

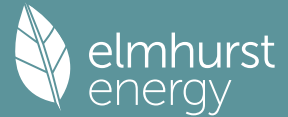
	m ³ per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	2 * 10 = 20.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	Air changes per hour 20.0000 / (5) = 0.1341 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	5.0000 (17)
Infiltration rate	0.3841 (18)
Number of sides sheltered	0 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] = 1.0000 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.3841 (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	0.4897	0.4801	0.4705	0.4225	0.4129	0.3649	0.3649	0.3553	0.3841	0.4129	0.4321	0.4513 (22b)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.0000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												0.0000 (23c)
Effective ac	0.6199	0.6153	0.6107	0.5893	0.5853	0.5666	0.5666	0.5631	0.5738	0.5853	0.5934	0.6018 (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
TER Opaque door			1.8900	1.0000	1.8900		(26)
TER Opening Type (Uw = 1.20)			11.6700	1.1450	13.3626		(27)
EXTERNAL	41.3900	11.6700	29.7200	0.1800	5.3496		(29a)
HALLWAY	26.4600	1.8900	24.5700	0.1800	4.4226		(29a)

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Total net area of external elements Aum(A, m2) 67.8500 (31)
 Fabric heat loss, W/K = Sum (A x U) (26)...(30) + (32) = 25.0248 (33)
 SOLID 24.8100 0.0000 0.0000 (32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 225.9082 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	5.0000	0.0500	0.2500
E3 Sill	7.5000	0.0500	0.3750
E4 Jamb	7.5000	0.0500	0.3750
E5 Ground floor (normal)	9.0000	0.1600	1.4400

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 2.4400 (36)
 Point Thermal bridges (36a) = 0.0000
 Total fabric heat loss (33) + (36) + (36a) = 27.4648 (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	30.5087	30.2795	30.0549	28.9998	28.8023	27.8834	27.8834	27.7132	28.2374	28.8023	29.2017	29.6192 (38)
Heat transfer coeff	57.9735	57.7443	57.5197	56.4645	56.2671	55.3482	55.3482	55.1780	55.7021	56.2671	56.6665	57.0840 (39)
Average = Sum(39)m / 12 =												56.4636

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.0690	1.0648	1.0607	1.0412	1.0376	1.0206	1.0206	1.0175	1.0271	1.0376	1.0449	1.0526 (40)
HLP (average)												1.0412
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

4. Water heating energy requirements (kWh/year)

Assumed occupancy 1.8148 (42)
 Hot water usage for mixer showers 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (42a)
 Hot water usage for baths 23.6233 23.2725 22.7784 21.8674 21.1853 20.4290 20.0205 20.5110 21.0452 21.8545 22.7842 23.5434 (42b)
 Hot water usage for other uses 33.2150 32.0072 30.7994 29.5915 28.3837 27.1759 27.1759 28.3837 29.5915 30.7994 32.0072 33.2150 (42c)
 Average daily hot water use (litres/day) 52.0980 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	56.8383	55.2796	53.5778	51.4590	49.5691	47.6049	47.1964	48.8948	50.6368	52.6539	54.7914	56.7584 (44)
Energy conte	90.0180	78.7175	82.3470	70.4448	66.7295	58.5358	57.0799	60.5419	62.4402	71.4509	78.0604	88.8700 (45)
Energy content (annual)												865.2358
Distribution loss (46)m = 0.15 x (45)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 (46)

Water storage loss:
 Total storage 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 (56)

If cylinder contains dedicated solar storage 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (57)

Primary 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 (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
 76.5153 66.9098 69.9950 59.8781 56.7201 49.7554 48.5179 51.4607 53.0742 60.7332 66.3514 75.5395 (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 76.5153 66.9098 69.9950 59.8781 56.7201 49.7554 48.5179 51.4607 53.0742 60.7332 66.3514 75.5395 (64)
 Total per year (kWh/year) = Sum(64)m = 735.4504 (64)
 735 (64)

12Total per year (kWh/year)
 Electric shower(s) 43.7633 38.9934 42.5793 40.6329 41.3954 39.4872 40.8034 41.3954 40.6329 42.5793 41.7787 43.7633 (64a)
 Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 497.8045 (64a)

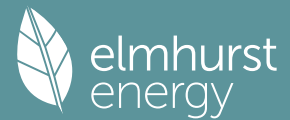
Heat gains from water heating, kWh/month
 30.0696 26.4758 28.1436 25.1277 24.5289 22.3106 22.3303 23.2140 23.4268 25.8281 27.0325 29.8257 (65)

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	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	79.8937	88.4538	79.8937	82.5569	79.8937	82.5569	79.8937	79.8937	82.5569	79.8937	82.5569	79.8937 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	158.1990	159.8407	155.7038	146.8971	135.7801	125.3317	118.3516	116.7100	120.8468	129.6535	140.7705	151.2189 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738 (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)	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906 (71)
Water heating gains (Table 5)	40.4162	39.3985	37.8274	34.8997	32.9689	30.9870	30.0139	31.2016	32.5372	34.7152	37.5452	40.0883 (72)
Total internal gains	328.7304	337.9144	323.6464	314.5751	298.8642	289.0971	278.4807	278.0268	286.1623	294.4840	311.0940	321.4224 (73)

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6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2		Specific data or Table 6b	Specific data or Table 6c	FF	Access factor Table 6d	Gains W
Southeast				5.8200	36.7938		0.6300		0.7000		65.4440 (77)
Northwest				5.8500	11.2829		0.6300		0.7000		20.1720 (81)
Solar gains	85.6160	152.5361	226.5039	310.4803	374.9922	384.2573	365.4808	315.5210	255.2967	173.3835	72.4799 (83)
Total gains	414.3465	490.4506	550.1503	625.0554	673.8564	673.3543	643.9615	593.5478	541.4590	467.8675	393.9023 (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		Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	58.7002	58.9332	59.1633	60.2689	60.4803	61.4845	61.4845	61.6741	61.0938	60.4803	60.0541	59.6149
alpha	4.9133	4.9289	4.9442	5.0179	5.0320	5.0990	5.0990	5.1116	5.0729	5.0320	5.0036	4.9743
util living area	0.9911	0.9793	0.9525	0.8686	0.7144	0.5164	0.3765	0.4244	0.6685	0.9122	0.9804	0.9929 (86)
MIT	19.7878	20.0220	20.3247	20.6932	20.9084	20.9858	20.9977	20.9958	20.9509	20.6534	20.1677	19.7611 (87)
Th 2	20.0262	20.0297	20.0331	20.0491	20.0521	20.0662	20.0662	20.0688	20.0608	20.0521	20.0461	20.0397 (88)
util rest of house	0.9886	0.9737	0.9396	0.8368	0.6586	0.4451	0.2975	0.3401	0.5923	0.8828	0.9741	0.9909 (89)
MIT 2	18.9344	19.1676	19.4635	19.8163	19.9949	20.0599	20.0656	20.0676	20.0359	19.7921	19.3261	18.9186 (90)
Living area fraction									fLA = Living area / (4) =			0.4955 (91)
MIT	19.3572	19.5910	19.8902	20.2508	20.4475	20.5187	20.5274	20.5275	20.4893	20.2189	19.7431	19.3360 (92)
Temperature adjustment												0.0000
adjusted MIT	19.3572	19.5910	19.8902	20.2508	20.4475	20.5187	20.5274	20.5275	20.4893	20.2189	19.7431	19.3360 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9863	0.9705	0.9374	0.8441	0.6827	0.4801	0.3367	0.3819	0.6282	0.8886	0.9716	0.9890 (94)
Useful gains	408.6826	475.9941	515.7085	527.6092	460.0557	323.2659	216.8070	226.6959	340.1525	415.7468	403.0716	389.5558 (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	872.9206	848.3197	770.2025	640.9176	492.1979	327.5883	217.3746	227.7479	355.8966	541.2268	716.4405	864.0259 (97)
Space heating kWh	345.3931	250.2028	189.3436	81.5820	23.9137	0.0000	0.0000	0.0000	0.0000	93.3571	225.6255	353.0057 (98a)
Space heating requirement - total per year (kWh/year)												1562.4236
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	345.3931	250.2028	189.3436	81.5820	23.9137	0.0000	0.0000	0.0000	0.0000	93.3571	225.6255	353.0057 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1562.4236
Space heating per m2										(98c) / (4) =		28.8111 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	520.2728	409.5765	419.3528	0.0000	0.0000	0.0000	0.0000 (100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9489	0.9756	0.9634	0.0000	0.0000	0.0000	0.0000 (101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	493.6632	399.6009	404.0127	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	758.1702	725.3954	668.0032	0.0000	0.0000	0.0000	0.0000 (103)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	190.4450	242.3911	196.4089	0.0000	0.0000	0.0000	0.0000 (104)
Cooled fraction	fC = cooled area / (4) =											1.0000 (105)
Intermittency factor (Table 10b)	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500 (106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	47.6113	60.5978	49.1022	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling requirement												157.3113 (107)
Energy for space heating												28.8111 (99)
Energy for space cooling												2.9008 (108)
Total												31.7119 (109)
Fabric Energy Efficiency (TFEE)												31.7 (109)

Building Regulations England Part L (BREL) Compliance Report

Approved Document L1 2021 Edition, England assessed by Array SAP 10 program, Array

Date: Wed 12 Apr 2023 06:38:31

Project Information			
Assessed By	Mark Simons	Building Type	Flat, End-terrace
OCDEA Registration	EES/004083	Assessment Date	2023-04-12

Dwelling Details			
Assessment Type	As designed	Total Floor Area	54 m ²
Site Reference	39-41 Richmond	Plot Reference	Flat 3 - Electric
Address	39-41 Richmond Street, MANCHESTER, M1 3WB		

Client Details	
Name	Mark Simons
Company	EAL Consult
Address	17 Dobree Avenue, London, NW10 2AD

This report covers items included within the SAP calculations. It is not a complete report of regulations compliance.

1a Target emission rate and dwelling emission rate			
Fuel for main heating system	Electricity		
Target carbon dioxide emission rate	14.09 kgCO ₂ /m ²		
Dwelling carbon dioxide emission rate	9.85 kgCO ₂ /m ²		OK
1b Target primary energy rate and dwelling primary energy			
Target primary energy	74.95 kWh _{PE} /m ²		
Dwelling primary energy	103.57 kWh _{PE} /m ²		FAIL
1c Target fabric energy efficiency and dwelling fabric energy efficiency			
Target fabric energy efficiency	32.5 kWh/m ²		
Dwelling fabric energy efficiency	32.0 kWh/m ²		OK

2a Fabric U-values				
Element	Maximum permitted average U-Value [W/m ² K]	Dwelling average U-Value [W/m ² K]	Element with highest individual U-Value	
External walls	0.26	0.12	Walls (1) (0.12)	OK
Party walls	0.2	0	Party Wall (1) (0)	N/A
Curtain walls	1.6	0	N/A	N/A
Floors	0.18	N/A	N/A	N/A
Roofs	0.16	0.11	Roof (1) (0.11)	OK
Windows, doors, and roof windows	1.6	1.2	FRONT (1.2)	OK
Rooflights	2.2	N/A	N/A	N/A

2b Envelope elements (better than typically expected values are flagged with a subsequent (!))			
Name	Net area [m ²]	U-Value [W/m ² K]	
Exposed wall: Walls (1)	24.67	0.12 (!)	
Sheltered wall: Walls (2)	24.57	0.12 (!)	
Party wall: Party Wall (1)	24.81	0 (!)	
Exposed roof: Roof (1)	7.28	0.11	

2c Openings (better than typically expected values are flagged with a subsequent (!))				
Name	Area [m ²]	Orientation	Frame factor	U-Value [W/m ² K]
FRONT, WINDOWS	8.38	North West	0.7	1.2
REAR, WINDOWS	8.34	South East	0.7	1.2
ENTRANCE DOOR, CORRIDOR DOOR	1.89	North East	N/A	1.2

2d Thermal bridging (better than typically expected values are flagged with a subsequent (!))				
Building part 1 - Main Dwelling: Thermal bridging calculated from linear thermal transmittances for each junction				
Main element	Junction detail	Source	Psi value [W/mK]	Drawing / reference
External wall	E2: Other lintels (including other steel lintels)	Calculated by person with suitable expertise	0.16	
External wall	E3: Sill	Calculated by person with suitable expertise	0.16	

Main element	Junction detail	Source	Psi value [W/mK]	Drawing / reference
External wall	E4: Jamb	Calculated by person with suitable expertise	0.16	
External wall	E5: Ground floor (normal)	Calculated by person with suitable expertise	0.16	

3 Air permeability (better than typically expected values are flagged with a subsequent (!))

Maximum permitted air permeability at 50Pa	8 m ³ /hm ²	
Dwelling air permeability at 50Pa	3 m ³ /hm ² , Design value (!)	OK
Air permeability test certificate reference		

4 Space heating

Main heating system 1: Boiler with radiators or underfloor heating - Electricity

Efficiency	100.0%
Emitter type	Underfloor
Flow temperature	
System type	Direct acting electric boiler
Manufacturer	
Model	
Commissioning	

Secondary heating system: N/A

Fuel	N/A
Efficiency	N/A
Commissioning	

5 Hot water

Cylinder/store - type: Cylinder

Capacity	200 litres
Declared heat loss	2.1 kWh/day
Primary pipework insulated	N/A
Manufacturer	
Model	
Commissioning	

Waste water heat recovery system 1 - type: N/A

Efficiency	
Manufacturer	
Model	

6 Controls

Main heating 1 - type: Time and temperature zone control by arrangement of plumbing and electrical services

Function	
Ecodesign class	
Manufacturer	
Model	

Water heating - type: Cylinder thermostat

Manufacturer	
Model	

7 Lighting

Minimum permitted light source efficacy	75 lm/W	
Lowest light source efficacy	100 lm/W	OK
External lights control	N/A	

8 Mechanical ventilation

System type: N/A

Maximum permitted specific fan power	N/A	
Specific fan power	N/A	N/A
Minimum permitted heat recovery efficiency	N/A	
Heat recovery efficiency	N/A	N/A
Manufacturer/Model		
Commissioning		

9 Local generation

N/A

10 Heat networks	
N/A	
11 Supporting documentary evidence	
N/A	
12 Declarations	
a. Assessor Declaration	
This declaration by the assessor is confirmation that the contents of this BREL Compliance Report are a true and accurate reflection based upon the design information submitted for this dwelling for the purpose of carrying out the "As designed" assessment, and that the supporting documentary evidence (SAP Conventions, Appendix 1 (documentary evidence) schedules the minimum documentary evidence required) has been reviewed in the course of preparing this BREL Compliance Report.	
Signed: Name:	Assessor ID: Date:
b. Client Declaration	
N/A	

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Property Reference	39-41 Richmond				Issued on Date	12/04/2023
Assessment Reference	Flat 3 - Electric	Prop Type Ref	39-41 Richmond			
Property	39-41 , Richmond Street, MANCHESTER, M1 3WB					
SAP Rating	66 D	DER	9.85	TER	14.09	
Environmental	93 A	% DER < TER				30.09
CO ₂ Emissions (t/year)	0.49	DFEE	32.00	TFEE	32.51	
Compliance Check	See BREL	% DFEE < TFEE				1.56
% DPER < TPER	-38.18	DPER	103.57	TPER	74.95	
Assessor Details	Mr. Mark Simons				Assessor ID	5542-0001
Client	EAI Consult, Mark Simons					

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	54.2300 (1b)	x 2.7500 (2b)	= 149.1325 (1b) - (4)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	54.2300		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 149.1325 (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	2 * 10 = 20.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	Air changes per hour
Pressure test	20.0000 / (5) = 0.1341 (8)
Pressure Test Method	Yes
Measured/design AP50	Blower Door
Infiltration rate	3.0000 (17)
Number of sides sheltered	0.2841 (18)
	0 (19)

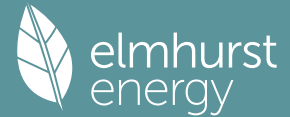
Shelter factor	(20) = 1 - [0.075 x (19)] = 1.0000 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.2841 (21)

	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	0.3622	0.3551	0.3480	0.3125	0.3054	0.2699	0.2699	0.2628	0.2841	0.3054	0.3196	0.3338 (22b)
Effective ac	0.5656	0.5631	0.5606	0.5488	0.5466	0.5364	0.5364	0.5345	0.5404	0.5466	0.5511	0.5557 (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
WINDOWS (Uw = 1.20)			16.7200	1.1450	19.1450		(27)
CORRIDOR DOOR			1.8900	1.2000	2.2680		(26)
EXTERNAL	41.3900	16.7200	24.6700	0.1200	2.9604	70.0000	1726.9000 (29a)
HALLWAY	26.4600	1.8900	24.5700	0.1100	2.7027	70.0000	1719.9000 (29a)
FLAT ROOF	7.2800		7.2800	0.1100	0.8008	9.0000	65.5200 (30)
Total net area of external elements Aum(A, m ²)			75.1300				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	27.8769		(33)
SOLID			24.8100	0.0000	0.0000	180.0000	4465.8000 (32)

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FLOORS 54.2300 40.0000 2169.2000 (32d)
CEILING 46.9500 30.0000 1408.5000 (32b)

Heat capacity $C_m = \text{Sum}(A \times k)$ (28)...(30) + (32) + (32a)...(32e) = 11555.8200 (34)
Thermal mass parameter (TMP = C_m / TFA) in kJ/m²K 213.0891 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	5.0000	0.1600	0.8000
E3 Sill	7.5000	0.1600	1.2000
E4 Jamb	7.5000	0.1600	1.2000
E5 Ground floor (normal)	9.0000	0.1600	1.4400

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 4.6400 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 32.5169 (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	27.8357	27.7103	27.5874	27.0102	26.9022	26.3994	26.3994	26.3063	26.5931	26.9022	27.1207	27.3491 (38)
Heat transfer coeff	60.3526	60.2273	60.1044	59.5271	59.4191	58.9164	58.9164	58.8233	59.1100	59.4191	59.6376	59.8660 (39)
Average = Sum(39)m / 12 =												59.5266

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.1129	1.1106	1.1083	1.0977	1.0957	1.0864	1.0864	1.0847	1.0900	1.0957	1.0997	1.1039 (40)
HLP (average)												1.0977
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

4. Water heating energy requirements (kWh/year)

Assumed occupancy 1.8148 (42)
Hot water usage for mixer showers 54.6471 53.8259 52.6292 50.3395 48.6498 46.7654 45.6943 46.8820 48.1839 50.2071 52.5460 54.4378 (42a)
Hot water usage for baths 24.8666 24.4973 23.9773 23.0184 22.3004 21.5042 21.0742 21.5906 22.1529 23.0048 23.9834 24.7826 (42b)
Hot water usage for other uses 34.9632 33.6918 32.4204 31.1490 29.8776 28.6062 28.6062 29.8776 31.1490 32.4204 33.6918 34.9632 (42c)
Average daily hot water use (litres/day) 105.2228 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	114.4769	112.0150	109.0268	104.5069	100.8277	96.8758	95.3747	98.3502	101.4857	105.6323	110.2212	114.1835 (44)
Energy conte	181.3035	159.5079	167.5702	143.0647	135.7335	119.1201	115.3475	121.7781	125.1421	143.3420	157.0303	178.7837 (45)
Energy content (annual)												1747.7235
Distribution loss (46)m = 0.15 x (45)m	27.1955	23.9262	25.1355	21.4597	20.3600	17.8680	17.3021	18.2667	18.7713	21.5013	23.5545	26.8176 (46)

Water storage loss:
Store volume 200.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): 2.1000 (48)
Temperature factor from Table 2b 0.6000 (49)
Enter (49) or (54) in (55) 1.2600 (55)
Total storage loss 39.0600 35.2800 39.0600 37.8000 39.0600 37.8000 39.0600 39.0600 37.8000 39.0600 37.8000 39.0600 (56)

If cylinder contains dedicated solar storage 39.0600 35.2800 39.0600 37.8000 39.0600 37.8000 39.0600 39.0600 37.8000 39.0600 37.8000 39.0600 (57)
Primary 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 (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 220.3635 194.7879 206.6302 180.8647 174.7935 156.9201 154.4075 160.8381 162.9421 182.4020 194.8303 217.8437 (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 220.3635 194.7879 206.6302 180.8647 174.7935 156.9201 154.4075 160.8381 162.9421 182.4020 194.8303 217.8437 (64)
Total per year (kWh/year) = Sum(64)m = 2207.6235 (64)
2208 (64)

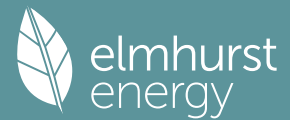
12Total per year (kWh/year)
Electric shower(s) 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (64a)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 0.0000 (64a)

Heat gains from water heating, kWh/month 91.5314 81.2604 86.9651 77.8090 76.3794 69.8474 69.6010 71.7392 71.8497 78.9092 82.4526 90.6936 (65)

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

Metabolic gains (Table 5), Watts 90.7382 90.7382 90.7382 90.7382 90.7382 90.7382 90.7382 90.7382 90.7382 90.7382 90.7382 90.7382 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 79.7932 88.3425 79.7932 82.4530 79.7932 82.4530 79.7932 79.7932 82.4530 79.7932 82.4530 79.7932 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 158.1990 159.8407 155.7038 146.8971 135.7801 125.3317 118.3516 116.7100 120.8468 129.6535 140.7705 151.2189 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 32.0738 32.0738 32.0738 32.0738 32.0738 32.0738 32.0738 32.0738 32.0738 32.0738 32.0738 32.0738 (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) -72.5906 -72.5906 -72.5906 -72.5906 -72.5906 -72.5906 -72.5906 -72.5906 -72.5906 -72.5906 -72.5906 -72.5906 (71)
Water heating gains (Table 5) 123.0261 120.9232 116.8886 108.0681 102.6605 97.0103 93.5498 96.4237 99.7913 106.0608 114.5174 121.9000 (72)

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Total internal gains
414.2398 422.3278 405.6071 390.6396 371.4553 355.0166 341.9160 343.1483 353.3125 368.7290 390.9624 406.1336 (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				
Southeast			8.3400	36.7938	0.6300	0.7000	0.7700	93.7806 (77)				
Northwest			8.3800	11.2829	0.6300	0.7000	0.7700	28.8960 (81)				
Solar gains	122.6766	218.5617	324.5400	444.8530	537.2765	550.5477	523.6470	452.0720	365.7915	248.4312	148.6862	103.8546 (83)
Total gains	536.9164	640.8895	730.1471	835.4926	908.7318	905.5643	865.5630	795.2203	719.1040	617.1602	539.6486	509.9882 (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	53.1866	53.2973	53.4063	53.9242	54.0222	54.4832	54.4832	54.5694	54.3047	54.0222	53.8243	53.6189
alpha	4.5458	4.5532	4.5604	4.5949	4.6015	4.6322	4.6322	4.6380	4.6203	4.6015	4.5883	4.5746
util living area	0.9725	0.9428	0.8844	0.7555	0.5823	0.4122	0.2987	0.3388	0.5485	0.8220	0.9464	0.9774 (86)
MIT	20.1104	20.3137	20.5500	20.7816	20.8930	20.9267	20.9320	20.9312	20.9102	20.7449	20.3929	20.0728 (87)
Th 2	19.9903	19.9922	19.9940	20.0027	20.0044	20.0119	20.0119	20.0133	20.0090	20.0044	20.0011	19.9976 (88)
util rest of house	0.9657	0.9298	0.8604	0.7140	0.5275	0.3503	0.2320	0.2669	0.4767	0.7784	0.9320	0.9718 (89)
MIT 2	18.9731	19.2253	19.5098	19.7761	19.8875	19.9226	19.9258	19.9270	19.9089	19.7473	19.3347	18.9320 (90)
Living area fraction	19.5366	19.7646	20.0252	20.2743	20.3857	20.4201	20.4244	20.4246	20.4051	20.2416	19.8590	19.4973 (92)
MIT	19.5366	19.7646	20.0252	20.2743	20.3857	20.4201	20.4244	20.4246	20.4051	20.2416	19.8590	19.4973 (93)
Temperature adjustment												0.0000
adjusted MIT	19.5366	19.7646	20.0252	20.2743	20.3857	20.4201	20.4244	20.4246	20.4051	20.2416	19.8590	19.4973 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9620	0.9265	0.8612	0.7258	0.5490	0.3760	0.2599	0.2969	0.5060	0.7896	0.9296	0.9683 (94)
Useful gains	516.5258	593.7761	628.8188	606.4280	498.8662	340.5199	224.9922	236.1349	363.8558	487.3172	501.6434	493.8445 (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	919.5681	895.2525	812.9235	677.0802	516.0984	342.9005	225.3192	236.7384	372.6919	572.8967	760.9148	915.7859 (97)
Space heating kWh	299.8635	202.5921	136.9739	50.8696	12.8207	0.0000	0.0000	0.0000	0.0000	63.6712	186.6754	313.9244 (98a)
Space heating requirement - total per year (kWh/year)												1267.3908
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	299.8635	202.5921	136.9739	50.8696	12.8207	0.0000	0.0000	0.0000	0.0000	63.6712	186.6754	313.9244 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1267.3908
Space heating per m2										(98c) / (4) =		23.3707 (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 %)												100.0000 (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	299.8635	202.5921	136.9739	50.8696	12.8207	0.0000	0.0000	0.0000	0.0000	63.6712	186.6754	313.9244 (98)
Space heating efficiency (main heating system 1)	100.0000	100.0000	100.0000	100.0000	100.0000	0.0000	0.0000	0.0000	0.0000	100.0000	100.0000	100.0000 (210)
Space heating fuel (main heating system)	299.8635	202.5921	136.9739	50.8696	12.8207	0.0000	0.0000	0.0000	0.0000	63.6712	186.6754	313.9244 (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	220.3635	194.7879	206.6302	180.8647	174.7935	156.9201	154.4075	160.8381	162.9421	182.4020	194.8303	217.8437 (64)
Efficiency of water heater												100.0000 (216)

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(217)m	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	(217)
Fuel for water heating, kWh/month	220.3635	194.7879	206.6302	180.8647	174.7935	156.9201	154.4075	160.8381	162.9421	182.4020	194.8303	217.8437	(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	3.4822	3.1452	3.4822	3.3699	3.4822	3.3699	3.4822	3.4822	3.3699	3.4822	3.3699	3.4822	(231)
Lighting	15.4273	12.3763	11.1435	8.1642	6.3063	5.1523	5.7528	7.4777	9.7128	12.7437	14.3940	15.8561	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)
Annual totals kWh/year													
Space heating fuel - main system 1												1267.3908	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												100.0000	
Water heating fuel used												2207.6235	(219)
Space cooling fuel												0.0000	(221)
Electricity for pumps and fans:													
central heating pump												41.0000	(230c)
Total electricity for the above, kWh/year												41.0000	(231)
Electricity for lighting (calculated in Appendix L)												124.5070	(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												3640.5213	(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	1267.3908	0.1572	199.2331	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2207.6235	0.1410	311.2331	(264)
Space and water heating			510.4663	(265)
Pumps, fans and electric keep-hot	41.0000	0.1387	5.6872	(267)
Energy for lighting	124.5070	0.1443	17.9702	(268)
Total CO2, kg/year			534.1237	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			9.8500	(273)

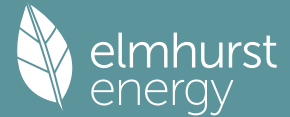
13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	1267.3908	1.5819	2004.9170	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2207.6235	1.5213	3358.4596	(278)
Space and water heating			5363.3767	(279)
Pumps, fans and electric keep-hot	41.0000	1.5128	62.0248	(281)
Energy for lighting	124.5070	1.5338	190.9730	(282)
Total Primary energy kWh/year			5616.3745	(286)
Dwelling Primary energy Rate (DPER)			103.5700	(287)

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

1. Overall dwelling characteristics

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Ground floor	Area (m2)	Storey height (m)	Volume (m3)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	54.2300 (1b)	x 2.7500 (2b)	= 149.1325 (1b) - (4)
Dwelling volume	(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		149.1325 (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	2 * 10 =	20.0000 (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)+(6g)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1341 (8)	
Pressure test	Yes		
Pressure Test Method	Blower Door		
Measured/design AP50	5.0000 (17)		
Infiltration rate	0.3841 (18)		
Number of sides sheltered	0 (19)		
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000 (20)	
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3841 (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	0.4897	0.4801	0.4705	0.4225	0.4129	0.3649	0.3649	0.3553	0.3841	0.4129	0.4321	0.4513 (22b)
Effective ac	0.6199	0.6153	0.6107	0.5893	0.5853	0.5666	0.5666	0.5631	0.5738	0.5853	0.5934	0.6018 (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 Opaque door			1.8900	1.0000	1.8900		(26)
TER Opening Type (Uw = 1.20)			11.6700	1.1450	13.3626		(27)
EXTERNAL	41.3900	11.6700	29.7200	0.1800	5.3496		(29a)
HALLWAY	26.4600	1.8900	24.5700	0.1800	4.4226		(29a)
FLAT ROOF	7.2800		7.2800	0.1100	0.8008		(30)
Total net area of external elements Aum(A, m2)			75.1300				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =	25.8256			(33)
SOLID			24.8100	0.0000	0.0000		(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 221.7466 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	5.0000	0.0500	0.2500
E3 Sill	7.5000	0.0500	0.3750
E4 Jamb	7.5000	0.0500	0.3750
E5 Ground floor (normal)	9.0000	0.1600	1.4400
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			2.4400 (36)
Point Thermal bridges		(36a) =	0.0000
Total fabric heat loss		(33) + (36) + (36a) =	28.2656 (37)

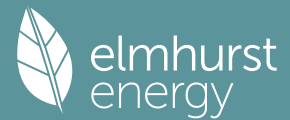
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heat transfer coeff	30.5087	30.2795	30.0549	28.9998	28.8023	27.8834	27.8834	27.7132	28.2374	28.8023	29.2017	29.6192 (38)
Average = Sum(39)m / 12 =	58.7743	58.5451	58.3205	57.2653	57.0679	56.1490	56.1490	55.9788	56.5029	57.0679	57.4673	57.8848 (39)
	57.2644											
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.0838	1.0796	1.0754	1.0560	1.0523	1.0354	1.0354	1.0322	1.0419	1.0523	1.0597	1.0674 (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												1.8148 (42)
Hot water usage for mixer showers												
54.6471	53.8259	52.6292	50.3395	48.6498	46.7654	45.6943	46.8820	48.1839	50.2071	52.5460	54.4378 (42a)	
Hot water usage for baths												
23.6233	23.2725	22.7784	21.8674	21.1853	20.4290	20.0205	20.5110	21.0452	21.8545	22.7842	23.5434 (42b)	
Hot water usage for other uses												

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	33.2150	32.0072	30.7994	29.5915	28.3837	27.1759	27.1759	28.3837	29.5915	30.7994	32.0072	33.2150 (42c)
Average daily hot water use (litres/day)												102.4808 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	111.4854	109.1055	106.2070	101.7985	98.2189	94.3703	92.8907	95.7768	98.8206	102.8610	107.3374	111.1962 (44)
Energy conte	176.5657	155.3648	163.2361	139.3571	132.2215	116.0393	112.3432	118.5916	121.8557	139.5814	152.9218	174.1064 (45)
Energy content (annual)										Total = Sum(45)m =		1702.1847
Distribution loss (46)m = 0.15 x (45)m												
	26.4849	23.3047	24.4854	20.9036	19.8332	17.4059	16.8515	17.7887	18.2784	20.9372	22.9383	26.1160 (46)
Water storage loss:												
Store volume												200.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.6525 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.8924 (55)
Total storage loss												
	27.6637	24.9865	27.6637	26.7713	27.6637	26.7713	27.6637	27.6637	26.7713	27.6637	26.7713	27.6637 (56)
If cylinder contains dedicated solar storage												
	27.6637	24.9865	27.6637	26.7713	27.6637	26.7713	27.6637	27.6637	26.7713	27.6637	26.7713	27.6637 (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												
	227.4918	201.3626	214.1622	188.6404	183.1475	165.3226	163.2693	169.5177	171.1390	190.5075	202.2051	225.0325 (62)
WWHRS	-24.9824	-22.0946	-23.1362	-19.1577	-17.8543	-15.2780	-14.3207	-15.2287	-15.8073	-18.6350	-21.1112	-24.5198 (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												
	202.5094	179.2679	191.0260	169.4827	165.2932	150.0446	148.9486	154.2890	155.3318	171.8725	181.0939	200.5127 (64)
								Total per year (kWh/year) = Sum(64)m =				2069.6722 (64)
12Total per year (kWh/year)												2070 (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)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =												
Heat gains from water heating, kWh/month												
	99.4489	88.4570	95.0169	85.7629	84.7045	78.0097	78.0950	80.1726	79.9437	87.1517	90.2731	98.6312 (65)

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

Metabolic gains (Table 5), Watts												
(66)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5												
	79.8937	88.4538	79.8937	82.5569	79.8937	82.5569	79.8937	79.8937	82.5569	79.8937	82.5569	79.8937 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5												
	158.1990	159.8407	155.7038	146.8971	135.7801	125.3317	118.3516	116.7100	120.8468	129.6535	140.7705	151.2189 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												
	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738 (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)												
	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906 (71)
Water heating gains (Table 5)												
	133.6679	131.6324	127.7109	119.1151	113.8501	108.3468	104.9664	107.7588	111.0329	117.1394	125.3794	132.5689 (72)
Total internal gains												
	424.9822	433.1483	416.5299	401.7905	382.7454	366.4569	353.4331	354.5840	364.6580	379.9081	401.9282	416.9029 (73)

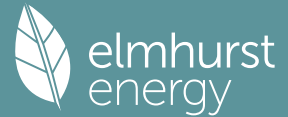
6. Solar gains

[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
Southeast				5.8200	36.7938		0.6300		0.7000		0.7700		65.4440 (77)
Northwest				5.8500	11.2829		0.6300		0.7000		0.7700		20.1720 (81)
Solar gains	85.6160	152.5361	226.5039	310.4803	374.9922	384.2573	365.4808	315.5210	255.2967	173.3835	103.7685		72.4799 (83)
Total gains	510.5982	585.6845	643.0338	712.2708	757.7376	750.7141	718.9140	670.1050	619.9547	553.2916	505.6967		489.3829 (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, n11,m (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	56.8338	57.0563	57.2761	58.3314	58.5332	59.4911	59.4911	59.6720	59.1185	58.5332	58.1264	57.7071
alpha	4.7889	4.8038	4.8184	4.8888	4.9022	4.9661	4.9661	4.9781	4.9412	4.9022	4.8751	4.8471
util living area												
	0.9785	0.9589	0.9197	0.8185	0.6587	0.4722	0.3425	0.3822	0.6037	0.8583	0.9576	0.9819 (86)
MIT	19.9399	20.1612	20.4397	20.7569	20.9300	20.9891	20.9982	20.9970	20.9654	20.7374	20.3047	19.9142 (87)
Th 2	20.0141	20.0176	20.0210	20.0370	20.0400	20.0539	20.0539	20.0565	20.0486	20.0400	20.0339	20.0275 (88)
util rest of house												
	0.9730	0.9488	0.9006	0.7813	0.6026	0.4051	0.2695	0.3049	0.5298	0.8193	0.9454	0.9771 (89)
MIT 2	18.8094	19.0870	19.4288	19.8063	19.9850	20.0479	20.0533	20.0554	20.0267	19.7973	19.2817	18.7871 (90)
Living area fraction									fLA = Living area / (4) =			0.4955 (91)

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MIT	19.3695	19.6193	19.9297	20.2773	20.4532	20.5143	20.5215	20.5220	20.4918	20.2631	19.7886	19.3456 (92)
Temperature adjustment												0.0000
adjusted MIT	19.3695	19.6193	19.9297	20.2773	20.4532	20.5143	20.5215	20.5220	20.4918	20.2631	19.7886	19.3456 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9684	0.9439	0.8986	0.7912	0.6274	0.4380	0.3057	0.3432	0.5650	0.8292	0.9417	0.9729	(94)
Useful gains	494.4665	552.8409	577.8402	563.5324	475.3886	328.8306	219.7597	229.9911	350.2745	458.7828	476.2382	476.1343	(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	885.7017	861.7425	783.2258	651.5242	499.5281	332.0802	220.1886	230.7420	361.1548	551.4549	729.1779	876.6979	(97)
Space heating kWh	291.0790	207.5819	152.8069	63.3541	17.9598	0.0000	0.0000	0.0000	0.0000	68.9480	182.1166	298.0193	(98a)
Space heating requirement - total per year (kWh/year)												1281.8656	
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	291.0790	207.5819	152.8069	63.3541	17.9598	0.0000	0.0000	0.0000	0.0000	68.9480	182.1166	298.0193	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1281.8656	
Space heating per m2											(98c) / (4) =	23.6376	(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	291.0790	207.5819	152.8069	63.3541	17.9598	0.0000	0.0000	0.0000	0.0000	68.9480	182.1166	298.0193	(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)	315.3619	224.8991	165.5546	68.6393	19.4581	0.0000	0.0000	0.0000	0.0000	74.6999	197.3094	322.8811	(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	202.5094	179.2679	191.0260	169.4827	165.2932	150.0446	148.9486	154.2890	155.3318	171.8725	181.0939	200.5127	(64)
Efficiency of water heater													79.8000 (216)
(217)m	84.8728	84.3895	83.5640	82.0631	80.6006	79.8000	79.8000	79.8000	79.8000	82.1848	84.0724	84.9467	(217)
Fuel for water heating, kWh/month	238.6035	212.4292	228.5986	206.5273	205.0769	188.0258	186.6524	193.3447	194.6513	209.1293	215.4023	236.0454	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting	16.6003	13.3174	11.9909	8.7850	6.7858	5.5441	6.1902	8.0463	10.4513	13.7127	15.4885	17.0617	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-14.6530	-21.7766	-32.9837	-39.1560	-44.0652	-41.8269	-41.3350	-38.1121	-32.7416	-25.8155	-16.5075	-12.5425	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	-5.1979	-11.1823	-22.6887	-34.7599	-46.6256	-47.0741	-46.5026	-39.0542	-28.2208	-16.1949	-7.0060	-4.0909	(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													1388.8035 (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													2514.4865 (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)													133.9743 (232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation													-670.1134 (233)
Wind generation													0.0000 (234)
Hydro-electric generation (Appendix N)													0.0000 (235a)

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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	3453.1509 (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	1388.8035	0.2100	291.6487 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	2514.4865	0.2100	528.0422 (264)
Space and water heating			819.6909 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	133.9743	0.1443	19.3366 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-361.5156	0.1335	-48.2535
PV Unit electricity exported	-308.5978	0.1253	-38.6761
Total			-86.9297 (269)
Total CO2, kg/year			764.0271 (272)
EPC Target Carbon Dioxide Emission Rate (TER)			14.0900 (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	1388.8035	1.1300	1569.3479 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	2514.4865	1.1300	2841.3698 (278)
Space and water heating			4410.7177 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	133.9743	1.5338	205.4942 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-361.5156	1.4932	-539.8295
PV Unit electricity exported	-308.5978	0.4600	-141.9599
Total			-681.7895 (283)
Total Primary energy kWh/year			4064.5232 (286)
Target Primary Energy Rate (TPER)			74.9500 (287)

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF FABRIC ENERGY EFFICIENCY

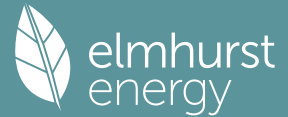
1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	54.2300 (1b)	x 2.7500 (2b)	= 149.1325 (1b) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	54.2300		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 149.1325 (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	2 * 10 = 20.0000 (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) =	20.0000 / (5) = 0.1341 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	3.0000 (17)
Infiltration rate	0.2841 (18)

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Number of sides sheltered

0 (19)

Shelter factor

(20) = 1 - [0.075 x (19)] = 1.0000 (20)

Infiltration rate adjusted to include shelter factor

(21) = (18) x (20) = 0.2841 (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	0.3622	0.3551	0.3480	0.3125	0.3054	0.2699	0.2699	0.2628	0.2841	0.3054	0.3196	0.3338	(22b)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)													0.0000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =													0.0000 (23c)
Effective ac	0.5656	0.5631	0.5606	0.5488	0.5466	0.5364	0.5364	0.5345	0.5404	0.5466	0.5511	0.5557	(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	
WINDOWS (Uw = 1.20)			16.7200	1.1450	19.1450			(27)
CORRIDOR DOOR			1.8900	1.2000	2.2680			(26)
EXTERNAL	41.3900	16.7200	24.6700	0.1200	2.9604	70.0000	1726.9000	(29a)
HALLWAY	26.4600	1.8900	24.5700	0.1100	2.7027	70.0000	1719.9000	(29a)
FLAT ROOF	7.2800		7.2800	0.1100	0.8008	9.0000	65.5200	(30)
Total net area of external elements Aum(A, m2)			75.1300					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	27.8769			(33)
SOLID			24.8100	0.0000	0.0000	180.0000	4465.8000	(32)
FLOORS			54.2300			40.0000	2169.2000	(32d)
CEILING			46.9500			40.0000	1878.0000	(32b)

Heat capacity Cm = Sum(A x k)

(28)...(30) + (32) + (32a)...(32e) = 12025.3200 (34)

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

221.7466 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total	
E2 Other lintels (including other steel lintels)	5.0000	0.1600	0.8000	
E3 Sill	7.5000	0.1600	1.2000	
E4 Jamb	7.5000	0.1600	1.2000	
E5 Ground floor (normal)	9.0000	0.1600	1.4400	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)				4.6400 (36)
Point Thermal bridges			(36a) =	0.0000
Total fabric heat loss			(33) + (36) + (36a) =	32.5169 (37)

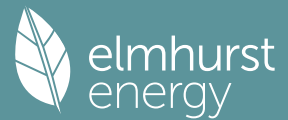
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	27.8357	27.7103	27.5874	27.0102	26.9022	26.3994	26.3994	26.3063	26.5931	26.9022	27.1207	27.3491	(38)
Heat transfer coeff	60.3526	60.2273	60.1044	59.5271	59.4191	58.9164	58.9164	58.8233	59.1100	59.4191	59.6376	59.8660	(39)
Average = Sum(39)m / 12 =												59.5266	
HLP	1.1129	1.1106	1.1083	1.0977	1.0957	1.0864	1.0864	1.0847	1.0900	1.0957	1.0997	1.1039	(40)
HLP (average)												1.0977	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy													1.8148 (42)
Hot water usage for mixer showers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42a)
Hot water usage for baths	23.6233	23.2725	22.7784	21.8674	21.1853	20.4290	20.0205	20.5110	21.0452	21.8545	22.7842	23.5434	(42b)
Hot water usage for other uses	33.2150	32.0072	30.7994	29.5915	28.3837	27.1759	27.1759	28.3837	29.5915	30.7994	32.0072	33.2150	(42c)
Average daily hot water use (litres/day)												52.0980	(43)
Daily hot water use	56.8383	55.2796	53.5778	51.4590	49.5691	47.6049	47.1964	48.8948	50.6368	52.6539	54.7914	56.7584	(44)
Energy conte	90.0180	78.7175	82.3470	70.4448	66.7295	58.5358	57.0799	60.5419	62.4402	71.4509	78.0604	88.8700	(45)
Energy content (annual)										Total = Sum(45)m =		865.2358	
Distribution loss (46)m = 0.15 x (45)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	(46)
Water storage loss:													
Total storage 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	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary 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	(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	76.5153	66.9098	69.9950	59.8781	56.7201	49.7554	48.5179	51.4607	53.0742	60.7332	66.3514	75.5395	(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	76.5153	66.9098	69.9950	59.8781	56.7201	49.7554	48.5179	51.4607	53.0742	60.7332	66.3514	75.5395	(64)

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12Total per year (kWh/year)	Total per year (kWh/year) = Sum(64)m =											735.4504 (64)
Electric shower(s)												735 (64)
	43.7633	38.9934	42.5793	40.6329	41.3954	39.4872	40.8034	41.3954	40.6329	42.5793	41.7787	43.7633 (64a)
	Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =											497.8045 (64a)
Heat gains from water heating, kWh/month	30.0696	26.4758	28.1436	25.1277	24.5289	22.3106	22.3303	23.2140	23.4268	25.8281	27.0325	29.8257 (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	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5												
	79.7932	88.3425	79.7932	82.4530	79.7932	82.4530	79.7932	79.7932	82.4530	79.7932	82.4530	79.7932 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5												
	158.1990	159.8407	155.7038	146.8971	135.7801	125.3317	118.3516	116.7100	120.8468	129.6535	140.7705	151.2189 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												
	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738 (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)												
	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906 (71)
Water heating gains (Table 5)												
	40.4162	39.3985	37.8274	34.8997	32.9689	30.9870	30.0139	31.2016	32.5372	34.7152	37.5452	40.0883 (72)
Total internal gains	328.6299	337.8032	323.5459	314.4712	298.7637	288.9932	278.3802	277.9263	286.0584	294.3835	310.9901	321.3219 (73)

6. Solar gains

[Jan]			Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	Specific data or Table 6c	FF	Access factor Table 6d	Gains W			
Southeast			8.3400	36.7938	0.6300	0.7000	0.7700	93.7806 (77)				
Northwest			8.3800	11.2829	0.6300	0.7000	0.7700	28.8960 (81)				
Solar gains	122.6766	218.5617	324.5400	444.8530	537.2765	550.5477	523.6470	452.0720	365.7915	248.4312	148.6862	103.8546 (83)
Total gains	451.3065	556.3649	648.0859	759.3242	836.0402	839.5410	802.0272	729.9983	651.8499	542.8147	459.6763	425.1765 (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	55.3475	55.4627	55.5761	56.1150	56.2170	56.6968	56.6968	56.7865	56.5110	56.2170	56.0111	55.7974
alpha	4.6898	4.6975	4.7051	4.7410	4.7478	4.7798	4.7798	4.7858	4.7674	4.7478	4.7341	4.7198
util living area	0.9871	0.9673	0.9220	0.8033	0.6264	0.4437	0.3222	0.3686	0.5989	0.8749	0.9717	0.9900 (86)
MIT	19.7701	20.0559	20.4003	20.7581	20.9366	20.9899	20.9983	20.9967	20.9616	20.6861	20.1618	19.7188 (87)
Th 2	19.9903	19.9922	19.9940	20.0027	20.0044	20.0119	20.0119	20.0133	20.0090	20.0044	20.0011	19.9976 (88)
util rest of house	0.9836	0.9588	0.9031	0.7640	0.5694	0.3775	0.2504	0.2906	0.5228	0.8378	0.9629	0.9872 (89)
MIT 2	18.8902	19.1706	19.4999	19.8256	19.9662	20.0077	20.0115	20.0124	19.9903	19.7761	19.2846	18.8453 (90)
Living area fraction									fLA = Living area / (4) =			
MIT	19.3262	19.6093	19.9460	20.2876	20.4470	20.4944	20.5004	20.5001	20.4715	20.2270	19.7192	19.2781 (92)
Temperature adjustment												0.0000
adjusted MIT	19.3262	19.6093	19.9460	20.2876	20.4470	20.4944	20.5004	20.5001	20.4715	20.2270	19.7192	19.2781 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9806	0.9550	0.9021	0.7759	0.5953	0.4101	0.2860	0.3293	0.5591	0.8469	0.9599	0.9846 (94)
Useful gains	442.5490	531.3227	584.6415	589.1718	497.7231	344.2615	229.3811	240.3768	364.4769	459.7307	441.2448	418.6493 (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	906.8689	885.8991	808.1642	677.8715	519.7390	347.2750	229.7984	241.1841	376.6223	572.0264	752.5796	902.6634 (97)
Space heating kWh	345.4540	238.2754	166.3008	63.8638	16.3799	0.0000	0.0000	0.0000	0.0000	83.5480	224.1610	360.1065 (98a)
Space heating requirement - total per year (kWh/year)												1498.0895
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	345.4540	238.2754	166.3008	63.8638	16.3799	0.0000	0.0000	0.0000	0.0000	83.5480	224.1610	360.1065 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1498.0895
Space heating per m ²												(98c) / (4) =
												27.6247 (99)

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8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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
Heat loss rate W												
	0.0000	0.0000	0.0000	0.0000	0.0000	553.8138	435.9811	447.0567	0.0000	0.0000	0.0000	0.0000 (100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9672	0.9843	0.9752	0.0000	0.0000	0.0000	0.0000 (101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	535.6682	429.1503	435.9534	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	952.5269	910.2554	827.5959	0.0000	0.0000	0.0000	0.0000 (103)
Space cooling kWh												
	0.0000	0.0000	0.0000	0.0000	0.0000	300.1383	357.9422	291.3820	0.0000	0.0000	0.0000	0.0000 (104)
Cooled fraction									fc = cooled area / (4) =			1.0000 (105)
Intermittency factor (Table 10b)												
	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500 (106)
Space cooling kWh												
	0.0000	0.0000	0.0000	0.0000	0.0000	75.0346	89.4856	72.8455	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling requirement												237.3656 (107)
Energy for space heating												27.6247 (99)
Energy for space cooling												4.3770 (108)
Total												32.0018 (109)
Fabric Energy Efficiency (DFEE)												32.0 (109)

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

1. Overall dwelling characteristics

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	54.2300 (1b)	x 2.7500 (2b)	= 149.1325 (1b) - (4)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	54.2300		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	149.1325 (5)

2. Ventilation rate

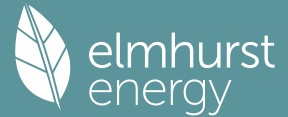
	m ³ per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	2 * 10 = 20.0000 (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) =	20.0000 / (5) = 0.1341 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	5.0000 (17)
Infiltration rate	0.3841 (18)
Number of sides sheltered	0 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] = 1.0000 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.3841 (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	0.4897	0.4801	0.4705	0.4225	0.4129	0.3649	0.3649	0.3553	0.3841	0.4129	0.4321	0.4513 (22b)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.0000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												0.0000 (23c)
Effective ac	0.6199	0.6153	0.6107	0.5893	0.5853	0.5666	0.5666	0.5631	0.5738	0.5853	0.5934	0.6018 (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
TER Opaque door			1.8900	1.0000	1.8900		(26)

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TER Opening Type (Uw = 1.20)			11.6700	1.1450	13.3626	(27)
EXTERNAL	41.3900	11.6700	29.7200	0.1800	5.3496	(29a)
HALLWAY	26.4600	1.8900	24.5700	0.1800	4.4226	(29a)
FLAT ROOF	7.2800		7.2800	0.1100	0.8008	(30)
Total net area of external elements Aum(A, m2)			75.1300			(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		25.8256	(33)
SOLID			24.8100	0.0000	0.0000	(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 221.7466 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total	
E2 Other lintels (including other steel lintels)	5.0000	0.0500	0.2500	
E3 Sill	7.5000	0.0500	0.3750	
E4 Jamb	7.5000	0.0500	0.3750	
E5 Ground floor (normal)	9.0000	0.1600	1.4400	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)				2.4400 (36)
Point Thermal bridges			(36a) =	0.0000
Total fabric heat loss			(33) + (36) + (36a) =	28.2656 (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	30.5087	30.2795	30.0549	28.9998	28.8023	27.8834	27.8834	27.7132	28.2374	28.8023	29.2017	29.6192	(38)
Heat transfer coeff	58.7743	58.5451	58.3205	57.2653	57.0679	56.1490	56.1490	55.9788	56.5029	57.0679	57.4673	57.8848	(39)
Average = Sum(39)m / 12 =												57.2644	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0838	1.0796	1.0754	1.0560	1.0523	1.0354	1.0354	1.0322	1.0419	1.0523	1.0597	1.0674	(40)
HLP (average)												1.0560	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

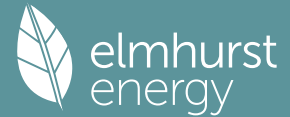
4. Water heating energy requirements (kWh/year)

Assumed occupancy													1.8148 (42)
Hot water usage for mixer showers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42a)
Hot water usage for baths	23.6233	23.2725	22.7784	21.8674	21.1853	20.4290	20.0205	20.5110	21.0452	21.8545	22.7842	23.5434	(42b)
Hot water usage for other uses	33.2150	32.0072	30.7994	29.5915	28.3837	27.1759	27.1759	28.3837	29.5915	30.7994	32.0072	33.2150	(42c)
Average daily hot water use (litres/day)												52.0980	(43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	56.8383	55.2796	53.5778	51.4590	49.5691	47.6049	47.1964	48.8948	50.6368	52.6539	54.7914	56.7584	(44)
Energy conte	90.0180	78.7175	82.3470	70.4448	66.7295	58.5358	57.0799	60.5419	62.4402	71.4509	78.0604	88.8700	(45)
Energy content (annual)										Total = Sum(45)m =		865.2358	
Distribution loss (46)m = 0.15 x (45)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	(46)
Water storage loss:													
Total storage 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	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary 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	(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	76.5153	66.9098	69.9950	59.8781	56.7201	49.7554	48.5179	51.4607	53.0742	60.7332	66.3514	75.5395	(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	76.5153	66.9098	69.9950	59.8781	56.7201	49.7554	48.5179	51.4607	53.0742	60.7332	66.3514	75.5395	(64)
12Total per year (kWh/year)										Total per year (kWh/year) = Sum(64)m =		735.4504	(64)
Electric shower(s)	43.7633	38.9934	42.5793	40.6329	41.3954	39.4872	40.8034	41.3954	40.6329	42.5793	41.7787	43.7633	(64a)
												497.8045	(64a)
Heat gains from water heating, kWh/month	30.0696	26.4758	28.1436	25.1277	24.5289	22.3106	22.3303	23.2140	23.4268	25.8281	27.0325	29.8257	(65)

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

Metabolic gains (Table 5), Watts													
(66)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	(66)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	79.8937	88.4538	79.8937	82.5569	79.8937	82.5569	79.8937	79.8937	82.5569	79.8937	82.5569	79.8937	(67)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	158.1990	159.8407	155.7038	146.8971	135.7801	125.3317	118.3516	116.7100	120.8468	129.6535	140.7705	151.2189	(68)
Pumps, fans	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	(69)
Losses e.g. evaporation (negative values) (Table 5)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Water heating gains (Table 5)	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	(71)
	40.4162	39.3985	37.8274	34.8997	32.9689	30.9870	30.0139	31.2016	32.5372	34.7152	37.5452	40.0883	(72)

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Total internal gains
328.7304 337.9144 323.6464 314.5751 298.8642 289.0971 278.4807 278.0268 286.1623 294.4840 311.0940 321.4224 (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

Southeast				5.8200	36.7938		0.6300		0.7000		0.7700		65.4440 (77)
Northwest				5.8500	11.2829		0.6300		0.7000		0.7700		20.1720 (81)

Solar gains	85.6160	152.5361	226.5039	310.4803	374.9922	384.2573	365.4808	315.5210	255.2967	173.3835	103.7685	72.4799	(83)
Total gains	414.3465	490.4506	550.1503	625.0554	673.8564	673.3543	643.9615	593.5478	541.4590	467.8675	414.8625	393.9023	(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	56.8338	57.0563	57.2761	58.3314	58.5332	59.4911	59.4911	59.6720	59.1185	58.5332	58.1264	57.7071
alpha	4.7889	4.8038	4.8184	4.8888	4.9022	4.9661	4.9661	4.9781	4.9412	4.9022	4.8751	4.8471
util living area	0.9906	0.9787	0.9520	0.8699	0.7189	0.5224	0.3816	0.4300	0.6737	0.9126	0.9799	0.9925 (86)
MIT	19.7438	19.9816	20.2907	20.6701	20.8975	20.9831	20.9971	20.9949	20.9443	20.6313	20.1328	19.7165 (87)
Th 2	20.0141	20.0176	20.0210	20.0370	20.0400	20.0539	20.0539	20.0565	20.0486	20.0400	20.0339	20.0275 (88)
util rest of house	0.9880	0.9730	0.9392	0.8384	0.6630	0.4498	0.3006	0.3437	0.5970	0.8834	0.9734	0.9904 (89)
MIT 2	18.8830	19.1196	19.4219	19.7854	19.9754	20.0465	20.0532	20.0551	20.0201	19.7623	19.2835	18.8665 (90)
Living area fraction	19.3095	19.5467	19.8524	20.2237	20.4323	20.5106	20.5209	20.5207	20.4780	20.1929	19.7043	19.2877 (92)
MIT	19.3095	19.5467	19.8524	20.2237	20.4323	20.5106	20.5209	20.5207	20.4780	20.1929	19.7043	19.2877 (93)
Temperature adjustment												0.0000
adjusted MIT	19.3095	19.5467	19.8524	20.2237	20.4323	20.5106	20.5209	20.5207	20.4780	20.1929	19.7043	19.2877 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9856	0.9696	0.9366	0.8451	0.6868	0.4853	0.3408	0.3865	0.6329	0.8886	0.9707	0.9883 (94)
Useful gains	408.3799	475.5285	515.2584	528.2162	462.7718	326.7842	219.4496	229.3925	342.6791	415.7597	402.6896	389.3002 (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	882.1719	857.4918	778.7172	648.4581	498.3343	331.8726	220.1525	230.6734	360.3765	547.4449	724.3364	873.3473 (97)
Space heating kWh	352.5012	256.6794	196.0133	86.5742	26.4585	0.0000	0.0000	0.0000	0.0000	97.9738	231.5858	360.1311 (98a)
Space heating requirement - total per year (kWh/year)												1607.9172
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	352.5012	256.6794	196.0133	86.5742	26.4585	0.0000	0.0000	0.0000	0.0000	97.9738	231.5858	360.1311 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1607.9172
Space heating per m2										(98c) / (4) =		29.6500 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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
Heat loss rate W												
	0.0000	0.0000	0.0000	0.0000	0.0000	527.8004	415.5024	425.4388	0.0000	0.0000	0.0000	0.0000 (100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9432	0.9722	0.9588	0.0000	0.0000	0.0000	0.0000 (101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	497.7985	403.9324	407.9095	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	758.1702	725.3954	668.0032	0.0000	0.0000	0.0000	0.0000 (103)
Space cooling kWh												
	0.0000	0.0000	0.0000	0.0000	0.0000	187.4676	239.1684	193.5097	0.0000	0.0000	0.0000	0.0000 (104)
Cooled fraction									fc = cooled area / (4) =			1.0000 (105)
Intermittency factor (Table 10b)	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500 (106)
Space cooling kWh												
	0.0000	0.0000	0.0000	0.0000	0.0000	46.8669	59.7921	48.3774	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling requirement												155.0364 (107)
Energy for space heating												29.6500 (99)
Energy for space cooling												2.8589 (108)
Total												32.5088 (109)
Fabric Energy Efficiency (TFEE)												32.5 (109)

Building Regulations England Part L (BREL) Compliance Report

Approved Document L1 2021 Edition, England assessed by Array SAP 10 program, Array

Date: Wed 12 Apr 2023 06:39:00

Project Information			
Assessed By	Mark Simons	Building Type	Flat, End-terrace
OCDEA Registration	EES/004083	Assessment Date	2023-04-12

Dwelling Details			
Assessment Type	As designed	Total Floor Area	47 m ²
Site Reference	39-41 Richmond	Plot Reference	Flat 4 - Electric
Address	39-41 Richmond Street, MANCHESTER, M1 3WB		

Client Details	
Name	Mark Simons
Company	EAL Consult
Address	17 Dobree Avenue, London, NW10 2AD

This report covers items included within the SAP calculations. It is not a complete report of regulations compliance.

1a Target emission rate and dwelling emission rate			
Fuel for main heating system	Electricity		
Target carbon dioxide emission rate	17.55 kgCO ₂ /m ²		
Dwelling carbon dioxide emission rate	12.0 kgCO ₂ /m ²		OK
1b Target primary energy rate and dwelling primary energy			
Target primary energy	93.73 kWh _{PE} /m ²		
Dwelling primary energy	125.94 kWh _{PE} /m ²		FAIL
1c Target fabric energy efficiency and dwelling fabric energy efficiency			
Target fabric energy efficiency	44.0 kWh/m ²		
Dwelling fabric energy efficiency	42.3 kWh/m ²		OK

2a Fabric U-values				
Element	Maximum permitted average U-Value [W/m ² K]	Dwelling average U-Value [W/m ² K]	Element with highest individual U-Value	
External walls	0.26	0.12	Walls (1) (0.12)	OK
Party walls	0.2	N/A	N/A	N/A
Curtain walls	1.6	N/A	N/A	N/A
Floors	0.18	N/A	N/A	N/A
Roofs	0.16	0.11	Roof (1) (0.11)	OK
Windows, doors, and roof windows	1.6	1.2	FRONT (1.2)	OK
Rooflights	2.2	N/A	N/A	N/A

2b Envelope elements (better than typically expected values are flagged with a subsequent (!))			
Name	Net area [m ²]	U-Value [W/m ² K]	
Exposed wall: Walls (1)	52.43	0.12 (!)	
Sheltered wall: Walls (2)	20.06	0.12 (!)	
Exposed roof: Roof (1)	46.95	0.11	

2c Openings (better than typically expected values are flagged with a subsequent (!))				
Name	Area [m ²]	Orientation	Frame factor	U-Value [W/m ² K]
FRONT, WINDOWS	8.38	North West	0.7	1.2
REAR, WINDOWS	6.7	South East	0.7	1.2
ENTRANCE DOOR, CORRIDOR DOOR	1.89	North East	N/A	1.2

2d Thermal bridging (better than typically expected values are flagged with a subsequent (!))				
Building part 1 - Main Dwelling: Thermal bridging calculated from linear thermal transmittances for each junction				
Main element	Junction detail	Source	Psi value [W/mK]	Drawing / reference
External wall	E2: Other lintels (including other steel lintels)	Calculated by person with suitable expertise	0.16	
External wall	E3: Sill	Calculated by person with suitable expertise	0.16	

Main element	Junction detail	Source	Psi value [W/mK]	Drawing / reference
External wall	E4: Jamb	Calculated by person with suitable expertise	0.16	
External wall	E5: Ground floor (normal)	Calculated by person with suitable expertise	0.16	

3 Air permeability (better than typically expected values are flagged with a subsequent (!))

Maximum permitted air permeability at 50Pa	8 m ³ /hm ²	
Dwelling air permeability at 50Pa	3 m ³ /hm ² , Design value (!)	OK
Air permeability test certificate reference		

4 Space heating

Main heating system 1: Boiler with radiators or underfloor heating - Electricity

Efficiency	100.0%
Emitter type	Underfloor
Flow temperature	
System type	Direct acting electric boiler
Manufacturer	
Model	
Commissioning	

Secondary heating system: N/A

Fuel	N/A
Efficiency	N/A
Commissioning	

5 Hot water

Cylinder/store - type: Cylinder

Capacity	200 litres
Declared heat loss	2.1 kWh/day
Primary pipework insulated	N/A
Manufacturer	
Model	
Commissioning	

Waste water heat recovery system 1 - type: N/A

Efficiency	
Manufacturer	
Model	

6 Controls

Main heating 1 - type: Time and temperature zone control by arrangement of plumbing and electrical services

Function	
Ecodesign class	
Manufacturer	
Model	

Water heating - type: Cylinder thermostat

Manufacturer	
Model	

7 Lighting

Minimum permitted light source efficacy	75 lm/W	
Lowest light source efficacy	100 lm/W	OK
External lights control	N/A	

8 Mechanical ventilation

System type: N/A

Maximum permitted specific fan power	N/A	
Specific fan power	N/A	N/A
Minimum permitted heat recovery efficiency	N/A	
Heat recovery efficiency	N/A	N/A
Manufacturer/Model		
Commissioning		

9 Local generation

N/A

10 Heat networks	
N/A	
11 Supporting documentary evidence	
N/A	
12 Declarations	
a. Assessor Declaration	
This declaration by the assessor is confirmation that the contents of this BREL Compliance Report are a true and accurate reflection based upon the design information submitted for this dwelling for the purpose of carrying out the "As designed" assessment, and that the supporting documentary evidence (SAP Conventions, Appendix 1 (documentary evidence) schedules the minimum documentary evidence required) has been reviewed in the course of preparing this BREL Compliance Report.	
Signed: Name:	Assessor ID: Date:
b. Client Declaration	
N/A	

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Property Reference	39-41 Richmond				Issued on Date	12/04/2023
Assessment Reference	Flat 4 - Electric		Prop Type Ref	39-41 Richmond		
Property	39-41 , Richmond Street, MANCHESTER, M1 3WB					
SAP Rating	61 D	DER	12.00	TER	17.55	
Environmental	92 A	% DER < TER				31.62
CO ₂ Emissions (t/year)	0.52	DFEE	42.29	TFEE	43.99	
Compliance Check	See BREL	% DFEE < TFEE				3.85
% DPER < TPER	-34.36	DPER	125.94	TPER	93.73	
Assessor Details	Mr. Mark Simons				Assessor ID	5542-0001
Client	EAI Consult, Mark Simons					

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	46.9500 (1b)	2.7500 (2b)	129.1125 (1b) - (4)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	46.9500		
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 129.1125 (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	2 * 10 = 20.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	Air changes per hour
Pressure test	20.0000 / (5) = 0.1549 (8)
Pressure Test Method	Yes
Measured/design AP50	Blower Door
Infiltration rate	3.0000 (17)
Number of sides sheltered	0.3049 (18)
	0 (19)

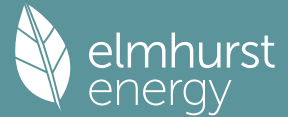
Shelter factor	(20) = 1 - [0.075 x (19)] = 1.0000 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.3049 (21)

	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	0.3888	0.3811	0.3735	0.3354	0.3278	0.2897	0.2897	0.2820	0.3049	0.3278	0.3430	0.3583 (22b)
Effective ac	0.5756	0.5726	0.5698	0.5562	0.5537	0.5420	0.5420	0.5398	0.5465	0.5537	0.5588	0.5642 (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
WINDOWS (U _w = 1.20)			15.0800	1.1450	17.2672		(27)
CORRIDOR DOOR			1.8900	1.2000	2.2680		(26)
EXTERNAL	67.5100	15.0800	52.4300	0.1200	6.2916	70.0000	3670.1000 (29a)
HALLWAY	21.9500	1.8900	20.0600	0.1100	2.2066	70.0000	1404.2000 (29a)
FLAT ROOF	46.9500		46.9500	0.1100	5.1645	9.0000	422.5500 (30)
Total net area of external elements A _{um} (A, m ²)			136.4100				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) = 33.1979		(33)
FLOORS			46.9500			40.0000	1878.0000 (32d)

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Heat capacity $C_m = \text{Sum}(A \times k)$
Thermal mass parameter (TMP = C_m / TFA) in kJ/m²K

$$(28) \dots (30) + (32) + (32a) \dots (32e) = 7374.8500 \quad (34)$$

$$157.0788 \quad (35)$$

List of Thermal Bridges

K1 Element
E2 Other lintels (including other steel lintels)
E3 Sill
E4 Jamb
E5 Ground floor (normal)

Length	Psi-value	Total
5.0000	0.1600	0.8000
7.5000	0.1600	1.2000
7.5000	0.1600	1.2000
9.0000	0.1600	1.4400

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

Point Thermal bridges

Total fabric heat loss

$$(33) + (36) + (36a) = 37.8379 \quad (37)$$

Ventilation heat loss calculated monthly (38)m = $0.33 \times (25)\text{m} \times (5)$

(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	24.5231	24.3981	24.2756	23.7000	23.5923	23.0910	23.0910	22.9981	23.2841	23.5923	23.8101	24.0379
Heat transfer coeff	62.3610	62.2360	62.1134	61.5379	61.4302	60.9289	60.9289	60.8360	61.1220	61.4302	61.6480	61.8758
Average = Sum(39)m / 12 =												61.5373

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.3282	1.3256	1.3230	1.3107	1.3084	1.2977	1.2977	1.2958	1.3019	1.3084	1.3131	1.3179
HLP (average)												1.3107
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

4. Water heating energy requirements (kWh/year)

Assumed occupancy

Hot water usage for mixer showers

	51.0601	50.2928	49.1746	47.0352	45.4564	43.6957	42.6949	43.8046	45.0211	46.9115	49.0968	50.8645
Hot water usage for baths	23.2429	22.8977	22.4116	21.5153	20.8442	20.1000	19.6981	20.1808	20.7063	21.5026	22.4174	23.1643

Hot water usage for other uses

	32.6569	31.4694	30.2819	29.0944	27.9068	26.7193	26.7193	27.9068	29.0944	30.2819	31.4694	32.6569
Average daily hot water use (litres/day)												98.3136

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	106.9599	104.6599	101.8681	97.6449	94.2074	90.5151	89.1123	91.8922	94.8218	98.6960	102.9836	106.6857
Energy conte	169.3984	149.0343	156.5675	133.6710	126.8213	111.2988	107.7736	113.7818	116.9247	133.9296	146.7190	167.0440
Energy content (annual)												1632.9639

Distribution loss (46)m = $0.15 \times (45)\text{m}$

	25.4098	22.3551	23.4851	20.0506	19.0232	16.6948	16.1660	17.0673	17.5387	20.0894	22.0079	25.0566
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Water storage loss:

Store volume

a) If manufacturer declared loss factor is known (kWh/day):

Temperature factor from Table 2b

Enter (49) or (54) in (55)

Total storage loss

	39.0600	35.2800	39.0600	37.8000	39.0600	37.8000	39.0600	39.0600	37.8000	39.0600	37.8000	39.0600
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If cylinder contains dedicated solar storage

	39.0600	35.2800	39.0600	37.8000	39.0600	37.8000	39.0600	39.0600	37.8000	39.0600	37.8000	39.0600
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Primary 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
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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
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Total heat required for water heating calculated for each month

	208.4584	184.3143	195.6275	171.4710	165.8813	149.0988	146.8336	152.8418	154.7247	172.9896	184.5190	206.1040
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WVHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
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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
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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
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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
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Output from w/h

	208.4584	184.3143	195.6275	171.4710	165.8813	149.0988	146.8336	152.8418	154.7247	172.9896	184.5190	206.1040
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$$\text{Total per year (kWh/year)} = \text{Sum}(64)\text{m} = 2092.8639 \quad (64)$$

12Total per year (kWh/year)

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
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$$\text{Total Energy used by instantaneous electric shower(s) (kWh/year)} = \text{Sum}(64a)\text{m} = 0.0000 \quad (64a)$$

Heat gains from water heating, kWh/month

	87.5730	77.7779	83.3067	74.6856	73.4161	67.2469	67.0827	69.0804	69.1175	75.7796	79.0241	86.7901
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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

(66)m	80.0414	80.0414	80.0414	80.0414	80.0414	80.0414	80.0414	80.0414	80.0414	80.0414	80.0414	80.0414
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Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	70.2708	77.7998	70.2708	72.6132	70.2708	72.6132	70.2708	70.2708	72.6132	70.2708	72.6132	70.2708
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Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	139.3197	140.7654	137.1223	129.3665	119.5763	110.3748	104.2276	102.7819	106.4250	114.1808	123.9711	133.1726
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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	31.0041	31.0041	31.0041	31.0041	31.0041	31.0041	31.0041	31.0041	31.0041	31.0041	31.0041	31.0041
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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
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Losses e.g. evaporation (negative values) (Table 5)

	-64.0331	-64.0331	-64.0331	-64.0331	-64.0331	-64.0331	-64.0331	-64.0331	-64.0331	-64.0331	-64.0331	-64.0331
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Water heating gains (Table 5)

	117.7056	115.7409	111.9713	103.7300	98.6775	93.3984	90.1650	92.8501	95.9965	101.8543	109.7557	116.6534
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Total internal gains

	377.3086	384.3186	369.3769	355.7221	338.5370	323.3988	311.6758	312.9152	322.0471	336.3183	356.3524	370.1092
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6. Solar gains

[Jan]			Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	g	Specific data or Table 6c	FF	Access factor Table 6d	Gains W		

Southeast			6.7000	36.7938	0.6300		0.7000		0.7700	75.3393 (77)		
Northwest			8.3800	11.2829	0.6300		0.7000		0.7700	28.8960 (81)		

Solar gains	104.2353	187.1494	281.5603	391.5991	477.6277	491.3303	466.5550	399.7509	319.2536	213.7139	126.5978	88.0727 (83)
Total gains	481.5439	571.4680	650.9372	747.3212	816.1647	814.7291	778.2309	712.6662	641.3007	550.0322	482.9502	458.1819 (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	32.8502	32.9162	32.9811	33.2896	33.3479	33.6223	33.6223	33.6736	33.5161	33.3479	33.2301	33.1078
alpha	3.1900	3.1944	3.1987	3.2193	3.2232	3.2415	3.2415	3.2449	3.2344	3.2232	3.2153	3.2072
util living area	0.9522	0.9210	0.8681	0.7616	0.6145	0.4547	0.3373	0.3810	0.5877	0.8169	0.9242	0.9583 (86)
MIT	19.5523	19.8003	20.1250	20.4960	20.7421	20.8595	20.8920	20.8857	20.8003	20.4629	19.9489	19.5085 (87)
Th 2	19.8188	19.8209	19.8229	19.8325	19.8342	19.8426	19.8426	19.8442	19.8394	19.8342	19.8306	19.8268 (88)
util rest of house	0.9427	0.9062	0.8441	0.7215	0.5564	0.3804	0.2516	0.2901	0.5088	0.7748	0.9073	0.9499 (89)
MIT 2	18.1666	18.4746	18.8711	19.3107	19.5755	19.6923	19.7156	19.7141	19.6441	19.2901	18.6728	18.1180 (90)
Living area fraction	fLA = Living area / (4) =											0.4175 (91)
MIT	18.7451	19.0280	19.3946	19.8055	20.0625	20.1796	20.2067	20.2032	20.1268	19.7797	19.2055	18.6985 (92)
Temperature adjustment	0.0000											
adjusted MIT	18.7451	19.0280	19.3946	19.8055	20.0625	20.1796	20.2067	20.2032	20.1268	19.7797	19.2055	18.6985 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9319	0.8943	0.8340	0.7205	0.5683	0.4026	0.2790	0.3189	0.5294	0.7726	0.8964	0.9397 (94)
Useful gains	448.7717	511.0437	542.9086	538.4134	463.8420	328.0115	217.1254	227.2792	339.5181	424.9729	432.9048	430.5627 (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	900.8082	879.2720	800.9257	671.1025	513.7107	339.9586	219.7541	231.3731	368.3670	563.9113	746.2832	897.1053 (97)
Space heating kWh	336.3152	247.4494	191.9648	95.5362	37.1023	0.0000	0.0000	0.0000	0.0000	103.3701	225.6325	347.1077 (98a)
Space heating requirement - total per year (kWh/year)												1584.4781
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	336.3152	247.4494	191.9648	95.5362	37.1023	0.0000	0.0000	0.0000	0.0000	103.3701	225.6325	347.1077 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1584.4781
Space heating per m2										(98c) / (4) =		33.7482 (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 %)												100.0000 (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	336.3152	247.4494	191.9648	95.5362	37.1023	0.0000	0.0000	0.0000	0.0000	103.3701	225.6325	347.1077 (98)
Space heating efficiency (main heating system 1)	100.0000	100.0000	100.0000	100.0000	100.0000	0.0000	0.0000	0.0000	0.0000	100.0000	100.0000	100.0000 (210)
Space heating fuel (main heating system)	336.3152	247.4494	191.9648	95.5362	37.1023	0.0000	0.0000	0.0000	0.0000	103.3701	225.6325	347.1077 (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	208.4584	184.3143	195.6275	171.4710	165.8813	149.0988	146.8336	152.8418	154.7247	172.9896	184.5190	206.1040 (64)
Efficiency of water heater												100.0000 (216)
(217)m	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000 (217)
Fuel for water heating, kWh/month												

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	208.4584	184.3143	195.6275	171.4710	165.8813	149.0988	146.8336	152.8418	154.7247	172.9896	184.5190	206.1040 (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	3.4822	3.1452	3.4822	3.3699	3.4822	3.3699	3.4822	3.4822	3.3699	3.4822	3.3699	3.4822 (231)
Lighting	13.5862	10.8994	9.8137	7.1899	5.5537	4.5374	5.0663	6.5853	8.5537	11.2229	12.6762	13.9638 (232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (233a)
Electricity generated by wind turbines (Appendix M) (negative quantity) (234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity) (235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) (235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235c)
Electricity generated by PVs (Appendix M) (negative quantity) (233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (233b)
Electricity generated by wind turbines (Appendix M) (negative quantity) (234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity) (235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) (235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235d)
Annual totals kWh/year												
Space heating fuel - main system 1												1584.4781 (211)
Space heating fuel - main system 2												0.0000 (213)
Space heating fuel - secondary												0.0000 (215)
Efficiency of water heater												100.0000
Water heating fuel used												2092.8639 (219)
Space cooling fuel												0.0000 (221)
Electricity for pumps and fans:												
central heating pump												41.0000 (230c)
Total electricity for the above, kWh/year												41.0000 (231)
Electricity for lighting (calculated in Appendix L)												109.6485 (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												3827.9905 (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	1584.4781	0.1559	247.0485	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2092.8639	0.1409	294.9857	(264)
Space and water heating			542.0341	(265)
Pumps, fans and electric keep-hot	41.0000	0.1387	5.6872	(267)
Energy for lighting	109.6485	0.1443	15.8257	(268)
Total CO2, kg/year			563.5470	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			12.0000	(273)

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

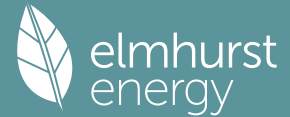
	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	1584.4781	1.5772	2499.0708	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2092.8639	1.5212	3183.6190	(278)
Space and water heating			5682.6898	(279)
Pumps, fans and electric keep-hot	41.0000	1.5128	62.0248	(281)
Energy for lighting	109.6485	1.5338	168.1825	(282)
Total Primary energy kWh/year			5912.8971	(286)
Dwelling Primary energy Rate (DPER)			125.9400	(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)
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Ground floor
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 46.9500 46.9500 (1b) x 2.7500 (2b) = 129.1125 (1b) -
Dwelling volume (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 129.1125 (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 2 * 10 = 20.0000 (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) = 20.0000 / (5) = 0.1549 (8)
Pressure test Yes
Pressure Test Method Blower Door
Measured/design AP50 5.0000 (17)
Infiltration rate 0.4049 (18)
Number of sides sheltered 0 (19)

Shelter factor (20) = 1 - [0.075 x (19)] = 1.0000 (20)
Infiltration rate adjusted to include shelter factor (21) = (18) x (20) = 0.4049 (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	0.5163	0.5061	0.4960	0.4454	0.4353	0.3847	0.3847	0.3745	0.4049	0.4353	0.4555	0.4758 (22b)
Effective ac	0.6333	0.6281	0.6230	0.5992	0.5947	0.5740	0.5740	0.5701	0.5820	0.5947	0.6037	0.6132 (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 Opaque door			1.8900	1.0000	1.8900		(26)
TER Opening Type (Uw = 1.20)			9.8500	1.1450	11.2786		(27)
EXTERNAL	67.5100	9.8500	57.6600	0.1800	10.3788		(29a)
HALLWAY	21.9500	1.8900	20.0600	0.1800	3.6108		(29a)
FLAT ROOF	46.9500		46.9500	0.1100	5.1645		(30)
Total net area of external elements Aum(A, m2)			136.4100				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	32.3227		(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							157.0788 (35)
List of Thermal Bridges							
K1 Element				Length	Psi-value	Total	
E2 Other lintels (including other steel lintels)				5.0000	0.0500	0.2500	
E3 Sill				7.5000	0.0500	0.3750	
E4 Jamb				7.5000	0.0500	0.3750	
E5 Ground floor (normal)				9.0000	0.1600	1.4400	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							2.4400 (36)
Point Thermal bridges						(36a) =	0.0000
Total fabric heat loss						(33) + (36) + (36a) =	34.7627 (37)

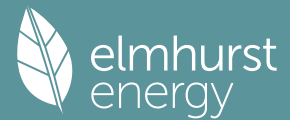
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	26.9813	26.7608	26.5447	25.5297	25.3398	24.4557	24.4557	24.2920	24.7962	25.3398	25.7240	26.1256 (38)
Heat transfer coeff	61.7440	61.5236	61.3075	60.2924	60.1025	59.2184	59.2184	59.0547	59.5589	60.1025	60.4867	60.8883 (39)
Average = Sum(39)m / 12 =												60.2915
HLP	1.3151	1.3104	1.3058	1.2842	1.2801	1.2613	1.2613	1.2578	1.2686	1.2801	1.2883	1.2969 (40)
HLP (average)												1.2842
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

4. Water heating energy requirements (kWh/year)

Assumed occupancy												1.6008 (42)
Hot water usage for mixer showers	51.0601	50.2928	49.1746	47.0352	45.4564	43.6957	42.6949	43.8046	45.0211	46.9115	49.0968	50.8645 (42a)
Hot water usage for baths	22.0807	21.7528	21.2910	20.4396	19.8020	19.0950	18.7132	19.1717	19.6710	20.4275	21.2965	22.0061 (42b)
Hot water usage for other uses	31.0241	29.8959	28.7678	27.6396	26.5115	25.3833	25.3833	26.5115	27.6396	28.7678	29.8959	31.0241 (42c)
Average daily hot water use (litres/day)												95.7517 (43)

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	104.1649	101.9415	99.2334	95.1144	91.7699	88.1741	86.7914	89.4879	92.3317	96.1068	100.2893	103.8946	(44)
Energy conte	164.9718	145.1634	152.5181	130.2069	123.5399	108.4203	104.9667	110.8047	113.8543	130.4160	142.8805	162.6739	(45)
Energy content (annual)	Total = Sum(45)m = 1590.4163												
Distribution loss (46)m = 0.15 x (45)m	24.7458	21.7745	22.8777	19.5310	18.5310	16.2630	15.7450	16.6207	17.0781	19.5624	21.4321	24.4011	(46)
Water storage loss:													
Store volume													200.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):													1.6525 (48)
Temperature factor from Table 2b													0.5400 (49)
Enter (49) or (54) in (55)													0.8924 (55)
Total storage loss	27.6637	24.9865	27.6637	26.7713	27.6637	26.7713	27.6637	27.6637	26.7713	27.6637	26.7713	27.6637	(56)
If cylinder contains dedicated solar storage	27.6637	24.9865	27.6637	26.7713	27.6637	26.7713	27.6637	27.6637	26.7713	27.6637	26.7713	27.6637	(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	215.8978	191.1611	203.4441	179.4902	174.4660	157.7036	155.8928	161.7307	163.1375	181.3421	192.1638	213.6000	(62)
WWHRS	-23.3425	-20.6443	-21.6176	-17.9002	-16.6823	-14.2752	-13.3807	-14.2291	-14.7697	-17.4118	-19.7255	-22.9103	(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	192.5553	170.5168	181.8266	161.5900	157.7836	143.4284	142.5121	147.5017	148.3679	163.9303	172.4383	190.6897	(64)
12Total per year (kWh/year)	Total per year (kWh/year) = Sum(64)m = 1973.1406 (64)												1973 (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	95.5940	85.0650	91.4531	82.7204	81.8179	75.4764	75.6423	77.5834	77.2832	84.1042	86.9344	94.8299	(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	80.0414	80.0414	80.0414	80.0414	80.0414	80.0414	80.0414	80.0414	80.0414	80.0414	80.0414	80.0414	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	70.4683	78.0185	70.4683	72.8173	70.4683	72.8173	70.4683	70.4683	72.8173	70.4683	72.8173	70.4683	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	139.3197	140.7654	137.1223	129.3665	119.5763	110.3748	104.2276	102.7819	106.4250	114.1808	123.9711	133.1726	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	31.0041	31.0041	31.0041	31.0041	31.0041	31.0041	31.0041	31.0041	31.0041	31.0041	31.0041	31.0041	(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)	-64.0331	-64.0331	-64.0331	-64.0331	-64.0331	-64.0331	-64.0331	-64.0331	-64.0331	-64.0331	-64.0331	-64.0331	(71)
Water heating gains (Table 5)	128.4865	126.5848	122.9208	114.8895	109.9703	104.8283	101.6698	104.2788	107.3377	113.0432	120.7422	127.4596	(72)
Total internal gains	388.2870	395.3812	380.5239	367.0857	350.0273	335.0328	323.3781	324.5415	333.5925	347.7048	367.5430	381.1129	(73)

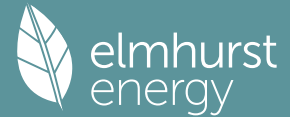
6. Solar gains

[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
Southeast				4.3800	36.7938		0.6300		0.7000		0.7700		49.2517 (77)
Northwest				5.4700	11.2829		0.6300		0.7000		0.7700		18.8617 (81)
Solar gains	68.1134	122.2874	183.9602	255.8289	312.0093	320.9519	304.7714	261.1462	208.5787	139.6406	82.7251	57.5526	(83)
Total gains	456.4004	517.6686	564.4842	622.9146	662.0366	655.9847	628.1496	585.6876	542.1712	487.3454	450.2681	438.6655	(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)													
tau	33.1784	33.2973	33.4147	33.9772	34.0846	34.5935	34.5935	34.6894	34.3957	34.0846	33.8681	33.6447	
alpha	3.2119	3.2198	3.2276	3.2651	3.2723	3.3062	3.3062	3.3126	3.2930	3.2723	3.2579	3.2430	
util living area	0.9580	0.9368	0.9012	0.8220	0.6975	0.5338	0.4013	0.4436	0.6521	0.8509	0.9347	0.9623	(86)
MIT	19.1582	19.4303	19.8181	20.3204	20.6960	20.9095	20.9733	20.9627	20.8199	20.3419	19.6891	19.1284	(87)
Th 2	19.8290	19.8327	19.8363	19.8532	19.8564	19.8713	19.8713	19.8740	19.8655	19.8564	19.8500	19.8433	(88)
util rest of house	0.9495	0.9244	0.8816	0.7874	0.6410	0.4535	0.3040	0.3432	0.5733	0.8139	0.9198	0.9547	(89)
MIT 2	17.7380	18.0791	18.5602	19.1719	19.5922	19.8122	19.8601	19.8572	19.7344	19.2154	18.4197	17.7098	(90)
Living area fraction	18.3309	18.6432	19.0853	19.6513	20.0530	20.2703	20.3248	20.3187	20.1876	19.6857	18.9496	18.3020	(91)
MIT	18.3309	18.6432	19.0853	19.6513	20.0530	20.2703	20.3248	20.3187	20.1876	19.6857	18.9496	18.3020	(92)
Temperature adjustment	18.3309	18.6432	19.0853	19.6513	20.0530	20.2703	20.3248	20.3187	20.1876	19.6857	18.9496	18.3020	(93)
adjusted MIT	18.3309	18.6432	19.0853	19.6513	20.0530	20.2703	20.3248	20.3187	20.1876	19.6857	18.9496	18.3020	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9352	0.9086	0.8665	0.7806	0.6514	0.4830	0.3439	0.3839	0.5971	0.8075	0.9051	0.9412	(94)
Useful gains	426.8458	470.3425	489.1244	486.2161	431.2595	316.8170	216.0305	224.8378	323.7443	393.5258	407.5518	412.8716	(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	866.3215	845.5299	771.5749	648.2234	502.0353	335.7851	220.5788	231.4170	362.5701	546.0723	716.7445	858.6475	(97)
Space heating kWh	326.9699	252.1259	210.1432	116.6452	52.6572	0.0000	0.0000	0.0000	0.0000	113.4946	222.6187	331.6573	(98a)
Space heating requirement - total per year (kWh/year)												1626.3121	
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	326.9699	252.1259	210.1432	116.6452	52.6572	0.0000	0.0000	0.0000	0.0000	113.4946	222.6187	331.6573	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1626.3121	
Space heating per m2										(98c) / (4) =		34.6392	(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	326.9699	252.1259	210.1432	116.6452	52.6572	0.0000	0.0000	0.0000	0.0000	113.4946	222.6187	331.6573	(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)	354.2469	273.1592	227.6741	126.3762	57.0500	0.0000	0.0000	0.0000	0.0000	122.9627	241.1904	359.3254	(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	192.5553	170.5168	181.8266	161.5900	157.7836	143.4284	142.5121	147.5017	148.3679	163.9303	172.4383	190.6897	(64)
Efficiency of water heater													79.8000 (216)
(217)m	85.2370	84.9353	84.3852	83.3411	81.8764	79.8000	79.8000	79.8000	79.8000	83.2519	84.6336	85.2885	(217)
Fuel for water heating, kWh/month	225.9058	200.7609	215.4721	193.8898	192.7095	179.7349	178.5866	184.8392	185.9247	196.9088	203.7467	223.5821	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting	14.6419	11.7463	10.5762	7.7486	5.9852	4.8900	5.4599	7.0970	9.2184	12.0950	13.6612	15.0489	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-12.7429	-18.9689	-28.7804	-34.2319	-38.5894	-36.6626	-36.2408	-33.3883	-28.6372	-22.5236	-14.3695	-10.9048	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	-4.4431	-9.5655	-19.4184	-29.7613	-39.9268	-40.3041	-39.8052	-33.4190	-24.1415	-13.8471	-5.9876	-3.4957	(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												1761.9849	(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												2382.0610	(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)												118.1687	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-580.1553	(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)

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Energy used 0.0000 (237)
Total delivered energy for all uses 3768.0593 (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	1761.9849	0.2100	370.0168 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	2382.0610	0.2100	500.2328 (264)
Space and water heating			870.2496 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	118.1687	0.1443	17.0554 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-316.0400	0.1334	-42.1704
PV Unit electricity exported	-264.1153	0.1253	-33.0999
Total			-75.2703 (269)
Total CO2, kg/year			823.9640 (272)
EPC Target Carbon Dioxide Emission Rate (TER)			17.5500 (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	1761.9849	1.1300	1991.0429 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	2382.0610	1.1300	2691.7289 (278)
Space and water heating			4682.7719 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	118.1687	1.5338	181.2512 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-316.0400	1.4931	-471.8738
PV Unit electricity exported	-264.1153	0.4600	-121.4924
Total			-593.3662 (283)
Total Primary energy kWh/year			4400.7576 (286)
Target Primary Energy Rate (TPER)			93.7300 (287)

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022) CALCULATION OF FABRIC ENERGY EFFICIENCY

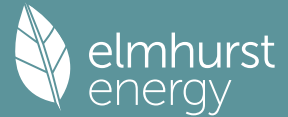
1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	46.9500 (1b)	x 2.7500 (2b)	= 129.1125 (1b) - (4)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	46.9500		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 129.1125 (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	2 * 10 = 20.0000 (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) = 20.0000 / (5) = 0.1549 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	3.0000 (17)
Infiltration rate	0.3049 (18)
Number of sides sheltered	0 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] = 1.0000 (20)

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Infiltration rate adjusted to include shelter factor

$$(21) = (18) \times (20) = 0.3049 \quad (21)$$

	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	0.3888	0.3811	0.3735	0.3354	0.3278	0.2897	0.2897	0.2820	0.3049	0.3278	0.3430	0.3583	(22b)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)													0.0000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =													0.0000 (23c)
Effective ac	0.5756	0.5726	0.5698	0.5562	0.5537	0.5420	0.5420	0.5398	0.5465	0.5537	0.5588	0.5642	(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	
WINDOWS (Uw = 1.20)			15.0800	1.1450	17.2672			(27)
CORRIDOR DOOR			1.8900	1.2000	2.2680			(26)
EXTERNAL	67.5100	15.0800	52.4300	0.1200	6.2916	70.0000	3670.1000	(29a)
HALLWAY	21.9500	1.8900	20.0600	0.1100	2.2066	70.0000	1404.2000	(29a)
FLAT ROOF	46.9500		46.9500	0.1100	5.1645	9.0000	422.5500	(30)
Total net area of external elements Aum(A, m2)			136.4100					(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) = 33.1979			(33)
FLOORS			46.9500			40.0000	1878.0000	(32d)

$$\text{Heat capacity } C_m = \text{Sum}(A \times k) \quad (28)...(30) + (32) + (32a)...(32e) = 7374.8500 \quad (34)$$

$$\text{Thermal mass parameter (TMP} = C_m / \text{TFA) in kJ/m2K} \quad 157.0788 \quad (35)$$

List of Thermal Bridges

K1 Element	Length	Psi-value	Total	
E2 Other lintels (including other steel lintels)	5.0000	0.1600	0.8000	
E3 Sill	7.5000	0.1600	1.2000	
E4 Jamb	7.5000	0.1600	1.2000	
E5 Ground floor (normal)	9.0000	0.1600	1.4400	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)				4.6400 (36)
Point Thermal bridges			(36a) = 0.0000	
Total fabric heat loss			(33) + (36) + (36a) = 37.8379	(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	24.5231	24.3981	24.2756	23.7000	23.5923	23.0910	23.0910	22.9981	23.2841	23.5923	23.8101	24.0379	(38)
Heat transfer coeff	62.3610	62.2360	62.1134	61.5379	61.4302	60.9289	60.9289	60.8360	61.1220	61.4302	61.6480	61.8758	(39)
Average = Sum(39)m / 12 =												61.5373	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3282	1.3256	1.3230	1.3107	1.3084	1.2977	1.2977	1.2958	1.3019	1.3084	1.3131	1.3179	(40)
HLP (average)												1.3107	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy													1.6008 (42)
Hot water usage for mixer showers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42a)
Hot water usage for baths	22.0807	21.7528	21.2910	20.4396	19.8020	19.0950	18.7132	19.1717	19.6710	20.4275	21.2965	22.0061	(42b)
Hot water usage for other uses	31.0241	29.8959	28.7678	27.6396	26.5115	25.3833	25.3833	26.5115	27.6396	28.7678	29.8959	31.0241	(42c)
Average daily hot water use (litres/day)												48.6760	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	53.1048	51.6487	50.0588	48.0792	46.3135	44.4784	44.0965	45.6832	47.3107	49.1953	51.1924	53.0302	(44)
Energy conte	84.1051	73.5471	76.9385	65.8180	62.3468	54.6913	53.3309	56.5654	58.3388	66.7575	72.9330	83.0324	(45)
Energy content (annual)										Total = Sum(45)m =		808.4049	
Distribution loss (46)m = 0.15 x (45)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	(46)
Water storage loss:													
Total storage 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	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary 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	(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	71.4893	62.5151	65.3977	55.9453	52.9948	46.4876	45.3313	48.0806	49.5880	56.7439	61.9930	70.5776	(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	71.4893	62.5151	65.3977	55.9453	52.9948	46.4876	45.3313	48.0806	49.5880	56.7439	61.9930	70.5776	(64)
Total per year (kWh/year) = Sum(64)m =												687.1442	(64)
12Total per year (kWh/year)												687	(64)
Electric shower(s)	40.8906	36.4339	39.7844	37.9658	38.6782	36.8952	38.1251	38.6782	37.9658	39.7844	39.0363	40.8906	(64a)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =												465.1285	(64a)

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Heat gains from water heating, kWh/month
 28.0950 24.7372 26.2955 23.4778 22.9183 20.8457 20.8641 21.6897 21.8884 24.1321 25.2573 27.8671 (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	80.0414	80.0414	80.0414	80.0414	80.0414	80.0414	80.0414	80.0414	80.0414	80.0414	80.0414	80.0414	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	70.2708	77.7998	70.2708	72.6132	70.2708	72.6132	70.2708	70.2708	72.6132	70.2708	72.6132	70.2708	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	139.3197	140.7654	137.1223	129.3665	119.5763	110.3748	104.2276	102.7819	106.4250	114.1808	123.9711	133.1726	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	31.0041	31.0041	31.0041	31.0041	31.0041	31.0041	31.0041	31.0041	31.0041	31.0041	31.0041	31.0041	(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)	-64.0331	-64.0331	-64.0331	-64.0331	-64.0331	-64.0331	-64.0331	-64.0331	-64.0331	-64.0331	-64.0331	-64.0331	(71)
Water heating gains (Table 5)	37.7621	36.8114	35.3435	32.6080	30.8041	28.9524	28.0431	29.1528	30.4006	32.4356	35.0796	37.4557	(72)
Total internal gains	294.3651	302.3891	289.7490	281.6002	267.6636	258.9528	249.5540	249.2180	256.4512	263.8996	278.6763	287.9115	(73)

6. Solar gains

[Jan]			Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	Specific data or Table 6c	FF	Access factor Table 6d	Gains W			

Southeast			6.7000	36.7938	0.6300		0.7000	0.7700	75.3393 (77)			
Northwest			8.3800	11.2829	0.6300		0.7000	0.7700	28.8960 (81)			

Solar gains	104.2353	187.1494	281.5603	391.5991	477.6277	491.3303	466.5550	399.7509	319.2536	213.7139	126.5978	88.0727 (83)
Total gains	398.6004	489.5385	571.3093	673.1993	745.2913	750.2830	716.1090	648.9689	575.7048	477.6136	405.2742	375.9842 (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, n _{l,m} (see Table 9a)														
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
tau	32.8502	32.9162	32.9811	33.2896	33.3479	33.6223	33.6223	33.6736	33.5161	33.3479	33.2301	33.1078		
alpha	3.1900	3.1944	3.1987	3.2193	3.2232	3.2415	3.2415	3.2449	3.2344	3.2232	3.2153	3.2072		
util living area	0.9706	0.9454	0.8999	0.7999	0.6540	0.4878	0.3645	0.4147	0.6348	0.8603	0.9504	0.9752	(86)	
MIT	18.9768	19.3322	19.8037	20.3601	20.7393	20.9254	20.9780	20.9667	20.8249	20.2918	19.5364	18.9148	(87)	
Th 2	19.8188	19.8209	19.8229	19.8325	19.8342	19.8426	19.8426	19.8442	19.8394	19.8342	19.8306	19.8268	(88)	
util rest of house	0.9644	0.9344	0.8800	0.7627	0.5957	0.4100	0.2728	0.3172	0.5547	0.8242	0.9384	0.9699	(89)	
MIT 2	18.0156	18.3633	18.8177	19.3380	19.6613	19.8057	19.8357	19.8328	19.7415	19.2950	18.5756	17.9604	(90)	
Living area fraction									f _{LA} = Living area / (4) =			0.4175	(91)	
MIT	18.4168	18.7678	19.2293	19.7647	20.1113	20.2732	20.3126	20.3062	20.1937	19.7111	18.9767	18.3588	(92)	
Temperature adjustment												0.0000		
adjusted MIT	18.4168	18.7678	19.2293	19.7647	20.1113	20.2732	20.3126	20.3062	20.1937	19.7111	18.9767	18.3588	(93)	

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9547	0.9220	0.8682	0.7604	0.6103	0.4398	0.3107	0.3571	0.5806	0.8198	0.9273	0.9610	(94)
Useful gains	380.5299	451.3741	496.0115	511.8780	454.8810	329.9565	222.4837	231.7702	334.2670	391.5531	375.8229	361.3296	(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	880.3395	863.0760	790.6625	668.5896	516.7092	345.6603	226.2044	237.6347	372.4615	559.6961	732.1737	876.0888	(97)
Space heating kWh	371.8583	276.6637	219.2204	112.8323	46.0002	0.0000	0.0000	0.0000	0.0000	125.0983	256.5726	382.9809	(98a)
Space heating requirement - total per year (kWh/year)												1791.2267	
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	371.8583	276.6637	219.2204	112.8323	46.0002	0.0000	0.0000	0.0000	0.0000	125.0983	256.5726	382.9809	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1791.2267	
Space heating per m ²										(98c) / (4) =		38.1518	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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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
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	572.7312	450.8735	462.3537	0.0000	0.0000	0.0000	0.0000 (100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8890	0.9284	0.9047	0.0000	0.0000	0.0000	0.0000 (101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	509.1754	418.5846	418.2736	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	852.3438	813.7968	736.6580	0.0000	0.0000	0.0000	0.0000 (103)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	247.0812	294.0378	236.8780	0.0000	0.0000	0.0000	0.0000 (104)
Cooled fraction									fC = cooled area / (4) =			1.0000 (105)
Intermittency factor (Table 10b)	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500 (106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	61.7703	73.5095	59.2195	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling requirement												194.4993 (107)
Energy for space heating												38.1518 (99)
Energy for space cooling												4.1427 (108)
Total												42.2945 (109)
Fabric Energy Efficiency (DFEE)												42.3 (109)

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

1. Overall dwelling characteristics

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	46.9500 (1b)	x 2.7500 (2b)	= 129.1125 (1b) - (4)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	46.9500		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	129.1125 (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	2 * 10 = 20.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)

Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	Air changes per hour 20.0000 / (5) =	0.1549 (8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000 (17)	
Infiltration rate		0.4049 (18)	
Number of sides sheltered		0 (19)	

Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4049 (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	0.5163	0.5061	0.4960	0.4454	0.4353	0.3847	0.3847	0.3745	0.4049	0.4353	0.4555	0.4758 (22b)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.0000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												0.0000 (23c)
Effective ac	0.6333	0.6281	0.6230	0.5992	0.5947	0.5740	0.5740	0.5701	0.5820	0.5947	0.6037	0.6132 (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
TER Opaque door			1.8900	1.0000	1.8900		(26)
TER Opening Type (Uw = 1.20)			9.8500	1.1450	11.2786		(27)
EXTERNAL	67.5100	9.8500	57.6600	0.1800	10.3788		(29a)
HALLWAY	21.9500	1.8900	20.0600	0.1800	3.6108		(29a)
FLAT ROOF	46.9500		46.9500	0.1100	5.1645		(30)
Total net area of external elements Aum(A, m ²)			136.4100				(31)

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Fabric heat loss, W/K = Sum (A x U) (26)...(30) + (32) = 32.3227 (33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 157.0788 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	5.0000	0.0500	0.2500
E3 Sill	7.5000	0.0500	0.3750
E4 Jamb	7.5000	0.0500	0.3750
E5 Ground floor (normal)	9.0000	0.1600	1.4400

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 2.4400 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 34.7627 (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	26.9813	26.7608	26.5447	25.5297	25.3398	24.4557	24.4557	24.2920	24.7962	25.3398	25.7240	26.1256 (38)
Heat transfer coeff	61.7440	61.5236	61.3075	60.2924	60.1025	59.2184	59.2184	59.0547	59.5589	60.1025	60.4867	60.8883 (39)
Average = Sum(39)m / 12 =												60.2915

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.3151	1.3104	1.3058	1.2842	1.2801	1.2613	1.2613	1.2578	1.2686	1.2801	1.2883	1.2969 (40)
HLP (average)												1.2842
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

4. Water heating energy requirements (kWh/year)

Assumed occupancy 1.6008 (42)

Hot water usage for mixer showers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (42a)
Hot water usage for baths	22.0807	21.7528	21.2910	20.4396	19.8020	19.0950	18.7132	19.1717	19.6710	20.4275	21.2965	22.0061 (42b)
Hot water usage for other uses	31.0241	29.8959	28.7678	27.6396	26.5115	25.3833	25.3833	26.5115	27.6396	28.7678	29.8959	31.0241 (42c)
Average daily hot water use (litres/day)												48.6760 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	53.1048	51.6487	50.0588	48.0792	46.3135	44.4784	44.0965	45.6832	47.3107	49.1953	51.1924	53.0302 (44)
Energy conte	84.1051	73.5471	76.9385	65.8180	62.3468	54.6913	53.3309	56.5654	58.3388	66.7575	72.9330	83.0324 (45)
Energy content (annual)												808.4049
Distribution loss (46)m = 0.15 x (45)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 (46)

Water storage loss:
Total storage loss 0.0000 (56)

If cylinder contains dedicated solar storage
Primary loss 0.0000 (57)
Combi loss 0.0000 (59)

Total heat required for water heating calculated for each month	71.4893	62.5151	65.3977	55.9453	52.9948	46.4876	45.3313	48.0806	49.5880	56.7439	61.9930	70.5776 (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 71.4893 (64)
Total per year (kWh/year) = Sum(64)m = 687.1442 (64)

12Total per year (kWh/year) 687 (64)

Electric shower(s) 40.8906 (64a)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 465.1285 (64a)

Heat gains from water heating, kWh/month 28.0950 (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	80.0414	80.0414	80.0414	80.0414	80.0414	80.0414	80.0414	80.0414	80.0414	80.0414	80.0414	80.0414 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	70.4683	78.0185	70.4683	72.8173	70.4683	72.8173	70.4683	70.4683	72.8173	70.4683	72.8173	70.4683 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	139.3197	140.7654	137.1223	129.3665	119.5763	110.3748	104.2276	102.7819	106.4250	114.1808	123.9711	133.1726 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	31.0041	31.0041	31.0041	31.0041	31.0041	31.0041	31.0041	31.0041	31.0041	31.0041	31.0041	31.0041 (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)	-64.0331	-64.0331	-64.0331	-64.0331	-64.0331	-64.0331	-64.0331	-64.0331	-64.0331	-64.0331	-64.0331	-64.0331 (71)
Water heating gains (Table 5)	37.7621	36.8114	35.3435	32.6080	30.8041	28.9524	28.0431	29.1528	30.4006	32.4356	35.0796	37.4557 (72)
Total internal gains	294.5626	302.6078	289.9465	281.8043	267.8611	259.1569	249.7515	249.4155	256.6553	264.0972	278.8804	288.1091 (73)

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6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	g	Specific data or Table 6c	FF	Access factor Table 6d	Gains W
Southeast				4.3800	36.7938		0.6300		0.7000	0.7700	49.2517 (77)
Northwest				5.4700	11.2829		0.6300		0.7000	0.7700	18.8617 (81)
Solar gains	68.1134	122.2874	183.9602	255.8289	312.0093	320.9519	304.7714	261.1462	208.5787	139.6406	57.5526 (83)
Total gains	362.6760	424.8952	473.9068	537.6331	579.8705	580.1088	554.5229	510.5617	465.2340	403.7377	345.6617 (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	33.1784	33.2973	33.4147	33.9772	34.0846	34.5935	34.5935	34.6894	34.3957	34.0846	33.8681	33.6447
alpha	3.2119	3.2198	3.2276	3.2651	3.2723	3.3062	3.3062	3.3126	3.2930	3.2723	3.2579	3.2430
util living area	0.9771	0.9615	0.9341	0.8666	0.7517	0.5873	0.4486	0.4991	0.7174	0.8998	0.9625	0.9802 (86)
MIT	18.9013	19.1930	19.6128	20.1762	20.6150	20.8797	20.9628	20.9471	20.7579	20.1811	19.4618	18.8688 (87)
Th 2	19.8290	19.8327	19.8363	19.8532	19.8564	19.8713	19.8713	19.8740	19.8655	19.8564	19.8500	19.8433 (88)
util rest of house	0.9722	0.9533	0.9197	0.8374	0.6981	0.5037	0.3422	0.3899	0.6405	0.8712	0.9531	0.9759 (89)
MIT 2	17.9489	18.2379	18.6496	19.1964	19.5892	19.8085	19.8589	19.8548	19.7231	19.2164	18.5183	17.9269 (90)
Living area fraction	fLA = Living area / (4) = 0.4175 (91)											
MIT	18.3465	18.6366	19.0517	19.6054	20.0174	20.2557	20.3197	20.3108	20.1551	19.6191	18.9122	18.3201 (92)
Temperature adjustment	0.0000											
adjusted MIT	18.3465	18.6366	19.0517	19.6054	20.0174	20.2557	20.3197	20.3108	20.1551	19.6191	18.9122	18.3201 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9637	0.9425	0.9078	0.8301	0.7063	0.5335	0.3857	0.4338	0.6619	0.8641	0.9432	0.9682 (94)
Useful gains	349.5137	400.4712	430.1961	446.3017	409.5496	309.5111	213.8843	221.5065	307.9175	348.8662	341.0504	334.6667 (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	867.2878	845.1268	769.5137	645.4547	499.8970	334.9207	220.2774	230.9505	360.6329	542.0711	714.4803	859.7498 (97)
Space heating kWh	385.2239	298.8085	252.4524	143.3902	67.2185	0.0000	0.0000	0.0000	0.0000	143.7444	268.8695	390.6618 (98a)
Space heating requirement - total per year (kWh/year)												1950.3693
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	385.2239	298.8085	252.4524	143.3902	67.2185	0.0000	0.0000	0.0000	0.0000	143.7444	268.8695	390.6618 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1950.3693
Space heating per m2										(98c) / (4) =		41.5414 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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
Heat loss rate W												
	0.0000	0.0000	0.0000	0.0000	0.0000	556.6530	438.2162	448.8157	0.0000	0.0000	0.0000	0.0000 (100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8250	0.8819	0.8527	0.0000	0.0000	0.0000	0.0000 (101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	459.2551	386.4684	382.7093	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	653.2175	624.7177	574.6767	0.0000	0.0000	0.0000	0.0000 (103)
Space cooling kWh	0.0000											
	0.0000	0.0000	0.0000	0.0000	0.0000	139.6530	177.2575	142.8237	0.0000	0.0000	0.0000	0.0000 (104)
Cooled fraction									fC = cooled area / (4) =			1.0000 (105)
Intermittency factor (Table 10b)	0.2500	0.2500										
	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500 (106)
Space cooling kWh												
	0.0000	0.0000	0.0000	0.0000	0.0000	34.9132	44.3144	35.7059	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling requirement												114.9335 (107)
Energy for space heating												41.5414 (99)
Energy for space cooling												2.4480 (108)
Total												43.9894 (109)
Fabric Energy Efficiency (TFEE)												44.0 (109)

Building Regulations England Part L (BREL) Compliance Report

Approved Document L1 2021 Edition, England assessed by Array SAP 10 program, Array

Date: Wed 12 Apr 2023 06:31:31

Project Information			
Assessed By	Mark Simons	Building Type	Flat, End-terrace
OCDEA Registration	EES/004083	Assessment Date	2023-04-12

Dwelling Details			
Assessment Type	As designed	Total Floor Area	45 m ²
Site Reference	39-41 Richmond	Plot Reference	Flat 1 - Boiler
Address	39-41 Richmond Street, MANCHESTER, M1 3WB		

Client Details	
Name	Mark Simons
Company	EAL Consult
Address	17 Dobree Avenue, London, NW10 2AD

This report covers items included within the SAP calculations. It is not a complete report of regulations compliance.

1a Target emission rate and dwelling emission rate			
Fuel for main heating system	Mains gas		
Target carbon dioxide emission rate	18.13 kgCO ₂ /m ²		
Dwelling carbon dioxide emission rate	21.9 kgCO ₂ /m ²		FAIL
1b Target primary energy rate and dwelling primary energy			
Target primary energy	96.89 kWh _{PE} /m ²		
Dwelling primary energy	121.12 kWh _{PE} /m ²		FAIL
1c Target fabric energy efficiency and dwelling fabric energy efficiency			
Target fabric energy efficiency	43.9 kWh/m ²		
Dwelling fabric energy efficiency	43.6 kWh/m ²		OK

2a Fabric U-values				
Element	Maximum permitted average U-Value [W/m ² K]	Dwelling average U-Value [W/m ² K]	Element with highest individual U-Value	
External walls	0.26	0.12	Walls (1) (0.12)	OK
Party walls	0.2	0	Party Wall (1) (0)	N/A
Curtain walls	1.6	0	N/A	N/A
Floors	0.18	0.1	UNHEATED (0.1)	OK
Roofs	0.16	N/A	N/A	N/A
Windows, doors, and roof windows	1.6	1.2	FRONT (1.2)	OK
Rooflights	2.2	N/A	N/A	N/A

2b Envelope elements (better than typically expected values are flagged with a subsequent (!))			
Name	Net area [m ²]	U-Value [W/m ² K]	
Exposed wall: Walls (1)	14.87	0.12	(!)
Sheltered wall: Walls (2)	21.49	0.12	(!)
Party wall: Party Wall (1)	24.81	0	(!)
Ground floor: UNHEATED, UNHEATED	44.76	0.1	(!)

2c Openings (better than typically expected values are flagged with a subsequent (!))				
Name	Area [m ²]	Orientation	Frame factor	U-Value [W/m ² K]
FRONT, WINDOWS	8.38	North West	0.7	1.2
REAR, WINDOWS	4.53	South East	0.7	1.2
ENTRANCE DOOR, CORRIDOR DOOR	1.89	North East	N/A	1.2

2d Thermal bridging (better than typically expected values are flagged with a subsequent (!))				
Building part 1 - Main Dwelling: Thermal bridging calculated from linear thermal transmittances for each junction				
Main element	Junction detail	Source	Psi value [W/mK]	Drawing / reference
External wall	E2: Other lintels (including other steel lintels)	Calculated by person with suitable expertise	0.16	
External wall	E3: Sill	Calculated by person with suitable expertise	0.16	

Main element	Junction detail	Source	Psi value [W/mK]	Drawing / reference
External wall	E4: Jamb	Calculated by person with suitable expertise	0.16	
External wall	E5: Ground floor (normal)	Calculated by person with suitable expertise	0.16	

3 Air permeability (better than typically expected values are flagged with a subsequent (!))

Maximum permitted air permeability at 50Pa	8 m ³ /hm ²	
Dwelling air permeability at 50Pa	3 m ³ /hm ² , Design value (!)	OK
Air permeability test certificate reference		

4 Space heating

Main heating system 1: Boiler with radiators or underfloor heating - Mains gas

Efficiency	84.1%
Emitter type	Underfloor
Flow temperature	
System type	Combi boiler
Manufacturer	Vaillant
Model	ecoFIT pure 835
Commissioning	

Secondary heating system: N/A

Fuel	N/A
Efficiency	N/A
Commissioning	

5 Hot water

Cylinder/store - type: N/A

Capacity	N/A
Declared heat loss	N/A
Primary pipework insulated	N/A
Manufacturer	
Model	
Commissioning	

Waste water heat recovery system 1 - type: N/A

Efficiency	
Manufacturer	
Model	

6 Controls

Main heating 1 - type: Time and temperature zone control by arrangement of plumbing and electrical services

Function	
Ecodesign class	
Manufacturer	
Model	

Water heating - type: N/A

Manufacturer	
Model	

7 Lighting

Minimum permitted light source efficacy	75 lm/W	
Lowest light source efficacy	100 lm/W	OK
External lights control	N/A	

8 Mechanical ventilation

System type: N/A

Maximum permitted specific fan power	N/A	
Specific fan power	N/A	N/A
Minimum permitted heat recovery efficiency	N/A	
Heat recovery efficiency	N/A	N/A
Manufacturer/Model		
Commissioning		

9 Local generation

N/A

10 Heat networks	
N/A	
11 Supporting documentary evidence	
N/A	
12 Declarations	
a. Assessor Declaration	
This declaration by the assessor is confirmation that the contents of this BREL Compliance Report are a true and accurate reflection based upon the design information submitted for this dwelling for the purpose of carrying out the "As designed" assessment, and that the supporting documentary evidence (SAP Conventions, Appendix 1 (documentary evidence) schedules the minimum documentary evidence required) has been reviewed in the course of preparing this BREL Compliance Report.	
Signed: Name:	Assessor ID: Date:
b. Client Declaration	
N/A	

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Property Reference	39-41 Richmond				Issued on Date	12/04/2023
Assessment Reference	Flat 1 - Boiler	Prop Type Ref	39-41 Richmond			
Property	39-41 , Richmond Street, MANCHESTER, M1 3WB					
SAP Rating	82 B	DER	21.90	TER	18.13	
Environmental	86 B	% DER < TER				-20.79
CO ₂ Emissions (t/year)	0.9	DFEE	43.58	TFEE	43.90	
Compliance Check	See BREL	% DFEE < TFEE				0.74
% DPER < TPER	-25.00	DPER	121.12	TPER	96.89	
Assessor Details	Mr. Mark Simons				Assessor ID	5542-0001
Client	EAL Consult, Mark Simons					

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	44.7600 (1b)	2.7500 (2b)	123.0900 (1b) - (4)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	44.7600		
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 123.0900 (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	2 * 10 = 20.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	Air changes per hour
Pressure test	20.0000 / (5) = 0.1625 (8)
Pressure Test Method	Yes
Measured/design AP50	Blower Door
Infiltration rate	3.0000 (17)
Number of sides sheltered	0.3125 (18)
	0 (19)

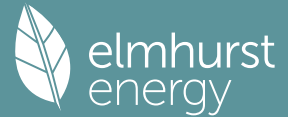
Shelter factor	(20) = 1 - [0.075 x (19)] = 1.0000 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.3125 (21)

	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	0.3984	0.3906	0.3828	0.3437	0.3359	0.2969	0.2969	0.2890	0.3125	0.3359	0.3515	0.3672 (22b)
Effective ac	0.5794	0.5763	0.5733	0.5591	0.5564	0.5441	0.5441	0.5418	0.5488	0.5564	0.5618	0.5674 (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
WINDOWS (Uw = 1.20)			12.9100	1.1450	14.7824		(27)
CORRIDOR DOOR			1.8900	1.2000	2.2680		(26)
UNHEATED			44.7600	0.1000	4.4760	110.0000	4923.6000 (28a)
EXTERNAL	27.7800	12.9100	14.8700	0.1200	1.7844	70.0000	1040.9000 (29a)
HALLWAY	23.3800	1.8900	21.4900	0.1100	2.3639	70.0000	1504.3000 (29a)
Total net area of external elements Aum(A, m ²)			95.9200				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		25.6747		(33)
SOLID			24.8100	0.0000	0.0000	180.0000	4465.8000 (32)

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CEILING	44.7600										30.0000	1342.8000 (32b)
Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =										13277.4000 (34)	
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K											296.6354 (35)	
List of Thermal Bridges												
K1 Element												
E2 Other lintels (including other steel lintels)												
E3 Sill												
E4 Jamb												
E5 Ground floor (normal)												
Thermal bridges (Sum(L x Psi) calculated using Appendix K)												
Point Thermal bridges												
Total fabric heat loss	(33) + (36) + (36a) =										0.0000	9.6000 (36)
											35.2747 (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	23.5337	23.4085	23.2858	22.7095	22.6016	22.0997	22.0997	22.0067	22.2930	22.6016	22.8198	23.0479 (38)
Average = Sum(39)m / 12 =	58.8085	58.6833	58.5606	57.9842	57.8764	57.3744	57.3744	57.2814	57.5678	57.8764	58.0945	58.3226 (39)
											57.9837	
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.3139	1.3111	1.3083	1.2954	1.2930	1.2818	1.2818	1.2797	1.2861	1.2930	1.2979	1.3030 (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												1.5378 (42)
Hot water usage for mixer showers											49.8118 (42a)	
Hot water usage for baths											22.6876 (42b)	
Hot water usage for other uses											31.9775 (42c)	
Average daily hot water use (litres/day)											96.2782 (43)	
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	104.7454	102.4930	99.7591	95.6233	92.2571	88.6412	87.2674	89.9897	92.8585	96.6526	100.8514	104.4768 (44)
Energy content (annual)	165.8911	145.9487	153.3260	130.9036	124.1958	108.9946	105.5424	111.4261	114.5039	131.1566	143.6813	163.5855 (45)
Distribution loss (46)m = 0.15 x (45)m											Total = Sum(45)m =	1599.1556
Water storage loss:												
Total storage 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 (56)
If cylinder contains dedicated solar storage												
Primary 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 (57)
Combi loss	50.9589	46.0274	50.8361	47.1567	47.0132	43.7134	44.4705	45.8578	45.7933	49.2531	49.3151	50.9589 (61)
Total heat required for water heating calculated for each month	216.8500	191.9761	204.1622	178.0603	171.2089	152.7081	150.0129	157.2838	160.2971	180.4097	192.9964	214.5444 (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	216.8500	191.9761	204.1622	178.0603	171.2089	152.7081	150.0129	157.2838	160.2971	180.4097	192.9964	214.5444 (64)
12Total per year (kWh/year)	Total per year (kWh/year) = Sum(64)m =										2170.5100 (64)	2171 (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	67.8985	60.0348	63.6899	55.3146	53.0484	47.1691	46.2105	48.5136	49.5209	55.9229	60.1028	67.1319 (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	76.8902	76.8902	76.8902	76.8902	76.8902	76.8902	76.8902	76.8902	76.8902	76.8902	76.8902	76.8902 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	67.4175	74.6408	67.4175	69.6647	67.4175	69.6647	67.4175	67.4175	69.6647	67.4175	69.6647	67.4175 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	133.6626	135.0496	131.5545	124.1136	114.7208	105.8930	99.9954	98.6084	102.1036	109.5445	118.9372	127.7651 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	30.6890	30.6890	30.6890	30.6890	30.6890	30.6890	30.6890	30.6890	30.6890	30.6890	30.6890	30.6890 (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)	-61.5121	-61.5121	-61.5121	-61.5121	-61.5121	-61.5121	-61.5121	-61.5121	-61.5121	-61.5121	-61.5121	-61.5121 (71)
Water heating gains (Table 5)	91.2614	89.3375	85.6048	76.8259	71.3016	65.5126	62.1108	65.2065	68.7790	75.1651	83.4761	90.2311 (72)
Total internal gains	341.4086	348.0949	333.6437	319.6712	302.5069	287.1374	275.5908	277.2994	286.6143	301.1941	321.1451	334.4807 (73)

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6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2		g Specific data or Table 6b		FF Specific data or Table 6c		Access factor Table 6d		Gains W
Southeast				4.5300	36.7938		0.6300		0.7000		0.7700		50.9384 (77)
Northwest				8.3800	11.2829		0.6300		0.7000		0.7700		28.8960 (81)
Solar gains	79.8344	145.5856	224.6908	321.1351	398.7021	412.9755	391.0126	330.5212	257.6760	167.7770	97.3711	67.1906	(83)
Total gains	421.2430	493.6805	558.3346	640.8063	701.2091	700.1128	666.6034	607.8207	544.2904	468.9711	418.5162	401.6712	(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	62.7149	62.8487	62.9804	63.6064	63.7249	64.2824	64.2824	64.3868	64.0665	63.7249	63.4856	63.2374	
alpha	5.1810	5.1899	5.1987	5.2404	5.2483	5.2855	5.2855	5.2925	5.2711	5.2483	5.2324	5.2158	
util living area	0.9928	0.9833	0.9582	0.8753	0.7125	0.5161	0.3773	0.4305	0.6863	0.9245	0.9843	0.9943	(86)
MIT	20.0799	20.2391	20.4607	20.7255	20.8818	20.9324	20.9399	20.9387	20.9049	20.6833	20.3357	20.0536	(87)
Th 2	19.8300	19.8322	19.8343	19.8444	19.8463	19.8551	19.8551	19.8567	19.8517	19.8463	19.8425	19.8385	(88)
util rest of house	0.9901	0.9771	0.9431	0.8356	0.6424	0.4278	0.2799	0.3252	0.5902	0.8899	0.9774	0.9922	(89)
MIT 2	18.7818	18.9841	19.2595	19.5739	19.7293	19.7759	19.7795	19.7809	19.7568	19.5391	19.1164	18.7552	(90)
Living area fraction	19.5590	19.7355	19.9787	20.2634	20.4194	20.4683	20.4743	20.4741	20.4442	20.2242	19.8465	19.5326	(91)
MIT	19.5590	19.7355	19.9787	20.2634	20.4194	20.4683	20.4743	20.4741	20.4442	20.2242	19.8465	19.5326	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.5590	19.7355	19.9787	20.2634	20.4194	20.4683	20.4743	20.4741	20.4442	20.2242	19.8465	19.5326	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9894	0.9765	0.9452	0.8512	0.6785	0.4756	0.3328	0.3825	0.6417	0.9027	0.9774	0.9915	(94)
Useful gains	416.7583	482.0824	527.7454	545.4620	475.7812	333.0069	221.8397	232.4618	349.2451	423.3540	409.0550	398.2438	(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	897.3608	870.5981	789.3206	658.9000	504.6459	336.6916	222.2866	233.3706	365.2233	557.0130	740.5012	894.2356	(97)
Space heating kWh	357.5683	261.0826	194.6120	81.6754	21.4753	0.0000	0.0000	0.0000	0.0000	99.4423	238.6413	369.0179	(98a)
Space heating requirement - total per year (kWh/year)												1623.5150	
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	357.5683	261.0826	194.6120	81.6754	21.4753	0.0000	0.0000	0.0000	0.0000	99.4423	238.6413	369.0179	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1623.5150	
Space heating per m2										(98c) / (4) =		36.2716	(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 %)													84.1000 (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	357.5683	261.0826	194.6120	81.6754	21.4753	0.0000	0.0000	0.0000	0.0000	99.4423	238.6413	369.0179	(98)
Space heating efficiency (main heating system 1)	84.1000	84.1000	84.1000	84.1000	84.1000	0.0000	0.0000	0.0000	0.0000	84.1000	84.1000	84.1000	(210)
Space heating fuel (main heating system)	425.1704	310.4430	231.4055	97.1170	25.5355	0.0000	0.0000	0.0000	0.0000	118.2429	283.7589	438.7847	(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	216.8500	191.9761	204.1622	178.0603	171.2089	152.7081	150.0129	157.2838	160.2971	180.4097	192.9964	214.5444	(64)
Efficiency of water heater	85.6459	85.2413	84.4794	83.0198	81.3754	80.5000	80.5000	80.5000	80.5000	83.3590	85.0380	85.7327	(216)
Fuel for water heating, kWh/month	253.1938	225.2150	241.6711	214.4794	210.3940	189.6995	186.3514	195.3837	199.1269	216.4250	226.9533	250.2480	(217)
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)

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Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting	13.0345	10.4568	9.4152	6.8980	5.3282	4.3532	4.8605	6.3179	8.2064	10.7672	12.1615	13.3968	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)
Annual totals kWh/year													
Space heating fuel - main system 1												1930.4578	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												80.5000	
Water heating fuel used												2609.1409	(219)
Space cooling fuel												0.0000	(221)
Electricity for pumps and fans:													
central heating pump												41.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												86.0000	(231)
Electricity for lighting (calculated in Appendix L)												105.1962	(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												4730.7949	(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	1930.4578	0.2100	405.3961 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	2609.1409	0.2100	547.9196 (264)
Space and water heating			953.3157 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	105.1962	0.1443	15.1831 (268)
Total CO2, kg/year			980.4280 (272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			21.9000 (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	1930.4578	1.1300	2181.4173 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	2609.1409	1.1300	2948.3292 (278)
Space and water heating			5129.7465 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	105.1962	1.5338	161.3534 (282)
Total Primary energy kWh/year			5421.2007 (286)
Dwelling Primary energy Rate (DPER)			121.1200 (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	44.7600 (1b)	x 2.7500 (2b)	= 123.0900 (1b) - (4)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	44.7600		

$$(3a)+(3b)+(3c)+(3d)+(3e)\dots(3n) = 123.0900 \quad (5)$$

		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	2 * 10 =	20.0000 (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)+(6g)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1625 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		5.0000 (17)
Infiltration rate		0.4125 (18)
Number of sides sheltered		0 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4125 (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	0.5259	0.5156	0.5053	0.4537	0.4434	0.3919	0.3919	0.3815	0.4125	0.4434	0.4640	0.4847 (22b)
Effective ac	0.6383	0.6329	0.6277	0.6029	0.5983	0.5768	0.5768	0.5728	0.5851	0.5983	0.6077	0.6175 (25)

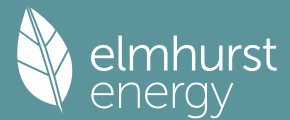
Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K
TER Opaque door			1.8900	1.0000	1.8900		(26)
TER Opening Type (Uw = 1.20)			9.3000	1.1450	10.6489		(27)
UNHEATED			44.7600	0.1300	5.8188		(28a)
EXTERNAL	27.7800	9.3000	18.4800	0.1800	3.3264		(29a)
HALLWAY	23.3800	1.8900	21.4900	0.1800	3.8682		(29a)
Total net area of external elements Aum(A, m2)			95.9200				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		25.5523		(33)
SOLID			24.8100	0.0000	0.0000		(32)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							306.6354 (35)
List of Thermal Bridges							
K1 Element				Length	Psi-value	Total	
E2 Other lintels (including other steel lintels)				5.0000	0.0500	0.2500	
E3 Sill				15.0000	0.0500	0.7500	
E4 Jamb				15.0000	0.0500	0.7500	
E5 Ground floor (normal)				25.0000	0.1600	4.0000	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							5.7500 (36)
Point Thermal bridges						(36a) =	0.0000
Total fabric heat loss					(33) + (36) + (36a) =		31.3023 (37)

[illegible]

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.2786	1.2737	1.2689	1.2465	1.2423	1.2228	1.2228	1.2191	1.2303	1.2423	1.2508	1.2597 (40)
HLP (average)												1.2465
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

Assumed occupancy												1.5378 (42)
Hot water usage for mixer showers	50.0033	49.2519	48.1569	46.0618	44.5156	42.7914	41.8113	42.8980	44.0893	45.9406	48.0807	49.8118 (42a)
Hot water usage for baths	21.6263	21.3051	20.8528	20.0189	19.3944	18.7020	18.3280	18.7772	19.2662	20.0071	20.8582	21.5532 (42b)
Hot water usage for other uses	30.3786	29.2740	28.1693	27.0646	25.9599	24.8553	24.8553	25.9599	27.0646	28.1693	29.2740	30.3786 (42c)
Average daily hot water use (litres/day)												93.7693 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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Daily hot water use											
Energy content (annual)	102.0083	99.8310	97.1790	93.1453	89.8700	86.3487	84.9946	87.6351	90.4201	94.1170	98.2129
Distribution loss (46)m = 0.15 x (45)m	161.5562	142.1580	149.3605	127.5112	120.9823	106.1758	102.7936	108.5106	111.4970	127.7159	139.9223
Total storage loss	24.2334	21.3237	22.4041	19.1267	18.1473	15.9264	15.4190	16.2766	16.7246	19.1574	20.9883
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Combi loss	50.9589	45.9496	49.5214	45.9347	45.7968	42.5829	43.3123	44.6579	44.5907	47.9610	48.4338
Total heat required for water heating calculated for each month	212.5151	188.1076	198.8818	173.4459	166.7791	148.7587	146.1059	153.1685	156.0877	175.6768	188.3560
WWHRS	-22.8594	-20.2171	-21.1702	-17.5297	-16.3371	-13.9798	-13.1038	-13.9346	-14.4640	-17.0514	-19.3172
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Output from w/h	189.6557	167.8905	177.7117	155.9161	150.4420	134.7789	133.0021	139.2339	141.6237	158.6254	169.0388
12Total per year (kWh/year)	Total per year (kWh/year) = Sum(64)m =										1905.7476
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
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =											0.0000
Heat gains from water heating, kWh/month	66.4572	58.7549	62.0427	53.8811	51.6758	45.9492	45.0070	47.2443	48.2204	54.4558	58.6326

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

Metabolic gains (Table 5), Watts											
(66)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	76.8902	76.8902	76.8902	76.8902	76.8902	76.8902	76.8902	76.8902	76.8902	76.8902	76.8902
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	67.6558	74.9046	67.6558	69.9110	67.6558	69.9110	67.6558	67.6558	69.9110	67.6558	69.9110
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	133.6626	135.0496	131.5545	124.1136	114.7208	105.8930	99.9954	98.6084	102.1036	109.5445	118.9372
Pumps, fans	30.6890	30.6890	30.6890	30.6890	30.6890	30.6890	30.6890	30.6890	30.6890	30.6890	30.6890
Losses e.g. evaporation (negative values) (Table 5)	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000
Water heating gains (Table 5)	-61.5121	-61.5121	-61.5121	-61.5121	-61.5121	-61.5121	-61.5121	-61.5121	-61.5121	-61.5121	-61.5121
Total internal gains	89.3241	87.4329	83.3907	74.8349	69.4567	63.8183	60.4932	63.5003	66.9728	73.1932	81.4342
	339.7096	346.4543	331.6680	317.9265	300.9004	285.6893	274.2115	275.8316	285.0545	299.4606	319.3494

6. Solar gains

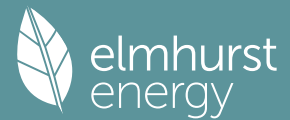
[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	Specific data or Table 6c	Access factor Table 6d	Gains W
Southeast	3.2600	36.7938	0.6300	0.7000	0.7700	36.6576
Northwest	6.0400	11.2829	0.6300	0.7000	0.7700	20.8272
Solar gains	57.4848	104.8359	161.8164	231.2982	287.1860	297.4750
Total gains	397.1945	451.2902	493.4844	549.2248	588.0864	583.1644

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)											21.0000
Utilisation factor for gains for living area, n11,m (see Table 9a)											
tau	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
alpha	66.6177	66.8726	67.1243	68.3325	68.5634	69.6592	69.6592	69.8660	69.2330	68.5634	68.0979
util living area	5.4412	5.4582	5.4750	5.5555	5.5709	5.6439	5.6439	5.6577	5.6155	5.5709	5.5399
	0.9951	0.9893	0.9748	0.9201	0.7885	0.5867	0.4310	0.4841	0.7456	0.9474	0.9891
MIT	19.8837	20.0605	20.3169	20.6602	20.8930	20.9836	20.9975	20.9955	20.9417	20.6393	20.2140
Th 2	19.8576	19.8615	19.8652	19.8830	19.8863	19.9018	19.9018	19.9047	19.8958	19.8863	19.8796
util rest of house	0.9931	0.9852	0.9647	0.8898	0.7225	0.4927	0.3247	0.3713	0.6515	0.9203	0.9840
MIT 2	18.5903	18.8171	19.1408	19.5643	19.8084	19.8945	19.9013	19.9036	19.8635	19.5533	19.0269
Living area fraction	19.3647	19.5615	19.8450	20.2205	20.4578	20.5466	20.5577	20.5573	20.5091	20.2035	19.7377
Temperature adjustment	19.3647	19.5615	19.8450	20.2205	20.4578	20.5466	20.5577	20.5573	20.5091	20.2035	19.7377
adjusted MIT	19.3647	19.5615	19.8450	20.2205	20.4578	20.5466	20.5577	20.5573	20.5091	20.2035	19.7377

8. Space heating requirement

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9920	0.9838	0.9645	0.9000	0.7580	0.5487	0.3885	0.4390	0.7061	0.9292	0.9832	0.9935	(94)
Useful gains	394.0146	443.9717	475.9667	494.2949	445.7835	319.9992	215.9576	225.6153	332.3283	390.5423	382.9207	378.6936	(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	862.1479	835.8753	757.9629	631.6087	486.9800	325.4615	216.6063	226.8614	352.9322	534.0080	707.5285	854.1980	(97)
Space heating kWh	348.2911	263.3592	209.8051	98.8659	30.6502	0.0000	0.0000	0.0000	0.0000	106.7385	233.7176	353.7753	(98a)
Space heating requirement - total per year (kWh/year)												1645.2029	
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	348.2911	263.3592	209.8051	98.8659	30.6502	0.0000	0.0000	0.0000	0.0000	106.7385	233.7176	353.7753	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1645.2029	
Space heating per m2										(98c) / (4) =		36.7561	(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 %)													92.4000 (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	348.2911	263.3592	209.8051	98.8659	30.6502	0.0000	0.0000	0.0000	0.0000	106.7385	233.7176	353.7753	(98)
Space heating efficiency (main heating system 1)	92.4000	92.4000	92.4000	92.4000	92.4000	0.0000	0.0000	0.0000	0.0000	92.4000	92.4000	92.4000	(210)
Space heating fuel (main heating system)	376.9385	285.0208	227.0618	106.9977	33.1712	0.0000	0.0000	0.0000	0.0000	115.5178	252.9411	382.8737	(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	189.6557	167.8905	177.7117	155.9161	150.4420	134.7789	133.0021	139.2339	141.6237	158.6254	169.0388	187.8287	(64)
Efficiency of water heater	85.6654	85.3417	84.7381	83.4319	81.6366	80.3000	80.3000	80.3000	80.3000	83.5511	85.0759	85.7163	(216)
Fuel for water heating, kWh/month	221.3911	196.7274	209.7187	186.8783	184.2824	167.8442	165.6316	173.3922	176.3683	189.8544	198.6918	219.1282	(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	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting	14.0575	11.2775	10.1541	7.4393	5.7464	4.6948	5.2420	6.8138	8.8504	11.6122	13.1160	14.4482	(232)
Electricity generated by PVs (Appendix M) (negative quantity)	-12.1681	-18.1239	-27.5152	-32.7495	-36.9407	-35.1075	-34.7066	-31.9656	-27.4013	-21.5327	-13.7260	-10.4119	(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)	-4.2163	-9.0795	-18.4353	-28.2587	-37.9131	-38.2691	-37.7922	-31.7254	-22.9155	-13.1415	-5.6815	-3.3169	(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												1780.5227	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												80.3000	
Water heating fuel used												2289.9086	(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)	113.4524 (232)

Energy saving/generation technologies (Appendices M ,N and Q)

PV generation	-553.0938 (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	3716.7898 (238)

Full SAP Calculation Printout



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	1780.5227	0.2100	373.9098 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	2289.9086	0.2100	480.8808 (264)
Space and water heating			854.7906 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	113.4524	0.1443	16.3747 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-302.3490	0.1334	-40.3391
PV Unit electricity exported	-250.7448	0.1253	-31.4237
Total			-71.7628 (269)
Total CO2, kg/year			811.3317 (272)
EPC Target Carbon Dioxide Emission Rate (TER)			18.1300 (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	1780.5227	1.1300	2011.9906 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	2289.9086	1.1300	2587.5967 (278)
Space and water heating			4599.5873 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	113.4524	1.5338	174.0171 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-302.3490	1.4930	-451.4151
PV Unit electricity exported	-250.7448	0.4600	-115.3402
Total			-566.7553 (283)
Total Primary energy kWh/year			4336.9499 (286)
Target Primary Energy Rate (TPER)			96.8900 (287)

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF FABRIC ENERGY EFFICIENCY

1. Overall dwelling characteristics

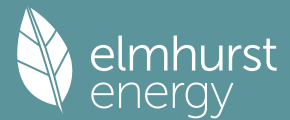
	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	44.7600 (1b)	x 2.7500 (2b)	= 123.0900 (1b) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	44.7600		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	123.0900 (5)

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	2 * 10 = 20.0000 (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) =	20.0000 / (5) = 0.1625 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	3.0000 (17)
Infiltration rate	0.3125 (18)
Number of sides sheltered	0 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] = 1.0000 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.3125 (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)

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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	0.3984	0.3906	0.3828	0.3437	0.3359	0.2969	0.2969	0.2890	0.3125	0.3359	0.3515	0.3672 (22b)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.0000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												0.0000 (23c)
Effective ac	0.5794	0.5763	0.5733	0.5591	0.5564	0.5441	0.5441	0.5418	0.5488	0.5564	0.5618	0.5674 (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	
WINDOWS (Uw = 1.20)			12.9100	1.1450	14.7824			(27)
CORRIDOR DOOR			1.8900	1.2000	2.2680			(26)
UNHEATED			44.7600	0.1000	4.4760	110.0000	4923.6000	(28a)
EXTERNAL	27.7800	12.9100	14.8700	0.1200	1.7844	70.0000	1040.9000	(29a)
HALLWAY	23.3800	1.8900	21.4900	0.1100	2.3639	70.0000	1504.3000	(29a)
Total net area of external elements Aum(A, m2)			95.9200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	25.6747			(33)
SOLID			24.8100	0.0000	0.0000	180.0000	4465.8000	(32)
CEILING			44.7600			40.0000	1790.4000	(32b)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 13725.0000 (34)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 306.6354 (35)

List of Thermal Bridges

K1 Element	Length m	Psi-value	Total	
E2 Other lintels (including other steel lintels)	5.0000	0.1600	0.8000	
E3 Sill	15.0000	0.1600	2.4000	
E4 Jamb	15.0000	0.1600	2.4000	
E5 Ground floor (normal)	25.0000	0.1600	4.0000	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)				9.6000 (36)
Point Thermal bridges			(36a) =	0.0000
Total fabric heat loss			(33) + (36) + (36a) =	35.2747 (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	23.5337	23.4085	23.2858	22.7095	22.6016	22.0997	22.0997	22.0067	22.2930	22.6016	22.8198	23.0479	(38)
Average = Sum(39)m / 12 =	58.8085	58.6833	58.5606	57.9842	57.8764	57.3744	57.3744	57.2814	57.5678	57.8764	58.0945	58.3226	(39)
												57.9837	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3139	1.3111	1.3083	1.2954	1.2930	1.2818	1.2818	1.2797	1.2861	1.2930	1.2979	1.3030	(40)
HLP (average)												1.2954	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

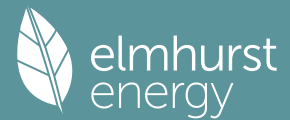
4. Water heating energy requirements (kWh/year)

Assumed occupancy													1.5378 (42)
Hot water usage for mixer showers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42a)
Hot water usage for baths	21.6263	21.3051	20.8528	20.0189	19.3944	18.7020	18.3280	18.7772	19.2662	20.0071	20.8582	21.5532	(42b)
Hot water usage for other uses	30.3786	29.2740	28.1693	27.0646	25.9599	24.8553	24.8553	25.9599	27.0646	28.1693	29.2740	30.3786	(42c)
Average daily hot water use (litres/day)												47.6679	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	52.0049	50.5791	49.0221	47.0835	45.3544	43.5573	43.1833	44.7371	46.3308	48.1764	50.1322	51.9318	(44)
Energy conte	82.3631	72.0239	75.3452	64.4550	61.0557	53.5588	52.2264	55.3939	57.1305	65.3749	71.4224	81.3127	(45)
Energy content (annual)													
Distribution loss (46)m = 0.15 x (45)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	(46)
Water storage loss:													
Total storage 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	(56)
If cylinder contains dedicated solar storage													
Primary 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	(57)
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	(59)
Total heat required for water heating calculated for each month													
WWHRS	70.0087	61.2204	64.0434	54.7867	51.8974	45.5250	44.3925	47.0848	48.5609	55.5686	60.7091	69.1158	(62)
PV diverter	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63b)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
Output from w/h	70.0087	61.2204	64.0434	54.7867	51.8974	45.5250	44.3925	47.0848	48.5609	55.5686	60.7091	69.1158	(64)
Total per year (kWh/year) = Sum(64)m =												672.9131	(64)
Electric shower(s)	40.0443	35.6798	38.9610	37.1800	37.8777	36.1316	37.3360	37.8777	37.1800	38.9610	38.2284	40.0443	(64a)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =												455.5021	(64a)

Heat gains from water heating, kWh/month	27.5132	24.2250	25.7511	22.9917	22.4438	20.4141	20.4321	21.2406	21.4352	23.6324	24.7344	27.2900	(65)
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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	76.8902	76.8902	76.8902	76.8902	76.8902	76.8902	76.8902	76.8902	76.8902	76.8902	76.8902	76.8902 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	67.4175	74.6408	67.4175	69.6647	67.4175	69.6647	67.4175	67.4175	69.6647	67.4175	69.6647	67.4175 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	133.6626	135.0496	131.5545	124.1136	114.7208	105.8930	99.9954	98.6084	102.1036	109.5445	118.9372	127.7651 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	30.6890	30.6890	30.6890	30.6890	30.6890	30.6890	30.6890	30.6890	30.6890	30.6890	30.6890	30.6890 (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)	-61.5121	-61.5121	-61.5121	-61.5121	-61.5121	-61.5121	-61.5121	-61.5121	-61.5121	-61.5121	-61.5121	-61.5121 (71)
Water heating gains (Table 5)	36.9802	36.0492	34.6117	31.9329	30.1663	28.3530	27.4625	28.5492	29.7712	31.7640	34.3533	36.6802 (72)
Total internal gains	284.1273	291.8066	279.6507	271.7782	258.3717	249.9777	240.9425	240.6422	247.6065	254.7930	269.0223	277.9298 (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				
Southeast			4.5300	36.7938	0.6300	0.7000	0.7700	50.9384 (77)				
Northwest			8.3800	11.2829	0.6300	0.7000	0.7700	28.8960 (81)				
Solar gains	79.8344	145.5856	224.6908	321.1351	398.7021	412.9755	391.0126	330.5212	257.6760	167.7770	97.3711	67.1906 (83)
Total gains	363.9617	437.3922	504.3415	592.9133	657.0738	662.9532	631.9551	571.1634	505.2826	422.5700	366.3934	345.1203 (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	64.8291	64.9674	65.1035	65.7506	65.8732	66.4495	66.4495	66.5573	66.2263	65.8732	65.6258	65.3692	
alpha	5.3219	5.3312	5.3402	5.3834	5.3915	5.4300	5.4300	5.4372	5.4151	5.3915	5.3751	5.3579	
util living area	0.9968	0.9911	0.9739	0.9049	0.7490	0.5437	0.3978	0.4576	0.7280	0.9506	0.9921	0.9976 (86)	
MIT	19.7731	19.9867	20.2903	20.6721	20.9084	20.9865	20.9979	20.9958	20.9416	20.6021	20.1183	19.7389 (87)	
Th 2	19.8300	19.8322	19.8343	19.8444	19.8463	19.8551	19.8551	19.8567	19.8517	19.8463	19.8425	19.8385 (88)	
util rest of house	0.9955	0.9875	0.9634	0.8705	0.6791	0.4513	0.2952	0.3460	0.6308	0.9244	0.9883	0.9966 (89)	
MIT 2	18.7385	18.9516	19.2495	19.6091	19.7961	19.8505	19.8547	19.8559	19.8270	19.5591	19.0916	18.7111 (90)	
Living area fraction									fLA = Living area / (4) =				0.5987 (91)
MIT	19.3580	19.5713	19.8727	20.2456	20.4621	20.5307	20.5392	20.5384	20.4944	20.1836	19.7063	19.3265 (92)	
Temperature adjustment												0.0000	
adjusted MIT	19.3580	19.5713	19.8727	20.2456	20.4621	20.5307	20.5392	20.5384	20.4944	20.1836	19.7063	19.3265 (93)	

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	0.9948	0.9865	0.9638	0.8837	0.7179	0.5065	0.3568	0.4130	0.6876	0.9333	0.9878	0.9960 (94)
Useful gains	362.0665	431.4921	486.0954	523.9398	471.7259	335.7800	225.4640	235.8867	347.4161	394.3996	361.9136	343.7411 (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	885.5374	860.9616	783.1112	657.8638	507.1180	340.2703	226.0107	237.0534	368.1107	554.6649	732.3582	882.2186 (97)
Space heating kWh	389.4624	288.6035	220.9797	96.4252	26.3317	0.0000	0.0000	0.0000	0.0000	119.2374	266.7202	400.6272 (98a)
Space heating requirement - total per year (kWh/year)												1808.3873
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	389.4624	288.6035	220.9797	96.4252	26.3317	0.0000	0.0000	0.0000	0.0000	119.2374	266.7202	400.6272 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1808.3873
Space heating per m2										(98c) / (4) =		40.4019 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

Ext. temp.	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	539.3193	424.5706	435.3389	0.0000	0.0000	0.0000	0.0000 (100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9471	0.9754	0.9588	0.0000	0.0000	0.0000	0.0000 (101)

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Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	510.8112	414.1256	417.4071	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	751.5203	716.6317	646.8552	0.0000	0.0000	0.0000	0.0000 (103)
Space cooling kwh	0.0000	0.0000	0.0000	0.0000	0.0000	173.3105	225.0646	170.7094	0.0000	0.0000	0.0000	0.0000 (104)
Cooled fraction									fc = cooled area / (4) =			1.0000 (105)
Intermittency factor (Table 10b)	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500 (106)
Space cooling kwh	0.0000	0.0000	0.0000	0.0000	0.0000	43.3276	56.2661	42.6773	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling requirement												142.2711 (107)
Energy for space heating												40.4019 (99)
Energy for space cooling												3.1785 (108)
Total												43.5804 (109)
Fabric Energy Efficiency (DFEE)												43.6 (109)

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

1. Overall dwelling characteristics

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	44.7600 (1b)	x 2.7500 (2b)	= 123.0900 (1b) - (4)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	44.7600		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	123.0900 (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	2 * 10 = 20.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	Air changes per hour 20.0000 / (5) = 0.1625 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	5.0000 (17)
Infiltration rate	0.4125 (18)
Number of sides sheltered	0 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] = 1.0000 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.4125 (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	0.5259	0.5156	0.5053	0.4537	0.4434	0.3919	0.3919	0.3815	0.4125	0.4434	0.4640	0.4847 (22b)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.0000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												0.0000 (23c)
Effective ac	0.6383	0.6329	0.6277	0.6029	0.5983	0.5768	0.5768	0.5728	0.5851	0.5983	0.6077	0.6175 (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
TER Opaque door			1.8900	1.0000	1.8900		(26)
TER Opening Type (Uw = 1.20)			9.3000	1.1450	10.6489		(27)
UNHEATED			44.7600	0.1300	5.8188		(28a)
EXTERNAL	27.7800	9.3000	18.4800	0.1800	3.3264		(29a)
HALLWAY	23.3800	1.8900	21.4900	0.1800	3.8682		(29a)
Total net area of external elements Aum(A, m ²)			95.9200				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	25.5523		(33)
SOLID			24.8100	0.0000	0.0000		(32)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							306.6354 (35)

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List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	5.0000	0.0500	0.2500
E3 Sill	15.0000	0.0500	0.7500
E4 Jamb	15.0000	0.0500	0.7500
E5 Ground floor (normal)	25.0000	0.1600	4.0000
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			5.7500 (36)
Point Thermal bridges			0.0000
Total fabric heat loss		(33) + (36) + (36a) =	31.3023 (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	25.9273	25.7092	25.4953	24.4911	24.3032	23.4285	23.4285	23.2665	23.7654	24.3032	24.6833	25.0807 (38)
Heat transfer coeff	57.2295	57.0114	56.7976	55.7933	55.6054	54.7307	54.7307	54.5688	55.0677	55.6054	55.9855	56.3829 (39)
Average = Sum(39)m / 12 =												55.7924
HLP	1.2786	1.2737	1.2689	1.2465	1.2423	1.2228	1.2228	1.2191	1.2303	1.2423	1.2508	1.2597 (40)
HLP (average)												1.2465
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

4. Water heating energy requirements (kWh/year)

Assumed occupancy												1.5378 (42)
Hot water usage for mixer showers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (42a)
Hot water usage for baths	21.6263	21.3051	20.8528	20.0189	19.3944	18.7020	18.3280	18.7772	19.2662	20.0071	20.8582	21.5532 (42b)
Hot water usage for other uses	30.3786	29.2740	28.1693	27.0646	25.9599	24.8553	24.8553	25.9599	27.0646	28.1693	29.2740	30.3786 (42c)
Average daily hot water use (litres/day)												47.6679 (43)
Daily hot water use	52.0049	50.5791	49.0221	47.0835	45.3544	43.5573	43.1833	44.7371	46.3308	48.1764	50.1322	51.9318 (44)
Energy conte	82.3631	72.0239	75.3452	64.4550	61.0557	53.5588	52.2264	55.3939	57.1305	65.3749	71.4224	81.3127 (45)
Energy content (annual)										Total = Sum(45)m =		791.6625
Distribution loss (46)m = 0.15 x (45)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 (46)
Water storage loss:												
Total storage 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 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Primary 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 (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	70.0087	61.2204	64.0434	54.7867	51.8974	45.5250	44.3925	47.0848	48.5609	55.5686	60.7091	69.1158 (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	70.0087	61.2204	64.0434	54.7867	51.8974	45.5250	44.3925	47.0848	48.5609	55.5686	60.7091	69.1158 (64)
Total per year (kWh/year)										Total per year (kWh/year) = Sum(64)m =		672.9131 (64)
Electric shower(s)	40.0443	35.6798	38.9610	37.1800	37.8777	36.1316	37.3360	37.8777	37.1800	38.9610	38.2284	40.0443 (64a)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =												455.5021 (64a)
Heat gains from water heating, kWh/month	27.5132	24.2250	25.7511	22.9917	22.4438	20.4141	20.4321	21.2406	21.4352	23.6324	24.7344	27.2900 (65)

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

Metabolic gains (Table 5), Watts												
(66)m	76.8902	76.8902	76.8902	76.8902	76.8902	76.8902	76.8902	76.8902	76.8902	76.8902	76.8902	76.8902 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	67.6558	74.9046	67.6558	69.9110	67.6558	69.9110	67.6558	67.6558	69.9110	67.6558	69.9110	67.6558 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	133.6626	135.0496	131.5545	124.1136	114.7208	105.8930	99.9954	98.6084	102.1036	109.5445	118.9372	127.7651 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	30.6890	30.6890	30.6890	30.6890	30.6890	30.6890	30.6890	30.6890	30.6890	30.6890	30.6890	30.6890 (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)	-61.5121	-61.5121	-61.5121	-61.5121	-61.5121	-61.5121	-61.5121	-61.5121	-61.5121	-61.5121	-61.5121	-61.5121 (71)
Water heating gains (Table 5)	36.9802	36.0492	34.6117	31.9329	30.1663	28.3530	27.4625	28.5492	29.7712	31.7640	34.3533	36.6802 (72)
Total internal gains	284.3657	292.0705	279.8890	272.0245	258.6100	250.2240	241.1808	240.8805	247.8528	255.0313	269.2686	278.1681 (73)

6. Solar gains

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[Jan]			Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
Southeast			3.2600	36.7938	0.6300	0.7000	0.7700	36.6576 (77)
Northwest			6.0400	11.2829	0.6300	0.7000	0.7700	20.8272 (81)

Solar gains	57.4848	104.8359	161.8164	231.2982	287.1860	297.4750	281.6516	238.0663	185.5799	120.8205	70.1134	48.3798 (83)
Total gains	341.8505	396.9064	441.7054	503.3228	545.7960	547.6991	522.8324	478.9468	433.4328	375.8518	339.3820	326.5479 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	66.6177	66.8726	67.1243	68.3325	68.5634	69.6592	69.6592	69.8660	69.2330	68.5634	68.0979	67.6180
alpha	5.4412	5.4582	5.4750	5.5555	5.5709	5.6439	5.6439	5.6577	5.6155	5.5709	5.5399	5.5079
util living area	0.9976	0.9941	0.9844	0.9417	0.8240	0.6200	0.4575	0.5176	0.7878	0.9663	0.9943	0.9981 (86)
MIT	19.7758	19.9570	20.2246	20.5975	20.8651	20.9786	20.9967	20.9937	20.9228	20.5692	20.1185	19.7591 (87)
Th 2	19.8576	19.8615	19.8652	19.8830	19.8863	19.9018	19.9018	19.9047	19.8958	19.8863	19.8796	19.8726 (88)
util rest of house	0.9966	0.9917	0.9778	0.9174	0.7617	0.5228	0.3451	0.3980	0.6963	0.9471	0.9915	0.9974 (89)
MIT 2	18.7629	18.9460	19.2126	19.5807	19.8073	19.8941	19.9012	19.9034	19.8610	19.5651	19.1216	18.7581 (90)
Living area fraction	fLA = Living area / (4) =											0.5987 (91)
MIT	19.3694	19.5513	19.8186	20.1895	20.4406	20.5434	20.5571	20.5562	20.4967	20.1663	19.7185	19.3574 (92)
Temperature adjustment												0.0000
adjusted MIT	19.3694	19.5513	19.8186	20.1895	20.4406	20.5434	20.5571	20.5562	20.4967	20.1663	19.7185	19.3574 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9961	0.9909	0.9774	0.9250	0.7947	0.5808	0.4126	0.4699	0.7491	0.9528	0.9910	0.9969 (94)
Useful gains	340.5046	393.2884	431.7373	465.5546	433.7251	318.0828	215.6978	225.0496	324.6702	358.1127	336.3193	325.5378 (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	862.4127	835.2926	756.4619	629.8794	486.0268	325.2880	216.5775	226.8006	352.2529	531.9372	706.4529	854.6205 (97)
Space heating kWh	388.2997	297.0268	241.5951	118.3139	38.9125	0.0000	0.0000	0.0000	0.0000	129.3255	266.4962	393.6375 (98a)
Space heating requirement - total per year (kWh/year)												1873.6071
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	388.2997	297.0268	241.5951	118.3139	38.9125	0.0000	0.0000	0.0000	0.0000	129.3255	266.4962	393.6375 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1873.6071
Space heating per m2	(98c) / (4) =											41.8590 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	514.4690	405.0075	414.7226	0.0000	0.0000	0.0000	0.0000 (100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9148	0.9588	0.9365	0.0000	0.0000	0.0000	0.0000 (101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	470.6307	388.3231	388.3938	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	616.5406	588.8297	538.8202	0.0000	0.0000	0.0000	0.0000 (103)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	105.0552	149.1769	111.9173	0.0000	0.0000	0.0000	0.0000 (104)
Cooled fraction	fC = cooled area / (4) =											1.0000 (105)
Intermittency factor (Table 10b)	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500 (106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	26.2638	37.2942	27.9793	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling requirement												91.5373 (107)
Energy for space heating												41.8590 (99)
Energy for space cooling												2.0451 (108)
Total												43.9040 (109)
Fabric Energy Efficiency (TFEE)												43.9 (109)

Building Regulations England Part L (BREL) Compliance Report

Approved Document L1 2021 Edition, England assessed by Array SAP 10 program, Array

Date: Wed 12 Apr 2023 06:32:41

Project Information			
Assessed By	Mark Simons	Building Type	Flat, End-terrace
OCDEA Registration	EES/004083	Assessment Date	2023-04-12

Dwelling Details			
Assessment Type	As designed	Total Floor Area	54 m ²
Site Reference	39-41 Richmond	Plot Reference	Flat 2 - Boiler
Address	39-41 Richmond Street, MANCHESTER, M1 3WB		

Client Details	
Name	Mark Simons
Company	EAL Consult
Address	17 Dobree Avenue, London, NW10 2AD

This report covers items included within the SAP calculations. It is not a complete report of regulations compliance.

1a Target emission rate and dwelling emission rate			
Fuel for main heating system	Mains gas		
Target carbon dioxide emission rate	14.28 kgCO ₂ /m ²		
Dwelling carbon dioxide emission rate	17.48 kgCO ₂ /m ²		FAIL
1b Target primary energy rate and dwelling primary energy			
Target primary energy	75.99 kWh _{PE} /m ²		
Dwelling primary energy	97.01 kWh _{PE} /m ²		FAIL
1c Target fabric energy efficiency and dwelling fabric energy efficiency			
Target fabric energy efficiency	31.7 kWh/m ²		
Dwelling fabric energy efficiency	31.2 kWh/m ²		OK

2a Fabric U-values				
Element	Maximum permitted average U-Value [W/m ² K]	Dwelling average U-Value [W/m ² K]	Element with highest individual U-Value	
External walls	0.26	0.12	Walls (1) (0.12)	OK
Party walls	0.2	0	Party Wall (1) (0)	N/A
Curtain walls	1.6	0	N/A	N/A
Floors	0.18	N/A	N/A	N/A
Roofs	0.16	N/A	N/A	N/A
Windows, doors, and roof windows	1.6	1.2	FRONT (1.2)	OK
Rooflights	2.2	N/A	N/A	N/A

2b Envelope elements (better than typically expected values are flagged with a subsequent (!))			
Name	Net area [m ²]	U-Value [W/m ² K]	
Exposed wall: Walls (1)	24.67	0.12 (!)	
Sheltered wall: Walls (2)	24.57	0.12 (!)	
Party wall: Party Wall (1)	24.81	0 (!)	

2c Openings (better than typically expected values are flagged with a subsequent (!))				
Name	Area [m ²]	Orientation	Frame factor	U-Value [W/m ² K]
FRONT, WINDOWS	8.38	North West	0.7	1.2
REAR, WINDOWS	8.34	South East	0.7	1.2
ENTRANCE DOOR, CORRIDOR DOOR	1.89	North East	N/A	1.2

2d Thermal bridging (better than typically expected values are flagged with a subsequent (!))				
Building part 1 - Main Dwelling: Thermal bridging calculated from linear thermal transmittances for each junction				
Main element	Junction detail	Source	Psi value [W/mK]	Drawing / reference
External wall	E2: Other lintels (including other steel lintels)	Calculated by person with suitable expertise	0.16	
External wall	E3: Sill	Calculated by person with suitable expertise	0.16	

Main element	Junction detail	Source	Psi value [W/mK]	Drawing / reference
External wall	E4: Jamb	Calculated by person with suitable expertise	0.16	
External wall	E5: Ground floor (normal)	Calculated by person with suitable expertise	0.16	

3 Air permeability (better than typically expected values are flagged with a subsequent (!))

Maximum permitted air permeability at 50Pa	8 m ³ /hm ²	
Dwelling air permeability at 50Pa	3 m ³ /hm ² , Design value (!)	OK
Air permeability test certificate reference		

4 Space heating

Main heating system 1: Boiler with radiators or underfloor heating - Mains gas

Efficiency	84.1%
Emitter type	Underfloor
Flow temperature	
System type	Combi boiler
Manufacturer	Vaillant
Model	ecoFIT pure 835
Commissioning	

Secondary heating system: N/A

Fuel	N/A
Efficiency	N/A
Commissioning	

5 Hot water

Cylinder/store - type: N/A

Capacity	N/A
Declared heat loss	N/A
Primary pipework insulated	N/A
Manufacturer	
Model	
Commissioning	

Waste water heat recovery system 1 - type: N/A

Efficiency	
Manufacturer	
Model	

6 Controls

Main heating 1 - type: Time and temperature zone control by arrangement of plumbing and electrical services

Function	
Ecodesign class	
Manufacturer	
Model	

Water heating - type: N/A

Manufacturer	
Model	

7 Lighting

Minimum permitted light source efficacy	75 lm/W	
Lowest light source efficacy	100 lm/W	OK
External lights control	N/A	

8 Mechanical ventilation

System type: N/A

Maximum permitted specific fan power	N/A	
Specific fan power	N/A	N/A
Minimum permitted heat recovery efficiency	N/A	
Heat recovery efficiency	N/A	N/A
Manufacturer/Model		
Commissioning		

9 Local generation

N/A

10 Heat networks	
N/A	
11 Supporting documentary evidence	
N/A	
12 Declarations	
a. Assessor Declaration	
This declaration by the assessor is confirmation that the contents of this BREL Compliance Report are a true and accurate reflection based upon the design information submitted for this dwelling for the purpose of carrying out the "As designed" assessment, and that the supporting documentary evidence (SAP Conventions, Appendix 1 (documentary evidence) schedules the minimum documentary evidence required) has been reviewed in the course of preparing this BREL Compliance Report.	
Signed: Name:	Assessor ID: Date:
b. Client Declaration	
N/A	

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Property Reference	39-41 Richmond				Issued on Date	12/04/2023
Assessment Reference	Flat 2 - Boiler	Prop Type Ref	39-41 Richmond			
Property	39-41 , Richmond Street, MANCHESTER, M1 3WB					
SAP Rating	84 B	DER	17.48	TER	14.28	
Environmental	88 B	% DER < TER				-22.41
CO ₂ Emissions (t/year)	0.88	DFEE	31.24	TFEE	31.71	
Compliance Check	See BREL	% DFEE < TFEE				1.50
% DPER < TPER	-27.67	DPER	97.01	TPER	75.99	
Assessor Details	Mr. Mark Simons				Assessor ID	5542-0001
Client	EAL Consult, Mark Simons					

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	54.2300 (1b)	x 2.7500 (2b)	= 149.1325 (1b) - (4)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	54.2300		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 149.1325 (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	2 * 10 = 20.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	Air changes per hour
Pressure test	20.0000 / (5) = 0.1341 (8)
Pressure Test Method	Yes
Measured/design AP50	Blower Door
Infiltration rate	3.0000 (17)
Number of sides sheltered	0.2841 (18)
	0 (19)

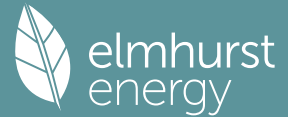
Shelter factor	(20) = 1 - [0.075 x (19)] = 1.0000 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.2841 (21)

	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	0.3622	0.3551	0.3480	0.3125	0.3054	0.2699	0.2699	0.2628	0.2841	0.3054	0.3196	0.3338 (22b)
Effective ac	0.5656	0.5631	0.5606	0.5488	0.5466	0.5364	0.5364	0.5345	0.5404	0.5466	0.5511	0.5557 (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
WINDOWS (Uw = 1.20)			16.7200	1.1450	19.1450		(27)
CORRIDOR DOOR			1.8900	1.2000	2.2680		(26)
EXTERNAL	41.3900	16.7200	24.6700	0.1200	2.9604	70.0000	1726.9000 (29a)
HALLWAY	26.4600	1.8900	24.5700	0.1100	2.7027	70.0000	1719.9000 (29a)
Total net area of external elements Aum(A, m ²)			67.8500				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		27.0761		(33)
SOLID			24.8100	0.0000	0.0000	180.0000	4465.8000 (32)
FLOORS			54.2300			40.0000	2169.2000 (32a)

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CEILING 54.2300 30.0000 1626.9000 (32b)

Heat capacity $C_m = \text{Sum}(A \times k)$ (28)...(30) + (32) + (32a)...(32e) = 11708.7000 (34)
Thermal mass parameter (TMP = C_m / TFA) in kJ/m²K 215.9082 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element	5.0000	0.1600	0.8000
E2 Other lintels (including other steel lintels)	7.5000	0.1600	1.2000
E3 Sill	7.5000	0.1600	1.2000
E4 Jamb	9.0000	0.1600	1.4400
E5 Ground floor (normal)			
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			4.6400 (36)
Point Thermal bridges			0.0000
Total fabric heat loss		(33) + (36) + (36a) =	31.7161 (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	27.8357	27.7103	27.5874	27.0102	26.9022	26.3994	26.3994	26.3063	26.5931	26.9022	27.1207	27.3491 (38)
Heat transfer coeff	59.5518	59.4265	59.3036	58.7263	58.6183	58.1156	58.1156	58.0225	58.3092	58.6183	58.8368	59.0652 (39)
Average = Sum(39)m / 12 =												58.7258
HLP	1.0981	1.0958	1.0936	1.0829	1.0809	1.0716	1.0716	1.0699	1.0752	1.0809	1.0849	1.0892 (40)
HLP (average)												1.0829
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

4. Water heating energy requirements (kWh/year)

Assumed occupancy												1.8148 (42)
Hot water usage for mixer showers	54.6471	53.8259	52.6292	50.3395	48.6498	46.7654	45.6943	46.8820	48.1839	50.2071	52.5460	54.4378 (42a)
Hot water usage for baths	24.8666	24.4973	23.9773	23.0184	22.3004	21.5042	21.0742	21.5906	22.1529	23.0048	23.9834	24.7826 (42b)
Hot water usage for other uses	34.9632	33.6918	32.4204	31.1490	29.8776	28.6062	28.6062	29.8776	31.1490	32.4204	33.6918	34.9632 (42c)
Average daily hot water use (litres/day)												105.2228 (43)
Daily hot water use	114.4769	112.0150	109.0268	104.5069	100.8277	96.8758	95.3747	98.3502	101.4857	105.6323	110.2212	114.1835 (44)
Energy conte	181.3035	159.5079	167.5702	143.0647	135.7335	119.1201	115.3475	121.7781	125.1421	143.3420	157.0303	178.7837 (45)
Energy content (annual)												Total = Sum(45)m = 1747.7235
Distribution loss (46)m = 0.15 x (45)m	27.1955	23.9262	25.1355	21.4597	20.3600	17.8680	17.3021	18.2667	18.7713	21.5013	23.5545	26.8176 (46)
Water storage loss:												
Total storage 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 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Primary 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 (59)
Combi loss	50.9589	46.0274	50.9589	49.3151	50.9589	47.7744	48.6019	50.1182	49.3151	50.9589	49.3151	50.9589 (61)
Total heat required for water heating calculated for each month	232.2624	205.5353	218.5291	192.3798	186.6924	166.8945	163.9494	171.8962	174.4571	194.3009	206.3453	229.7426 (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	232.2624	205.5353	218.5291	192.3798	186.6924	166.8945	163.9494	171.8962	174.4571	194.3009	206.3453	229.7426 (64)
12Total per year (kWh/year)												Total per year (kWh/year) = Sum(64)m = 2342.9851 (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	73.0231	64.5432	68.4568	59.8978	57.8711	51.5510	50.5035	53.0207	53.9385	60.4009	64.5413	72.1853 (65)

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

Metabolic gains (Table 5), Watts												
(66)m	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	79.7932	88.3425	79.7932	82.4530	79.7932	82.4530	79.7932	79.7932	82.4530	79.7932	82.4530	79.7932 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	158.1990	159.8407	155.7038	146.8971	135.7801	125.3317	118.3516	116.7100	120.8468	129.6535	140.7705	151.2189 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738 (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)	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906 (71)
Water heating gains (Table 5)	98.1494	96.0464	92.0118	83.1914	77.7838	71.5987	67.8811	71.2644	74.9146	81.1841	89.6407	97.0233 (72)
Total internal gains	389.3631	397.4511	380.7304	365.7629	346.5786	329.6049	316.2473	317.9891	328.4358	343.8523	366.0857	381.2569 (73)

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6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2		g Specific data or Table 6b	FF Specific data or Table 6c		Access factor Table 6d		Gains W
Southeast				8.3400	36.7938		0.6300	0.7000		0.7700		93.7806 (77)
Northwest				8.3800	11.2829		0.6300	0.7000		0.7700		28.8960 (81)
Solar gains	122.6766	218.5617	324.5400	444.8530	537.2765	550.5477	523.6470	452.0720	365.7915	248.4312	148.6862	103.8546 (83)
Total gains	512.0397	616.0128	705.2704	810.6159	883.8551	880.1526	839.8943	770.0611	694.2273	592.2835	514.7719	485.1115 (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	54.6149	54.7301	54.8435	55.3826	55.4846	55.9646	55.9646	56.0544	55.7788	55.4846	55.2786	55.0648
alpha	4.6410	4.6487	4.6562	4.6922	4.6990	4.7310	4.7310	4.7370	4.7186	4.6990	4.6852	4.6710
util living area	0.9772	0.9498	0.8940	0.7661	0.5907	0.4184	0.3037	0.3451	0.5601	0.8362	0.9544	0.9816 (86)
MIT	20.1034	20.3090	20.5479	20.7831	20.8953	20.9284	20.9335	20.9327	20.9116	20.7414	20.3840	20.0654 (87)
Th 2	20.0024	20.0042	20.0061	20.0148	20.0164	20.0241	20.0241	20.0255	20.0211	20.0164	20.0131	20.0097 (88)
util rest of house	0.9714	0.9381	0.8712	0.7251	0.5359	0.3564	0.2367	0.2727	0.4879	0.7943	0.9416	0.9769 (89)
MIT 2	18.9735	19.2295	19.5185	19.7898	19.9021	19.9367	19.9397	19.9409	19.9228	19.7556	19.3340	18.9317 (90)
Living area fraction	fLA = Living area / (4) =											
MIT	19.5334	19.7644	20.0286	20.2820	20.3942	20.4280	20.4321	20.4323	20.4127	20.2440	19.8542	19.4934 (92)
Temperature adjustment	0.0000											
adjusted MIT	19.5334	19.7644	20.0286	20.2820	20.3942	20.4280	20.4321	20.4323	20.4127	20.2440	19.8542	19.4934 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9681	0.9348	0.8718	0.7368	0.5574	0.3822	0.2648	0.3031	0.5174	0.8048	0.9392	0.9739 (94)
Useful gains	495.7020	575.8735	614.8573	597.2456	492.6703	336.4172	222.3993	233.3878	359.1916	476.6604	483.4499	472.4286 (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	907.1743	883.3361	802.2930	668.4206	509.6391	338.7002	222.7061	233.9653	368.0909	565.3170	750.4192	903.3095 (97)
Space heating kWh	306.1354	206.6149	139.4522	51.2460	12.6248	0.0000	0.0000	0.0000	0.0000	65.9605	192.2179	320.5754 (98a)
Space heating requirement - total per year (kWh/year)												1294.8271
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	306.1354	206.6149	139.4522	51.2460	12.6248	0.0000	0.0000	0.0000	0.0000	65.9605	192.2179	320.5754 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1294.8271
Space heating per m2												(98c) / (4) = 23.8766 (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 %)												84.1000 (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	306.1354	206.6149	139.4522	51.2460	12.6248	0.0000	0.0000	0.0000	0.0000	65.9605	192.2179	320.5754 (98)
Space heating efficiency (main heating system 1)	84.1000	84.1000	84.1000	84.1000	84.1000	0.0000	0.0000	0.0000	0.0000	84.1000	84.1000	84.1000 (210)
Space heating fuel (main heating system)	364.0136	245.6776	165.8171	60.9346	15.0117	0.0000	0.0000	0.0000	0.0000	78.4311	228.5587	381.1836 (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	232.2624	205.5353	218.5291	192.3798	186.6924	166.8945	163.9494	171.8962	174.4571	194.3009	206.3453	229.7426 (64)
Efficiency of water heater	85.1746	84.5932	83.6450	82.1683	80.9952	80.5000	80.5000	80.5000	80.5000	82.5186	84.4302	85.2958 (217)
Fuel for water heating, kWh/month	272.6898	242.9690	261.2577	234.1291	230.4982	207.3224	203.6638	213.5357	216.7169	235.4632	244.3975	269.3480 (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)

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Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041 (231)
Lighting	15.4273	12.3763	11.1435	8.1642	6.3063	5.1523	5.7528	7.4777	9.7128	12.7437	14.3940	15.8561 (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	(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	(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	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)												
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(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	(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	(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	(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	(235d)
Annual totals kWh/year												
Space heating fuel - main system 1												1539.6279 (211)
Space heating fuel - main system 2												0.0000 (213)
Space heating fuel - secondary												0.0000 (215)
Efficiency of water heater												80.5000
Water heating fuel used												2831.9914 (219)
Space cooling fuel												0.0000 (221)
Electricity for pumps and fans:												
central heating pump												41.0000 (230c)
main heating flue fan												45.0000 (230e)
Total electricity for the above, kWh/year												86.0000 (231)
Electricity for lighting (calculated in Appendix L)												124.5070 (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												4582.1263 (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	1539.6279	0.2100	323.3219 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	2831.9914	0.2100	594.7182 (264)
Space and water heating			918.0400 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	124.5070	0.1443	17.9702 (268)
Total CO2, kg/year			947.9395 (272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			17.4800 (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	1539.6279	1.1300	1739.7795 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	2831.9914	1.1300	3200.1503 (278)
Space and water heating			4939.9298 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	124.5070	1.5338	190.9730 (282)
Total Primary energy kWh/year			5261.0036 (286)
Dwelling Primary energy Rate (DPER)			97.0100 (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	54.2300 (1b)	x 2.7500 (2b)	= 149.1325 (1b) - (4)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	54.2300		

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Dwelling volume

(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 149.1325 (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	2 * 10 =	20.0000 (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)+(6g)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1341 (8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3841	(18)
Number of sides sheltered		0	(19)

Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3841 (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	0.4897	0.4801	0.4705	0.4225	0.4129	0.3649	0.3649	0.3553	0.3841	0.4129	0.4321	0.4513	(22b)
Effective ac	0.6199	0.6153	0.6107	0.5893	0.5853	0.5666	0.5666	0.5631	0.5738	0.5853	0.5934	0.6018	(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 Opaque door			1.8900	1.0000	1.8900			(26)
TER Opening Type (Uw = 1.20)			11.6700	1.1450	13.3626			(27)
EXTERNAL	41.3900	11.6700	29.7200	0.1800	5.3496			(29a)
HALLWAY	26.4600	1.8900	24.5700	0.1800	4.4226			(29a)
Total net area of external elements Aum(A, m2)			67.8500					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	25.0248			(33)
SOLID			24.8100	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 225.9082 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total	
E2 Other lintels (including other steel lintels)	5.0000	0.0500	0.2500	
E3 Sill	7.5000	0.0500	0.3750	
E4 Jamb	7.5000	0.0500	0.3750	
E5 Ground floor (normal)	9.0000	0.1600	1.4400	

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 2.4400 (36)

Point Thermal bridges

Total fabric heat loss (33) + (36) + (36a) = 27.4648 (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	30.5087	30.2795	30.0549	28.9998	28.8023	27.8834	27.8834	27.7132	28.2374	28.8023	29.2017	29.6192	(38)
Heat transfer coeff	57.9735	57.7443	57.5197	56.4645	56.2671	55.3482	55.3482	55.1780	55.7021	56.2671	56.6665	57.0840	(39)
Average = Sum(39)m / 12 =													56.4636

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0690	1.0648	1.0607	1.0412	1.0376	1.0206	1.0206	1.0175	1.0271	1.0376	1.0449	1.0526	(40)
HLP (average)													1.0412
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy													1.8148 (42)
Hot water usage for mixer showers	54.6471	53.8259	52.6292	50.3395	48.6498	46.7654	45.6943	46.8820	48.1839	50.2071	52.5460	54.4378	(42a)
Hot water usage for baths	23.6233	23.2725	22.7784	21.8674	21.1853	20.4290	20.0205	20.5110	21.0452	21.8545	22.7842	23.5434	(42b)
Hot water usage for other uses	33.2150	32.0072	30.7994	29.5915	28.3837	27.1759	27.1759	28.3837	29.5915	30.7994	32.0072	33.2150	(42c)
Average daily hot water use (litres/day)													102.4808 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													

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Energy conte	111.4854	109.1055	106.2070	101.7985	98.2189	94.3703	92.8907	95.7768	98.8206	102.8610	107.3374	111.1962 (44)
Energy content (annual)	176.5657	155.3648	163.2361	139.3571	132.2215	116.0393	112.3432	118.5916	121.8557	139.5814	152.9218	174.1064 (45)
Distribution loss (46) _m = 0.15 x (45) _m										Total = Sum(45) _m =		1702.1847
	26.4849	23.3047	24.4854	20.9036	19.8332	17.4059	16.8515	17.7887	18.2784	20.9372	22.9383	26.1160 (46)
Water storage loss:												
Total storage 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 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Primary 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 (59)
Combi loss	50.9589	46.0274	50.9589	49.3151	50.0513	46.5388	47.3361	48.8068	48.7335	50.9589	49.3151	50.9589 (61)
Total heat required for water heating calculated for each month												
	227.5246	201.3922	214.1950	188.6721	182.2727	162.5781	159.6793	167.3984	170.5892	190.5403	202.2369	225.0653 (62)
WWHRS	-24.9824	-22.0946	-23.1362	-19.1577	-17.8543	-15.2780	-14.3207	-15.2287	-15.8073	-18.6350	-21.1112	-24.5198 (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	202.5422	179.2976	191.0588	169.5144	164.4184	147.3000	145.3586	152.1698	154.7819	171.9053	181.1257	200.5455 (64)
										Total per year (kWh/year) = Sum(64) _m =		2060.0183 (64)
12Total per year (kWh/year)												2060 (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												
	71.4478	63.1657	67.0157	58.6650	56.4764	50.2178	49.1881	51.6334	52.7004	59.1506	63.1753	70.6301 (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	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5												
	79.8937	88.4538	79.8937	82.5569	79.8937	82.5569	79.8937	79.8937	82.5569	79.8937	82.5569	79.8937 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5												
	158.1990	159.8407	155.7038	146.8971	135.7801	125.3317	118.3516	116.7100	120.8468	129.6535	140.7705	151.2189 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												
	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)												
	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906 (71)
Water heating gains (Table 5)												
	96.0320	93.9965	90.0749	81.4792	75.9092	69.7469	66.1131	69.3998	73.1950	79.5034	87.7434	94.9329 (72)
Total internal gains	387.3463	395.5124	378.8940	364.1546	344.8045	327.8570	314.5799	316.2249	326.8201	342.2722	364.2923	379.2670 (73)

6. Solar gains

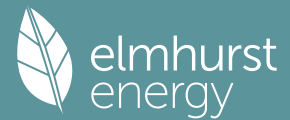
[Jan]				Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W			
Southeast				5.8200	36.7938	0.6300	0.7000	0.7700	65.4440 (77)			
Northwest				5.8500	11.2829	0.6300	0.7000	0.7700	20.1720 (81)			
Solar gains	85.6160	152.5361	226.5039	310.4803	374.9922	384.2573	365.4808	315.5210	255.2967	173.3835	103.7685	72.4799 (83)
Total gains	472.9623	548.0486	605.3979	674.6349	719.7967	712.1142	680.0607	631.7459	582.1168	515.6557	468.0607	451.7469 (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	58.7002	58.9332	59.1633	60.2689	60.4803	61.4845	61.4845	61.6741	61.0938	60.4803	60.0541	59.6149
alpha	4.9133	4.9289	4.9442	5.0179	5.0320	5.0990	5.0990	5.1116	5.0729	5.0320	5.0036	4.9743
util living area	0.9846	0.9683	0.9339	0.8391	0.6803	0.4902	0.3569	0.3995	0.6306	0.8822	0.9686	0.9874 (86)
MIT	19.9074	20.1316	20.4149	20.7438	20.9264	20.9887	20.9982	20.9968	20.9621	20.7149	20.2696	19.8809 (87)
Th 2	20.0262	20.0297	20.0331	20.0491	20.0521	20.0662	20.0662	20.0688	20.0608	20.0521	20.0461	20.0397 (88)
util rest of house	0.9805	0.9601	0.9173	0.8037	0.6242	0.4217	0.2818	0.3198	0.5557	0.8468	0.9590	0.9839 (89)
MIT 2	18.7762	19.0593	19.4096	19.8041	19.9941	20.0599	20.0656	20.0676	20.0367	19.7849	19.2478	18.7528 (90)
Living area fraction									fLA = Living area / (4) =			0.4955 (91)
MIT	19.3367	19.5906	19.9077	20.2697	20.4560	20.5201	20.5277	20.5280	20.4952	20.2457	19.7541	19.3117 (92)
Temperature adjustment												0.0000
adjusted MIT	19.3367	19.5906	19.9077	20.2697	20.4560	20.5201	20.5277	20.5280	20.4952	20.2457	19.7541	19.3117 (93)

8. Space heating requirement

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9767	0.9556	0.9148	0.8125	0.6488	0.4553	0.3190	0.3593	0.5912	0.8548	0.9555	0.9805	(94)
Useful gains	461.9409	523.7007	553.8426	548.1304	466.9960	324.2594	216.9474	226.9833	344.1711	440.7890	447.2198	442.9457	(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	871.7312	848.2987	771.2061	641.9861	492.6778	327.6683	217.3888	227.7768	356.2279	542.7379	717.0609	862.6376	(97)
Space heating kWh	304.8840	218.1299	161.7184	67.5762	19.1072	0.0000	0.0000	0.0000	0.0000	75.8500	194.2856	312.2508	(98a)
Space heating requirement - total per year (kWh/year)												1353.8020	
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	304.8840	218.1299	161.7184	67.5762	19.1072	0.0000	0.0000	0.0000	0.0000	75.8500	194.2856	312.2508	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1353.8020	
Space heating per m2										(98c) / (4) =		24.9641	(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 %)	92.4000	(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	304.8840	218.1299	161.7184	67.5762	19.1072	0.0000	0.0000	0.0000	0.0000	75.8500	194.2856	312.2508	(98)
Space heating efficiency (main heating system 1)	92.4000	92.4000	92.4000	92.4000	92.4000	0.0000	0.0000	0.0000	0.0000	92.4000	92.4000	92.4000	(210)
Space heating fuel (main heating system)	329.9610	236.0713	175.0200	73.1344	20.6788	0.0000	0.0000	0.0000	0.0000	82.0887	210.2658	337.9337	(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	202.5422	179.2976	191.0588	169.5144	164.4184	147.3000	145.3586	152.1698	154.7819	171.9053	181.1257	200.5455	(64)
Efficiency of water heater (217)m	85.2554	84.8026	84.0262	82.5768	81.1170	80.3000	80.3000	80.3000	80.3000	82.7508	84.5321	80.3000	(216)
Fuel for water heating, kWh/month	237.5710	211.4294	227.3800	205.2808	202.6930	183.4372	181.0194	189.5016	192.7546	207.7387	214.2686	235.0340	(219)
Space cooling fuel requirement (221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting	16.6003	13.3174	11.9909	8.7850	6.7858	5.5441	6.1902	8.0463	10.4513	13.7127	15.4885	17.0617	(232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-14.6530	-21.7766	-32.9837	-39.1560	-44.0652	-41.8269	-41.3350	-38.1121	-32.7416	-25.8155	-16.5075	-12.5425	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity) (234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity) (235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) (235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity) (233b)m	-5.1979	-11.1823	-22.6887	-34.7599	-46.6256	-47.0741	-46.5026	-39.0542	-28.2208	-16.1949	-7.0060	-4.0909	(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												1465.1537	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												80.3000	
Water heating fuel used												2488.1082	(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)	133.9743	(232)

Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-670.1134	(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	3503.1228	(238)

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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	1465.1537	0.2100	307.6823 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	2488.1082	0.2100	522.5027 (264)
Space and water heating			830.1850 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	133.9743	0.1443	19.3366 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-361.5156	0.1335	-48.2535
PV Unit electricity exported	-308.5978	0.1253	-38.6761
Total			-86.9297 (269)
Total CO2, kg/year			774.5212 (272)
EPC Target Carbon Dioxide Emission Rate (TER)			14.2800 (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	1465.1537	1.1300	1655.6237 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	2488.1082	1.1300	2811.5622 (278)
Space and water heating			4467.1859 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	133.9743	1.5338	205.4942 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-361.5156	1.4932	-539.8295
PV Unit electricity exported	-308.5978	0.4600	-141.9599
Total			-681.7895 (283)
Total Primary energy kWh/year			4120.9915 (286)
Target Primary Energy Rate (TPER)			75.9900 (287)

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022) CALCULATION OF FABRIC ENERGY EFFICIENCY

1. Overall dwelling characteristics

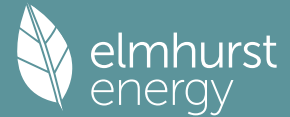
	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	54.2300 (1b)	x 2.7500 (2b)	= 149.1325 (1b) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	54.2300		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	149.1325 (5)

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	2 * 10 = 20.0000 (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) =	20.0000 / (5) = 0.1341 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	3.0000 (17)
Infiltration rate	0.2841 (18)
Number of sides sheltered	0 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] = 1.0000 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.2841 (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)

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Adj infilt rate

0.3622	0.3551	0.3480	0.3125	0.3054	0.2699	0.2699	0.2628	0.2841	0.3054	0.3196	0.3338 (22b)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)											0.0000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =											0.0000 (23c)
Effective ac	0.5656	0.5631	0.5606	0.5488	0.5466	0.5364	0.5364	0.5345	0.5404	0.5466	0.5557 (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
WINDOWS (Uw = 1.20)			16.7200	1.1450	19.1450		(27)
CORRIDOR DOOR			1.8900	1.2000	2.2680		(26)
EXTERNAL	41.3900	16.7200	24.6700	0.1200	2.9604	70.0000	1726.9000 (29a)
HALLWAY	26.4600	1.8900	24.5700	0.1100	2.7027	70.0000	1719.9000 (29a)
Total net area of external elements Aum(A, m2)			67.8500				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	27.0761		(33)
SOLID			24.8100	0.0000	0.0000	180.0000	4465.8000 (32)
FLOORS			54.2300			40.0000	2169.2000 (32d)
CEILING			54.2300			40.0000	2169.2000 (32b)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 12251.0000 (34)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 225.9082 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	5.0000	0.1600	0.8000
E3 Sill	7.5000	0.1600	1.2000
E4 Jamb	7.5000	0.1600	1.2000
E5 Ground floor (normal)	9.0000	0.1600	1.4400

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 4.6400 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 31.7161 (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	27.8357	27.7103	27.5874	27.0102	26.9022	26.3994	26.3994	26.3063	26.5931	26.9022	27.1207	27.3491 (38)
Heat transfer coeff	59.5518	59.4265	59.3036	58.7263	58.6183	58.1156	58.1156	58.0225	58.3092	58.6183	58.8368	59.0652 (39)
Average = Sum(39)m / 12 =												58.7258

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.0981	1.0958	1.0936	1.0829	1.0809	1.0716	1.0716	1.0699	1.0752	1.0809	1.0849	1.0892 (40)
HLP (average)												1.0829
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

4. Water heating energy requirements (kWh/year)

Assumed occupancy												1.8148 (42)
Hot water usage for mixer showers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (42a)
Hot water usage for baths	23.6233	23.2725	22.7784	21.8674	21.1853	20.4290	20.0205	20.5110	21.0452	21.8545	22.7842	23.5434 (42b)
Hot water usage for other uses	33.2150	32.0072	30.7994	29.5915	28.3837	27.1759	27.1759	28.3837	29.5915	30.7994	32.0072	33.2150 (42c)
Average daily hot water use (litres/day)												52.0980 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	56.8383	55.2796	53.5778	51.4590	49.5691	47.6049	47.1964	48.8948	50.6368	52.6539	54.7914	56.7584 (44)
Energy conte	90.0180	78.7175	82.3470	70.4448	66.7295	58.5358	57.0799	60.5419	62.4402	71.4509	78.0604	88.8700 (45)
Energy content (annual)										Total = Sum(45)m =		865.2358
Distribution loss (46)m = 0.15 x (45)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 (46)
Water storage loss:												
Total storage 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 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Primary 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 (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	76.5153	66.9098	69.9950	59.8781	56.7201	49.7554	48.5179	51.4607	53.0742	60.7332	66.3514	75.5395 (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	76.5153	66.9098	69.9950	59.8781	56.7201	49.7554	48.5179	51.4607	53.0742	60.7332	66.3514	75.5395 (64)
Total per year (kWh/year)										Total per year (kWh/year) = Sum(64)m =		735.4504 (64)
Electric shower(s)	43.7633	38.9934	42.5793	40.6329	41.3954	39.4872	40.8034	41.3954	40.6329	42.5793	41.7787	43.7633 (64a)
Heat gains from water heating, kWh/month	30.0696	26.4758	28.1436	25.1277	24.5289	22.3106	22.3303	23.2140	23.4268	25.8281	27.0325	29.8257 (65)

12Total per year (kWh/year) 735 (64)

Heat gains from water heating, kWh/month 29.8257 (65)

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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	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	79.7932	88.3425	79.7932	82.4530	79.7932	82.4530	79.7932	79.7932	82.4530	79.7932	82.4530	79.7932 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	158.1990	159.8407	155.7038	146.8971	135.7801	125.3317	118.3516	116.7100	120.8468	129.6535	140.7705	151.2189 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738 (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)	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906 (71)
Water heating gains (Table 5)	40.4162	39.3985	37.8274	34.8997	32.9689	30.9870	30.0139	31.2016	32.5372	34.7152	37.5452	40.0883 (72)
Total internal gains	328.6299	337.8032	323.5459	314.4712	298.7637	288.9932	278.3802	277.9263	286.0584	294.3835	310.9901	321.3219 (73)

6. Solar gains

[Jan]	Area m ²		Solar flux Table 6a W/m ²		Specific data or Table 6b		Specific data or Table 6c		Access factor Table 6d		Gains W	
Southeast	8.3400		36.7938		0.6300		0.7000		0.7700		93.7806	(77)
Northwest	8.3800		11.2829		0.6300		0.7000		0.7700		28.8960	(81)
Solar gains	122.6766	218.5617	324.5400	444.8530	537.2765	550.5477	523.6470	452.0720	365.7915	248.4312	148.6862	103.8546 (83)
Total gains	451.3065	556.3649	648.0859	759.3242	836.0402	839.5410	802.0272	729.9983	651.8499	542.8147	459.6763	425.1765 (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, n _l (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	57.1444	57.2650	57.3837	57.9477	58.0545	58.5567	58.5567	58.6507	58.3622	58.0545	57.8389	57.6152
alpha	4.8096	4.8177	4.8256	4.8632	4.8703	4.9038	4.9038	4.9100	4.8908	4.8703	4.8559	4.8410
util living area	0.9877	0.9679	0.9221	0.8008	0.6213	0.4384	0.3180	0.3640	0.5935	0.8740	0.9724	0.9905 (86)
MIT	19.8136	20.0954	20.4324	20.7777	20.9442	20.9916	20.9986	20.9974	20.9665	20.7067	20.1962	19.7630 (87)
Th 2	20.0024	20.0042	20.0061	20.0148	20.0164	20.0241	20.0241	20.0255	20.0211	20.0164	20.0131	20.0097 (88)
util rest of house	0.9842	0.9595	0.9031	0.7613	0.5648	0.3735	0.2479	0.2877	0.5183	0.8365	0.9637	0.9878 (89)
MIT 2	18.9411	19.2176	19.5394	19.8529	19.9832	20.0205	20.0237	20.0247	20.0050	19.8041	19.3265	18.8969 (90)
Living area fraction									f _{LA} = Living area / (4) =			0.4955 (91)
MIT	19.3734	19.6525	19.9819	20.3111	20.4593	20.5017	20.5068	20.5067	20.4814	20.2513	19.7574	19.3261 (92)
Temperature adjustment												0.0000
adjusted MIT	19.3734	19.6525	19.9819	20.3111	20.4593	20.5017	20.5068	20.5067	20.4814	20.2513	19.7574	19.3261 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9815	0.9560	0.9026	0.7738	0.5908	0.4055	0.2827	0.3255	0.5544	0.8463	0.9609	0.9854 (94)
Useful gains	442.9355	531.8938	584.9468	587.5889	493.8995	340.4511	226.7087	237.6197	361.4109	459.4076	441.7126	418.9745 (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	897.6491	876.6892	799.5227	670.1335	513.4579	342.9800	227.0430	238.2783	372.0932	565.7425	744.7202	893.4244 (97)
Space heating kWh	338.3069	231.7025	159.6445	59.4321	14.5514	0.0000	0.0000	0.0000	0.0000	79.1131	218.1655	352.9908 (98a)
Space heating requirement - total per year (kWh/year)												1453.9069
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	338.3069	231.7025	159.6445	59.4321	14.5514	0.0000	0.0000	0.0000	0.0000	79.1131	218.1655	352.9908 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1453.9069
Space heating per m ²										(98c) / (4) =		26.8100 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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
Heat loss rate W												
	0.0000	0.0000	0.0000	0.0000	0.0000	546.2863	430.0551	440.9707	0.0000	0.0000	0.0000	0.0000 (100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9710	0.9865	0.9782	0.0000	0.0000	0.0000	0.0000 (101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	530.4413	424.2456	431.3749	0.0000	0.0000	0.0000	0.0000 (102)

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Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	952.5269	910.2554	827.5959	0.0000	0.0000	0.0000	0.0000 (103)
Space cooling kwh	0.0000	0.0000	0.0000	0.0000	0.0000	303.9016	361.5913	294.7884	0.0000	0.0000	0.0000	0.0000 (104)
Cooled fraction	0.0000	0.0000	0.0000	0.0000	0.0000	303.9016	361.5913	294.7884	0.0000	0.0000	0.0000	0.0000 (104)
Intermittency factor (Table 10b)	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500 (105)
Space cooling kwh	0.0000	0.0000	0.0000	0.0000	0.0000	75.9754	90.3978	73.6971	0.0000	0.0000	0.0000	0.0000 (106)
Space cooling requirement												240.0703 (107)
Energy for space heating												26.8100 (99)
Energy for space cooling												4.4269 (108)
Total												31.2369 (109)
Fabric Energy Efficiency (DFEE)												31.2 (109)

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

1. Overall dwelling characteristics

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	54.2300 (1b)	x 2.7500 (2b)	= 149.1325 (1b) - (4)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	54.2300		
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 149.1325 (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	2 * 10 = 20.0000 (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) =	20.0000 / (5) = 0.1341 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	5.0000 (17)
Infiltration rate	0.3841 (18)
Number of sides sheltered	0 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] = 1.0000 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.3841 (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	0.4897	0.4801	0.4705	0.4225	0.4129	0.3649	0.3649	0.3553	0.3841	0.4129	0.4321	0.4513 (22b)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.0000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												0.0000 (23c)
Effective ac	0.6199	0.6153	0.6107	0.5893	0.5853	0.5666	0.5666	0.5631	0.5738	0.5853	0.5934	0.6018 (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
TER Opaque door			1.8900	1.0000	1.8900		(26)
TER Opening Type (Uw = 1.20)			11.6700	1.1450	13.3626		(27)
EXTERNAL	41.3900	11.6700	29.7200	0.1800	5.3496		(29a)
HALLWAY	26.4600	1.8900	24.5700	0.1800	4.4226		(29a)
Total net area of external elements Aum(A, m ²)			67.8500				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		25.0248		(33)
SOLID			24.8100	0.0000	0.0000		(32)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							225.9082 (35)
List of Thermal Bridges							
K1 Element				Length	Psi-value		Total

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E2 Other lintels (including other steel lintels)	5.0000	0.0500	0.2500	
E3 Sill	7.5000	0.0500	0.3750	
E4 Jamb	7.5000	0.0500	0.3750	
E5 Ground floor (normal)	9.0000	0.1600	1.4400	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)				2.4400 (36)
Point Thermal bridges			(36a) =	0.0000
Total fabric heat loss		(33) + (36) +	(36a) =	27.4648 (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	30.5087	30.2795	30.0549	28.9998	28.8023	27.8834	27.8834	27.7132	28.2374	28.8023	29.2017	29.6192 (38)
Average = Sum(39)m / 12 =	57.9735	57.7443	57.5197	56.4645	56.2671	55.3482	55.3482	55.1780	55.7021	56.2671	56.6665	57.0840 (39)
												56.4636
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.0690	1.0648	1.0607	1.0412	1.0376	1.0206	1.0206	1.0175	1.0271	1.0376	1.0449	1.0526 (40)
Days in mont	31	28	31	30	31	30	31	31	30	31	30	1.0412
												31

4. Water heating energy requirements (kWh/year)												
Assumed occupancy												1.8148 (42)
Hot water usage for mixer showers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (42a)
Hot water usage for baths	23.6233	23.2725	22.7784	21.8674	21.1853	20.4290	20.0205	20.5110	21.0452	21.8545	22.7842	23.5434 (42b)
Hot water usage for other uses	33.2150	32.0072	30.7994	29.5915	28.3837	27.1759	27.1759	28.3837	29.5915	30.7994	32.0072	33.2150 (42c)
Average daily hot water use (litres/day)												52.0980 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	56.8383	55.2796	53.5778	51.4590	49.5691	47.6049	47.1964	48.8948	50.6368	52.6539	54.7914	56.7584 (44)
Energy content (annual)	90.0180	78.7175	82.3470	70.4448	66.7295	58.5358	57.0799	60.5419	62.4402	71.4509	78.0604	88.8700 (45)
Distribution loss (46)m = 0.15 x (45)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 (46)
Water storage loss:												
Total storage 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 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Primary 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 (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	76.5153	66.9098	69.9950	59.8781	56.7201	49.7554	48.5179	51.4607	53.0742	60.7332	66.3514	75.5395 (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	76.5153	66.9098	69.9950	59.8781	56.7201	49.7554	48.5179	51.4607	53.0742	60.7332	66.3514	75.5395 (64)
12Total per year (kWh/year)												735.4504 (64)
Electric shower(s)	43.7633	38.9934	42.5793	40.6329	41.3954	39.4872	40.8034	41.3954	40.6329	42.5793	41.7787	43.7633 (64a)
Heat gains from water heating, kWh/month	30.0696	26.4758	28.1436	25.1277	24.5289	22.3106	22.3303	23.2140	23.4268	25.8281	27.0325	29.8257 (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	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	79.8937	88.4538	79.8937	82.5569	79.8937	82.5569	79.8937	79.8937	82.5569	79.8937	82.5569	79.8937 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	158.1990	159.8407	155.7038	146.8971	135.7801	125.3317	118.3516	116.7100	120.8468	129.6535	140.7705	151.2189 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738 (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)	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906 (71)
Water heating gains (Table 5)	40.4162	39.3985	37.8274	34.8997	32.9689	30.9870	30.0139	31.2016	32.5372	34.7152	37.5452	40.0883 (72)
Total internal gains	328.7304	337.9144	323.6464	314.5751	298.8642	289.0971	278.4807	278.0268	286.1623	294.4840	311.0940	321.4224 (73)

6. Solar gains												
[Jan]	Area	Solar flux	g	FF	Access	Gains						
	m2	Table 6a	Specific data	Specific data	factor	W						

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	W/m2		or Table 6b		or Table 6c		Table 6d		
Southeast	5.8200		36.7938		0.6300		0.7700		65.4440 (77)
Northwest	5.8500		11.2829		0.6300		0.7700		20.1720 (81)

Solar gains	85.6160	152.5361	226.5039	310.4803	374.9922	384.2573	365.4808	315.5210	255.2967	173.3835	103.7685	72.4799 (83)
Total gains	414.3465	490.4506	550.1503	625.0554	673.8564	673.3543	643.9615	593.5478	541.4590	467.8675	414.8625	393.9023 (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	58.7002	58.9332	59.1633	60.2689	60.4803	61.4845	61.4845	61.6741	61.0938	60.4803	60.0541	59.6149
alpha	4.9133	4.9289	4.9442	5.0179	5.0320	5.0990	5.0990	5.1116	5.0729	5.0320	5.0036	4.9743
util living area	0.9911	0.9793	0.9525	0.8686	0.7144	0.5164	0.3765	0.4244	0.6685	0.9122	0.9804	0.9929 (86)
MIT	19.7878	20.0220	20.3247	20.6932	20.9084	20.9858	20.9977	20.9958	20.9509	20.6534	20.1677	19.7611 (87)
Th 2	20.0262	20.0297	20.0331	20.0491	20.0521	20.0662	20.0662	20.0688	20.0608	20.0521	20.0461	20.0397 (88)
util rest of house	0.9886	0.9737	0.9396	0.8368	0.6586	0.4451	0.2975	0.3401	0.5923	0.8828	0.9741	0.9909 (89)
MIT 2	18.9344	19.1676	19.4635	19.8163	19.9949	20.0599	20.0656	20.0676	20.0359	19.7921	19.3261	18.9186 (90)
Living area fraction	fLA = Living area / (4) =											
MIT	19.3572	19.5910	19.8902	20.2508	20.4475	20.5187	20.5274	20.5275	20.4893	20.2189	19.7431	19.3360 (92)
Temperature adjustment	0.0000											
adjusted MIT	19.3572	19.5910	19.8902	20.2508	20.4475	20.5187	20.5274	20.5275	20.4893	20.2189	19.7431	19.3360 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9863	0.9705	0.9374	0.8441	0.6827	0.4801	0.3367	0.3819	0.6282	0.8886	0.9716	0.9890 (94)
Useful gains	408.6826	475.9941	515.7085	527.6092	460.0557	323.2659	216.8070	226.6959	340.1525	415.7468	403.0716	389.5558 (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	872.9206	848.3197	770.2025	640.9176	492.1979	327.5883	217.3746	227.7479	355.8966	541.2268	716.4405	864.0259 (97)
Space heating kWh	345.3931	250.2028	189.3436	81.5820	23.9137	0.0000	0.0000	0.0000	0.0000	93.3571	225.6255	353.0057 (98a)
Space heating requirement - total per year (kWh/year)												1562.4236
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	345.3931	250.2028	189.3436	81.5820	23.9137	0.0000	0.0000	0.0000	0.0000	93.3571	225.6255	353.0057 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1562.4236
Space heating per m2												(98c) / (4) = 28.8111 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	520.2728	409.5765	419.3528	0.0000	0.0000	0.0000	0.0000 (100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9489	0.9756	0.9634	0.0000	0.0000	0.0000	0.0000 (101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	493.6632	399.6009	404.0127	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	758.1702	725.3954	668.0032	0.0000	0.0000	0.0000	0.0000 (103)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	190.4450	242.3911	196.4089	0.0000	0.0000	0.0000	0.0000 (104)
Cooled fraction	fC = cooled area / (4) =											
Intermittency factor (Table 10b)	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500 (105)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	47.6113	60.5978	49.1022	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling requirement												157.3113 (107)
Energy for space heating												28.8111 (99)
Energy for space cooling												2.9008 (108)
Total												31.7119 (109)
Fabric Energy Efficiency (TFEE)												31.7 (109)

Building Regulations England Part L (BREL) Compliance Report

Approved Document L1 2021 Edition, England assessed by Array SAP 10 program, Array

Date: Wed 12 Apr 2023 06:33:30

Project Information			
Assessed By	Mark Simons	Building Type	Flat, End-terrace
OCDEA Registration	EES/004083	Assessment Date	2023-04-12

Dwelling Details			
Assessment Type	As designed	Total Floor Area	54 m ²
Site Reference	39-41 Richmond	Plot Reference	Flat 3 - Boiler
Address	39-41 Richmond Street, MANCHESTER, M1 3WB		

Client Details	
Name	Mark Simons
Company	EAL Consult
Address	17 Dobree Avenue, London, NW10 2AD

This report covers items included within the SAP calculations. It is not a complete report of regulations compliance.

1a Target emission rate and dwelling emission rate			
Fuel for main heating system	Mains gas		
Target carbon dioxide emission rate	14.46 kgCO ₂ /m ²		
Dwelling carbon dioxide emission rate	17.67 kgCO ₂ /m ²		FAIL
1b Target primary energy rate and dwelling primary energy			
Target primary energy	76.95 kWh _{PE} /m ²		
Dwelling primary energy	98.06 kWh _{PE} /m ²		FAIL
1c Target fabric energy efficiency and dwelling fabric energy efficiency			
Target fabric energy efficiency	32.5 kWh/m ²		
Dwelling fabric energy efficiency	32.0 kWh/m ²		OK

2a Fabric U-values				
Element	Maximum permitted average U-Value [W/m ² K]	Dwelling average U-Value [W/m ² K]	Element with highest individual U-Value	
External walls	0.26	0.12	Walls (1) (0.12)	OK
Party walls	0.2	0	Party Wall (1) (0)	N/A
Curtain walls	1.6	0	N/A	N/A
Floors	0.18	N/A	N/A	N/A
Roofs	0.16	0.11	Roof (1) (0.11)	OK
Windows, doors, and roof windows	1.6	1.2	FRONT (1.2)	OK
Rooflights	2.2	N/A	N/A	N/A

2b Envelope elements (better than typically expected values are flagged with a subsequent (!))			
Name	Net area [m ²]	U-Value [W/m ² K]	
Exposed wall: Walls (1)	24.67	0.12 (!)	
Sheltered wall: Walls (2)	24.57	0.12 (!)	
Party wall: Party Wall (1)	24.81	0 (!)	
Exposed roof: Roof (1)	7.28	0.11	

2c Openings (better than typically expected values are flagged with a subsequent (!))				
Name	Area [m ²]	Orientation	Frame factor	U-Value [W/m ² K]
FRONT, WINDOWS	8.38	North West	0.7	1.2
REAR, WINDOWS	8.34	South East	0.7	1.2
ENTRANCE DOOR, CORRIDOR DOOR	1.89	North East	N/A	1.2

2d Thermal bridging (better than typically expected values are flagged with a subsequent (!))				
Building part 1 - Main Dwelling: Thermal bridging calculated from linear thermal transmittances for each junction				
Main element	Junction detail	Source	Psi value [W/mK]	Drawing / reference
External wall	E2: Other lintels (including other steel lintels)	Calculated by person with suitable expertise	0.16	
External wall	E3: Sill	Calculated by person with suitable expertise	0.16	

Main element	Junction detail	Source	Psi value [W/mK]	Drawing / reference
External wall	E4: Jamb	Calculated by person with suitable expertise	0.16	
External wall	E5: Ground floor (normal)	Calculated by person with suitable expertise	0.16	

3 Air permeability (better than typically expected values are flagged with a subsequent (!))

Maximum permitted air permeability at 50Pa	8 m ³ /hm ²	
Dwelling air permeability at 50Pa	3 m ³ /hm ² , Design value (!)	OK
Air permeability test certificate reference		

4 Space heating

Main heating system 1: Boiler with radiators or underfloor heating - Mains gas

Efficiency	84.1%
Emitter type	Underfloor
Flow temperature	
System type	Combi boiler
Manufacturer	Vaillant
Model	ecoFIT pure 835
Commissioning	

Secondary heating system: N/A

Fuel	N/A
Efficiency	N/A
Commissioning	

5 Hot water

Cylinder/store - type: N/A

Capacity	N/A
Declared heat loss	N/A
Primary pipework insulated	N/A
Manufacturer	
Model	
Commissioning	

Waste water heat recovery system 1 - type: N/A

Efficiency	
Manufacturer	
Model	

6 Controls

Main heating 1 - type: Time and temperature zone control by arrangement of plumbing and electrical services

Function	
Ecodesign class	
Manufacturer	
Model	

Water heating - type: N/A

Manufacturer	
Model	

7 Lighting

Minimum permitted light source efficacy	75 lm/W	
Lowest light source efficacy	100 lm/W	OK
External lights control	N/A	

8 Mechanical ventilation

System type: N/A

Maximum permitted specific fan power	N/A	
Specific fan power	N/A	N/A
Minimum permitted heat recovery efficiency	N/A	
Heat recovery efficiency	N/A	N/A
Manufacturer/Model		
Commissioning		

9 Local generation

N/A

10 Heat networks	
N/A	
11 Supporting documentary evidence	
N/A	
12 Declarations	
a. Assessor Declaration	
This declaration by the assessor is confirmation that the contents of this BREL Compliance Report are a true and accurate reflection based upon the design information submitted for this dwelling for the purpose of carrying out the "As designed" assessment, and that the supporting documentary evidence (SAP Conventions, Appendix 1 (documentary evidence) schedules the minimum documentary evidence required) has been reviewed in the course of preparing this BREL Compliance Report.	
Signed: Name:	Assessor ID: Date:
b. Client Declaration	
N/A	

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Property Reference	39-41 Richmond				Issued on Date	12/04/2023
Assessment Reference	Flat 3 - Boiler		Prop Type Ref	39-41 Richmond		
Property	39-41 , Richmond Street, MANCHESTER, M1 3WB					
SAP Rating	83 B	DER	17.67	TER	14.46	
Environmental	87 B	% DER < TER				-22.20
CO ₂ Emissions (t/year)	0.89	DFEE	32.00	TFEE	32.51	
Compliance Check	See BREL	% DFEE < TFEE				1.56
% DPER < TPER	-27.43	DPER	98.06	TPER	76.95	
Assessor Details	Mr. Mark Simons				Assessor ID	5542-0001
Client	EAL Consult, Mark Simons					

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	54.2300 (1b)	x 2.7500 (2b)	= 149.1325 (1b) - (4)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	54.2300		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 149.1325 (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	2 * 10 = 20.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	Air changes per hour
Pressure test	20.0000 / (5) = 0.1341 (8)
Pressure Test Method	Yes
Measured/design AP50	Blower Door
Infiltration rate	3.0000 (17)
Number of sides sheltered	0.2841 (18)
	0 (19)

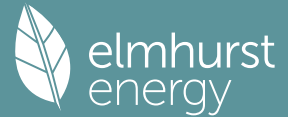
Shelter factor	(20) = 1 - [0.075 x (19)] = 1.0000 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.2841 (21)

	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	0.3622	0.3551	0.3480	0.3125	0.3054	0.2699	0.2699	0.2628	0.2841	0.3054	0.3196	0.3338 (22b)
Effective ac	0.5656	0.5631	0.5606	0.5488	0.5466	0.5364	0.5364	0.5345	0.5404	0.5466	0.5511	0.5557 (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
WINDOWS (Uw = 1.20)			16.7200	1.1450	19.1450		(27)
CORRIDOR DOOR			1.8900	1.2000	2.2680		(26)
EXTERNAL	41.3900	16.7200	24.6700	0.1200	2.9604	70.0000	1726.9000 (29a)
HALLWAY	26.4600	1.8900	24.5700	0.1100	2.7027	70.0000	1719.9000 (29a)
FLAT ROOF	7.2800		7.2800	0.1100	0.8008	9.0000	65.5200 (30)
Total net area of external elements Aum(A, m ²)			75.1300				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	27.8769		(33)
SOLID			24.8100	0.0000	0.0000	180.0000	4465.8000 (32)

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FLOORS	54.2300	40.0000	2169.2000 (32d)
CEILING	46.9500	30.0000	1408.5000 (32b)

Heat capacity $C_m = \text{Sum}(A \times k)$
 Thermal mass parameter (TMP = C_m / TFA) in kJ/m²K
 List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	5.0000	0.1600	0.8000
E3 Sill	7.5000	0.1600	1.2000
E4 Jamb	7.5000	0.1600	1.2000
E5 Ground floor (normal)	9.0000	0.1600	1.4400
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			4.6400 (36)
Point Thermal bridges			0.0000 (36a)
Total fabric heat loss			(33) + (36) + (36a) = 32.5169 (37)

Ventilation heat loss calculated monthly (38)m = $0.33 \times (25)\text{m} \times (5)$												
(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heat transfer coeff	27.8357	27.7103	27.5874	27.0102	26.9022	26.3994	26.3994	26.3063	26.5931	26.9022	27.1207	27.3491 (38)
Average = $\text{Sum}(39)\text{m} / 12 =$	60.3526	60.2273	60.1044	59.5271	59.4191	58.9164	58.9164	58.8233	59.1100	59.4191	59.6376	59.8660 (39)
												59.5266
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.1129	1.1106	1.1083	1.0977	1.0957	1.0864	1.0864	1.0847	1.0900	1.0957	1.0997	1.1039 (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												1.8148 (42)
Hot water usage for mixer showers	54.6471	53.8259	52.6292	50.3395	48.6498	46.7654	45.6943	46.8820	48.1839	50.2071	52.5460	54.4378 (42a)
Hot water usage for baths	24.8666	24.4973	23.9773	23.0184	22.3004	21.5042	21.0742	21.5906	22.1529	23.0048	23.9834	24.7826 (42b)
Hot water usage for other uses	34.9632	33.6918	32.4204	31.1490	29.8776	28.6062	28.6062	29.8776	31.1490	32.4204	33.6918	34.9632 (42c)
Average daily hot water use (litres/day)												105.2228 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	114.4769	112.0150	109.0268	104.5069	100.8277	96.8758	95.3747	98.3502	101.4857	105.6323	110.2212	114.1835 (44)
Energy content (annual)	181.3035	159.5079	167.5702	143.0647	135.7335	119.1201	115.3475	121.7781	125.1421	143.3420	157.0303	178.7837 (45)
Distribution loss (46)m = $0.15 \times (45)\text{m}$	27.1955	23.9262	25.1355	21.4597	20.3600	17.8680	17.3021	18.2667	18.7713	21.5013	23.5545	26.8176 (46)
Water storage loss:												
Total storage 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 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Primary 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 (59)
Combi loss	50.9589	46.0274	50.9589	49.3151	50.9589	47.7744	48.6019	50.1182	49.3151	50.9589	49.3151	50.9589 (61)
Total heat required for water heating calculated for each month	232.2624	205.5353	218.5291	192.3798	186.6924	166.8945	163.9494	171.8962	174.4571	194.3009	206.3453	229.7426 (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	232.2624	205.5353	218.5291	192.3798	186.6924	166.8945	163.9494	171.8962	174.4571	194.3009	206.3453	229.7426 (64)
12Total per year (kWh/year)												2342.9851 (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) = $\text{Sum}(64a)\text{m} =$												0.0000 (64a)
Heat gains from water heating, kWh/month	73.0231	64.5432	68.4568	59.8978	57.8711	51.5510	50.5035	53.0207	53.9385	60.4009	64.5413	72.1853 (65)

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

Metabolic gains (Table 5), Watts												
(66)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382 (66)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	79.7932	88.3425	79.7932	82.4530	79.7932	82.4530	79.7932	79.7932	82.4530	79.7932	82.4530	79.7932 (67)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	158.1990	159.8407	155.7038	146.8971	135.7801	125.3317	118.3516	116.7100	120.8468	129.6535	140.7705	151.2189 (68)
Pumps, fans	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738 (69)
Losses e.g. evaporation (negative values) (Table 5)	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000 (70)
Water heating gains (Table 5)	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906 (71)
Total internal gains	98.1494	96.0464	92.0118	83.1914	77.7838	71.5987	67.8811	71.2644	74.9146	81.1841	89.6407	97.0233 (72)
	389.3631	397.4511	380.7304	365.7629	346.5786	329.6049	316.2473	317.9891	328.4358	343.8523	366.0857	381.2569 (73)

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6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2		Specific data or Table 6b	Specific data or Table 6c	FF	Access factor Table 6d	Gains W
Southeast				8.3400	36.7938		0.6300		0.7000	0.7700	93.7806 (77)
Northwest				8.3800	11.2829		0.6300		0.7000	0.7700	28.8960 (81)
Solar gains	122.6766	218.5617	324.5400	444.8530	537.2765	550.5477	523.6470	452.0720	365.7915	248.4312	103.8546 (83)
Total gains	512.0397	616.0128	705.2704	810.6159	883.8551	880.1526	839.8943	770.0611	694.2273	592.2835	485.1115 (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	53.1866	53.2973	53.4063	53.9242	54.0222	54.4832	54.4832	54.5694	54.3047	54.0222	53.8243	53.6189
alpha	4.5458	4.5532	4.5604	4.5949	4.6015	4.6322	4.6322	4.6380	4.6203	4.6015	4.5883	4.5746
util living area	0.9768	0.9497	0.8950	0.7696	0.5961	0.4235	0.3077	0.3496	0.5656	0.8385	0.9542	0.9812 (86)
MIT	20.0732	20.2812	20.5253	20.7691	20.8891	20.9259	20.9319	20.9309	20.9072	20.7268	20.3597	20.0347 (87)
Th 2	19.9903	19.9922	19.9940	20.0027	20.0044	20.0119	20.0119	20.0133	20.0090	20.0044	20.0011	19.9976 (88)
util rest of house	0.9710	0.9380	0.8724	0.7288	0.5407	0.3602	0.2391	0.2755	0.4924	0.7968	0.9414	0.9765 (89)
MIT 2	18.9268	19.1860	19.4816	19.7636	19.8843	19.9222	19.9258	19.9269	19.9069	19.7288	19.2948	18.8844 (90)
Living area fraction	fLA = Living area / (4) =											0.4955 (91)
MIT	19.4948	19.7287	19.9988	20.2618	20.3822	20.4195	20.4243	20.4244	20.4026	20.2233	19.8225	19.4544 (92)
Temperature adjustment												0.0000
adjusted MIT	19.4948	19.7287	19.9988	20.2618	20.3822	20.4195	20.4243	20.4244	20.4026	20.2233	19.8225	19.4544 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9675	0.9345	0.8725	0.7399	0.5622	0.3865	0.2678	0.3065	0.5222	0.8067	0.9388	0.9733 (94)
Useful gains	495.3907	575.6579	615.3331	599.8044	496.9262	340.1958	224.9411	236.0358	362.5103	477.8107	483.2505	472.1399 (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	917.0479	893.0901	811.3340	676.3343	515.8871	342.8647	225.3130	236.7266	372.5441	571.8071	758.7371	913.2182 (97)
Space heating kWh	313.7130	213.3145	145.8247	55.1015	14.1069	0.0000	0.0000	0.0000	0.0000	69.9333	198.3504	328.1623 (98a)
Space heating requirement - total per year (kWh/year)												1338.5065
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	313.7130	213.3145	145.8247	55.1015	14.1069	0.0000	0.0000	0.0000	0.0000	69.9333	198.3504	328.1623 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1338.5065
Space heating per m2	(98c) / (4) =											24.6820 (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 %)											84.1000 (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	313.7130	213.3145	145.8247	55.1015	14.1069	0.0000	0.0000	0.0000	0.0000	69.9333	198.3504	328.1623 (98)
Space heating efficiency (main heating system 1)	84.1000	84.1000	84.1000	84.1000	84.1000	0.0000	0.0000	0.0000	0.0000	84.1000	84.1000	84.1000 (210)
Space heating fuel (main heating system)	373.0238	253.6438	173.3944	65.5191	16.7739	0.0000	0.0000	0.0000	0.0000	83.1550	235.8506	390.2048 (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	232.2624	205.5353	218.5291	192.3798	186.6924	166.8945	163.9494	171.8962	174.4571	194.3009	206.3453	229.7426 (64)
Efficiency of water heater (217)m	85.2267	84.6617	83.7347	82.2680	81.0496	80.5000	80.5000	80.5000	80.5000	82.6103	84.4973	80.5000 (216)
Fuel for water heating, kWh/month	272.5231	242.7724	260.9779	233.8453	230.3435	207.3224	203.6638	213.5357	216.7169	235.2017	244.2034	269.1916 (219)
Space cooling fuel requirement												

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(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	15.4273	12.3763	11.1435	8.1642	6.3063	5.1523	5.7528	7.4777	9.7128	12.7437	14.3940	15.8561	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)
Annual totals kWh/year													
Space heating fuel - main system 1												1591.5654	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												80.5000	
Water heating fuel used												2830.2978	(219)
Space cooling fuel												0.0000	(221)
Electricity for pumps and fans:													
central heating pump												41.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												86.0000	(231)
Electricity for lighting (calculated in Appendix L)												124.5070	(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												4632.3702	(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	1591.5654	0.2100	334.2287	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2830.2978	0.2100	594.3625	(264)
Space and water heating			928.5913	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	124.5070	0.1443	17.9702	(268)
Total CO2, kg/year			958.4907	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			17.6700	(273)

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

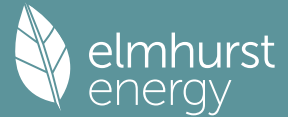
	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	1591.5654	1.1300	1798.4689	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2830.2978	1.1300	3198.2365	(278)
Space and water heating			4996.7054	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	124.5070	1.5338	190.9730	(282)
Total Primary energy kWh/year			5317.7792	(286)
Dwelling Primary energy Rate (DPER)			98.0600	(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	54.2300 (1b)	x 2.7500 (2b)	= 149.1325 (1b) -	

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Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 54.2300 (4)
 Dwelling volume (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 149.1325 (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 2 * 10 = 20.0000 (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)+(6g)+(7a)+(7b)+(7c) = 20.0000 / (5) = 0.1341 (8)
 Pressure test Yes
 Pressure Test Method Blower Door
 Measured/design AP50 5.0000 (17)
 Infiltration rate 0.3841 (18)
 Number of sides sheltered 0 (19)

Shelter factor (20) = 1 - [0.075 x (19)] = 1.0000 (20)
 Infiltration rate adjusted to include shelter factor (21) = (18) x (20) = 0.3841 (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	0.4897	0.4801	0.4705	0.4225	0.4129	0.3649	0.3649	0.3553	0.3841	0.4129	0.4321	0.4513	(22b)
Effective ac	0.6199	0.6153	0.6107	0.5893	0.5853	0.5666	0.5666	0.5631	0.5738	0.5853	0.5934	0.6018	(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 Opaque door			1.8900	1.0000	1.8900			(26)
TER Opening Type (Uw = 1.20)			11.6700	1.1450	13.3626			(27)
EXTERNAL	41.3900	11.6700	29.7200	0.1800	5.3496			(29a)
HALLWAY	26.4600	1.8900	24.5700	0.1800	4.4226			(29a)
FLAT ROOF	7.2800		7.2800	0.1100	0.8008			(30)
Total net area of external elements Aum(A, m2)			75.1300					(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	25.8256		(33)
SOLID			24.8100	0.0000	0.0000			(32)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K								221.7466 (35)
List of Thermal Bridges								
K1 Element				Length	Psi-value	Total		
E2 Other lintels (including other steel lintels)				5.0000	0.0500	0.2500		
E3 Sill				7.5000	0.0500	0.3750		
E4 Jamb				7.5000	0.0500	0.3750		
E5 Ground floor (normal)				9.0000	0.1600	1.4400		
Thermal bridges (Sum(L x Psi) calculated using Appendix K)								2.4400 (36)
Point Thermal bridges							(36a) =	0.0000
Total fabric heat loss							(33) + (36) + (36a) =	28.2656 (37)

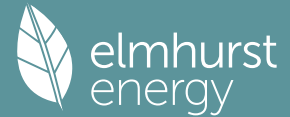
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	30.5087	30.2795	30.0549	28.9998	28.8023	27.8834	27.8834	27.7132	28.2374	28.8023	29.2017	29.6192	(38)
Heat transfer coeff	58.7743	58.5451	58.3205	57.2653	57.0679	56.1490	56.1490	55.9788	56.5029	57.0679	57.4673	57.8848	(39)
Average = Sum(39)m / 12 =												57.2644	
HLP	1.0838	1.0796	1.0754	1.0560	1.0523	1.0354	1.0354	1.0322	1.0419	1.0523	1.0597	1.0674	(40)
HLP (average)												1.0560	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy													1.8148 (42)
Hot water usage for mixer showers	54.6471	53.8259	52.6292	50.3395	48.6498	46.7654	45.6943	46.8820	48.1839	50.2071	52.5460	54.4378	(42a)
Hot water usage for baths	23.6233	23.2725	22.7784	21.8674	21.1853	20.4290	20.0205	20.5110	21.0452	21.8545	22.7842	23.5434	(42b)
Hot water usage for other uses	33.2150	32.0072	30.7994	29.5915	28.3837	27.1759	27.1759	28.3837	29.5915	30.7994	32.0072	33.2150	(42c)
Average daily hot water use (litres/day)												102.4808	(43)

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.4854	109.1055	106.2070	101.7985	98.2189	94.3703	92.8907	95.7768	98.8206	102.8610	107.3374	111.1962	(44)
Energy conte	176.5657	155.3648	163.2361	139.3571	132.2215	116.0393	112.3432	118.5916	121.8557	139.5814	152.9218	174.1064	(45)
Energy content (annual)	Total = Sum(45)m = 1702.1847												
Distribution loss (46)m = 0.15 x (45)m	26.4849	23.3047	24.4854	20.9036	19.8332	17.4059	16.8515	17.7887	18.2784	20.9372	22.9383	26.1160	(46)
Water storage loss:													
Total storage 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	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary 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	(59)
Combi loss	50.9589	46.0274	50.9589	49.3151	50.0513	46.5388	47.3361	48.8068	48.7335	50.9589	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month	227.5246	201.3922	214.1950	188.6721	182.2727	162.5781	159.6793	167.3984	170.5892	190.5403	202.2369	225.0653	(62)
WWHRS	-24.9824	-22.0946	-23.1362	-19.1577	-17.8543	-15.2780	-14.3207	-15.2287	-15.8073	-18.6350	-21.1112	-24.5198	(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	202.5422	179.2976	191.0588	169.5144	164.4184	147.3000	145.3586	152.1698	154.7819	171.9053	181.1257	200.5455	(64)
	Total per year (kWh/year) = Sum(64)m = 2060.0183												(64)
12Total per year (kWh/year)	2060												(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	71.4478	63.1657	67.0157	58.6650	56.4764	50.2178	49.1881	51.6334	52.7004	59.1506	63.1753	70.6301	(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	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	79.8937	88.4538	79.8937	82.5569	79.8937	82.5569	79.8937	79.8937	82.5569	79.8937	82.5569	79.8937	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	158.1990	159.8407	155.7038	146.8971	135.7801	125.3317	118.3516	116.7100	120.8468	129.6535	140.7705	151.2189	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	(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)	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	(71)
Water heating gains (Table 5)	96.0320	93.9965	90.0749	81.4792	75.9092	69.7469	66.1131	69.3998	73.1950	79.5034	87.7434	94.9329	(72)
Total internal gains	387.3463	395.5124	378.8940	364.1546	344.8045	327.8570	314.5799	316.2249	326.8201	342.2722	364.2923	379.2670	(73)

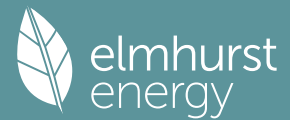
6. Solar gains

[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
Southeast				5.8200	36.7938		0.6300		0.7000		0.7700		65.4440 (77)
Northwest				5.8500	11.2829		0.6300		0.7000		0.7700		20.1720 (81)
Solar gains	85.6160	152.5361	226.5039	310.4803	374.9922	384.2573	365.4808	315.5210	255.2967	173.3835	103.7685		72.4799 (83)
Total gains	472.9623	548.0486	605.3979	674.6349	719.7967	712.1142	680.0607	631.7459	582.1168	515.6557	468.0607		451.7469 (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	56.8338	57.0563	57.2761	58.3314	58.5332	59.4911	59.4911	59.6720	59.1185	58.5332	58.1264	57.7071	
alpha	4.7889	4.8038	4.8184	4.8888	4.9022	4.9661	4.9661	4.9781	4.9412	4.9022	4.8751	4.8471	
util living area	0.9841	0.9677	0.9338	0.8411	0.6852	0.4961	0.3618	0.4048	0.6361	0.8832	0.9680	0.9868	(86)
MIT	19.8647	20.0924	20.3822	20.7224	20.9170	20.9865	20.9977	20.9961	20.9566	20.6944	20.2358	19.8376	(87)
Th 2	20.0141	20.0176	20.0210	20.0370	20.0400	20.0539	20.0539	20.0565	20.0486	20.0400	20.0339	20.0275	(88)
util rest of house	0.9798	0.9594	0.9172	0.8060	0.6289	0.4263	0.2848	0.3232	0.5606	0.8482	0.9584	0.9833	(89)
MIT 2	18.7151	19.0026	19.3614	19.7702	19.9739	20.0464	20.0532	20.0551	20.0207	19.7521	19.1980	18.6908	(90)
Living area fraction	fLA = Living area / (4) =												0.4955 (91)
MIT	19.2847	19.5426	19.8672	20.2420	20.4412	20.5122	20.5212	20.5213	20.4844	20.2190	19.7122	19.2590	(92)
Temperature adjustment													0.0000
adjusted MIT	19.2847	19.5426	19.8672	20.2420	20.4412	20.5122	20.5212	20.5213	20.4844	20.2190	19.7122	19.2590	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9758	0.9546	0.9142	0.8140	0.6532	0.4605	0.3229	0.3636	0.5962	0.8554	0.9545	0.9797	(94)
Useful gains	461.4972	523.1438	553.4791	549.1850	470.1749	327.9178	219.6189	229.7331	347.0444	441.1174	446.7622	442.5545	(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	880.7158	857.2503	779.5816	649.5023	498.8410	331.9640	220.1698	230.7079	360.7375	548.9345	724.7901	871.6888	(97)
Space heating kWh	311.8987	224.5196	168.2202	72.2284	21.3276	0.0000	0.0000	0.0000	0.0000	80.2159	200.1801	319.2759	(98a)
Space heating requirement - total per year (kWh/year)												1397.8663	
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	311.8987	224.5196	168.2202	72.2284	21.3276	0.0000	0.0000	0.0000	0.0000	80.2159	200.1801	319.2759	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1397.8663	
Space heating per m2										(98c) / (4) =		25.7766	(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 %)													92.4000 (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	311.8987	224.5196	168.2202	72.2284	21.3276	0.0000	0.0000	0.0000	0.0000	80.2159	200.1801	319.2759	(98)
Space heating efficiency (main heating system 1)	92.4000	92.4000	92.4000	92.4000	92.4000	0.0000	0.0000	0.0000	0.0000	92.4000	92.4000	92.4000	(210)
Space heating fuel (main heating system)	337.5527	242.9865	182.0565	78.1693	23.0818	0.0000	0.0000	0.0000	0.0000	86.8137	216.6451	345.5367	(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	202.5422	179.2976	191.0588	169.5144	164.4184	147.3000	145.3586	152.1698	154.7819	171.9053	181.1257	200.5455	(64)
Efficiency of water heater													80.3000 (216)
(217)m	85.3031	84.8645	84.1097	82.6900	81.2020	80.3000	80.3000	80.3000	80.3000	82.8500	84.5963	85.3726	(217)
Fuel for water heating, kWh/month	237.4382	211.2752	227.1544	204.9998	202.4808	183.4372	181.0194	189.5016	192.7546	207.4898	214.1059	234.9063	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting	16.6003	13.3174	11.9909	8.7850	6.7858	5.5441	6.1902	8.0463	10.4513	13.7127	15.4885	17.0617	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-14.6530	-21.7766	-32.9837	-39.1560	-44.0652	-41.8269	-41.3350	-38.1121	-32.7416	-25.8155	-16.5075	-12.5425	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	-5.1979	-11.1823	-22.6887	-34.7599	-46.6256	-47.0741	-46.5026	-39.0542	-28.2208	-16.1949	-7.0060	-4.0909	(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													1512.8424 (211)
Space heating fuel - main system 2													0.0000 (213)
Space heating fuel - secondary													0.0000 (215)
Efficiency of water heater													80.3000
Water heating fuel used													2486.5632 (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)													133.9743 (232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation													-670.1134 (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													3549.2664 (238)

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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	1512.8424	0.2100	317.6969 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	2486.5632	0.2100	522.1783 (264)
Space and water heating			839.8752 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	133.9743	0.1443	19.3366 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-361.5156	0.1335	-48.2535
PV Unit electricity exported	-308.5978	0.1253	-38.6761
Total			-86.9297 (269)
Total CO2, kg/year			784.2114 (272)
EPC Target Carbon Dioxide Emission Rate (TER)			14.4600 (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	1512.8424	1.1300	1709.5119 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	2486.5632	1.1300	2809.8164 (278)
Space and water heating			4519.3283 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	133.9743	1.5338	205.4942 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-361.5156	1.4932	-539.8295
PV Unit electricity exported	-308.5978	0.4600	-141.9599
Total			-681.7895 (283)
Total Primary energy kWh/year			4173.1338 (286)
Target Primary Energy Rate (TPER)			76.9500 (287)

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022) CALCULATION OF FABRIC ENERGY EFFICIENCY

1. Overall dwelling characteristics

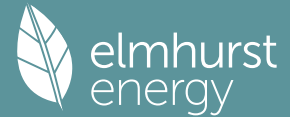
	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	54.2300	2.7500	149.1325
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	54.2300		
Dwelling volume			

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	2 * 10 = 20.0000 (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) = 20.0000 / (5) = 0.1341 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	3.0000 (17)
Infiltration rate	0.2841 (18)
Number of sides sheltered	0 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] = 1.0000 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.2841 (21)

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

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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 infiltr rate	0.3622	0.3551	0.3480	0.3125	0.3054	0.2699	0.2699	0.2628	0.2841	0.3054	0.3196	0.3338 (22b)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.0000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												0.0000 (23c)
Effective ac	0.5656	0.5631	0.5606	0.5488	0.5466	0.5364	0.5364	0.5345	0.5404	0.5466	0.5511	0.5557 (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
WINDOWS (Uw = 1.20)			16.7200	1.1450	19.1450		(27)
CORRIDOR DOOR			1.8900	1.2000	2.2680		(26)
EXTERNAL	41.3900	16.7200	24.6700	0.1200	2.9604	70.0000	1726.9000 (29a)
HALLWAY	26.4600	1.8900	24.5700	0.1100	2.7027	70.0000	1719.9000 (29a)
FLAT ROOF	7.2800		7.2800	0.1100	0.8008	9.0000	65.5200 (30)
Total net area of external elements Aum(A, m2)			75.1300				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	27.8769		(33)
SOLID			24.8100	0.0000	0.0000	180.0000	4465.8000 (32)
FLOORS			54.2300			40.0000	2169.2000 (32d)
CEILING			46.9500			40.0000	1878.0000 (32b)

Heat capacity Cm = Sum(A x k)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K
(28)...(30) + (32) + (32a)...(32e) = 12025.3200 (34)
221.7466 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	5.0000	0.1600	0.8000
E3 Sill	7.5000	0.1600	1.2000
E4 Jamb	7.5000	0.1600	1.2000
E5 Ground floor (normal)	9.0000	0.1600	1.4400
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			4.6400 (36)
Point Thermal bridges			(36a) = 0.0000
Total fabric heat loss			(33) + (36) + (36a) = 32.5169 (37)

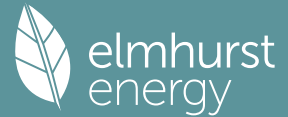
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	27.8357	27.7103	27.5874	27.0102	26.9022	26.3994	26.3994	26.3063	26.5931	26.9022	27.1207	27.3491 (38)
Heat transfer coeff	60.3526	60.2273	60.1044	59.5271	59.4191	58.9164	58.9164	58.8233	59.1100	59.4191	59.6376	59.8660 (39)
Average = Sum(39)m / 12 =												59.5266
HLP	1.1129	1.1106	1.1083	1.0977	1.0957	1.0864	1.0864	1.0847	1.0900	1.0957	1.0997	1.1039 (40)
HLP (average)												1.0977
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

4. Water heating energy requirements (kWh/year)

Assumed occupancy												1.8148 (42)
Hot water usage for mixer showers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (42a)
Hot water usage for baths	23.6233	23.2725	22.7784	21.8674	21.1853	20.4290	20.0205	20.5110	21.0452	21.8545	22.7842	23.5434 (42b)
Hot water usage for other uses	33.2150	32.0072	30.7994	29.5915	28.3837	27.1759	27.1759	28.3837	29.5915	30.7994	32.0072	33.2150 (42c)
Average daily hot water use (litres/day)												52.0980 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	56.8383	55.2796	53.5778	51.4590	49.5691	47.6049	47.1964	48.8948	50.6368	52.6539	54.7914	56.7584 (44)
Energy conte	90.0180	78.7175	82.3470	70.4448	66.7295	58.5358	57.0799	60.5419	62.4402	71.4509	78.0604	88.8700 (45)
Energy content (annual)										Total = Sum(45)m =		865.2358
Distribution loss (46)m = 0.15 x (45)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 (46)
Water storage loss:												
Total storage 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 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Primary 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 (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	76.5153	66.9098	69.9950	59.8781	56.7201	49.7554	48.5179	51.4607	53.0742	60.7332	66.3514	75.5395 (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	76.5153	66.9098	69.9950	59.8781	56.7201	49.7554	48.5179	51.4607	53.0742	60.7332	66.3514	75.5395 (64)
Total per year (kWh/year)										Total per year (kWh/year) = Sum(64)m =		735 (64)
Electric shower(s)	43.7633	38.9934	42.5793	40.6329	41.3954	39.4872	40.8034	41.3954	40.6329	42.5793	41.7787	43.7633 (64a)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =												497.8045 (64a)
Heat gains from water heating, kWh/month	30.0696	26.4758	28.1436	25.1277	24.5289	22.3106	22.3303	23.2140	23.4268	25.8281	27.0325	29.8257 (65)

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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	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	79.7932	88.3425	79.7932	82.4530	79.7932	82.4530	79.7932	79.7932	82.4530	79.7932	82.4530	79.7932 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	158.1990	159.8407	155.7038	146.8971	135.7801	125.3317	118.3516	116.7100	120.8468	129.6535	140.7705	151.2189 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738 (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)	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906 (71)
Water heating gains (Table 5)	40.4162	39.3985	37.8274	34.8997	32.9689	30.9870	30.0139	31.2016	32.5372	34.7152	37.5452	40.0883 (72)
Total internal gains	328.6299	337.8032	323.5459	314.4712	298.7637	288.9932	278.3802	277.9263	286.0584	294.3835	310.9901	321.3219 (73)

6. Solar gains

[Jan]	Area m ²	Solar flux Table 6a W/m ²	Specific data or Table 6b	Specific data or Table 6c	Access factor Table 6d	Gains W
Southeast	8.3400	36.7938	0.6300	0.7000	0.7700	93.7806 (77)
Northwest	8.3800	11.2829	0.6300	0.7000	0.7700	28.8960 (81)

Solar gains	122.6766	218.5617	324.5400	444.8530	537.2765	550.5477	523.6470	452.0720	365.7915	248.4312	148.6862	103.8546 (83)
Total gains	451.3065	556.3649	648.0859	759.3242	836.0402	839.5410	802.0272	729.9983	651.8499	542.8147	459.6763	425.1765 (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, n _{l,m} (see Table 9a)												
tau	55.3475	55.4627	55.5761	56.1150	56.2170	56.6968	56.6968	56.7865	56.5110	56.2170	56.0111	55.7974
alpha	4.6898	4.6975	4.7051	4.7410	4.7478	4.7798	4.7798	4.7858	4.7674	4.7478	4.7341	4.7198
util living area	0.9871	0.9673	0.9220	0.8033	0.6264	0.4437	0.3222	0.3686	0.5989	0.8749	0.9717	0.9900 (86)
MIT	19.7701	20.0559	20.4003	20.7581	20.9366	20.9899	20.9983	20.9967	20.9616	20.6861	20.1618	19.7188 (87)
Th 2	19.9903	19.9922	19.9940	20.0027	20.0044	20.0119	20.0119	20.0133	20.0090	20.0044	20.0011	19.9976 (88)
util rest of house	0.9836	0.9588	0.9031	0.7640	0.5694	0.3775	0.2504	0.2906	0.5228	0.8378	0.9629	0.9872 (89)
MIT 2	18.8902	19.1706	19.4999	19.8256	19.9662	20.0077	20.0115	20.0124	19.9903	19.7761	19.2846	18.8453 (90)
Living area fraction									f _{LA} = Living area / (4) =			0.4955 (91)
MIT	19.3262	19.6093	19.9460	20.2876	20.4470	20.4944	20.5004	20.5001	20.4715	20.2270	19.7192	19.2781 (92)
Temperature adjustment												0.0000
adjusted MIT	19.3262	19.6093	19.9460	20.2876	20.4470	20.4944	20.5004	20.5001	20.4715	20.2270	19.7192	19.2781 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	0.9806	0.9550	0.9021	0.7759	0.5953	0.4101	0.2860	0.3293	0.5591	0.8469	0.9599	0.9846 (94)
Ext temp.	442.5490	531.3227	584.6415	589.1718	497.7231	344.2615	229.3811	240.3768	364.4769	459.7307	441.2448	418.6493 (95)
Heat loss rate W	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)
Space heating kWh	906.8689	885.8991	808.1642	677.8715	519.7390	347.2750	229.7984	241.1841	376.6223	572.0264	752.5796	902.6634 (97)
Space heating requirement - total per year (kWh/year)	345.4540	238.2754	166.3008	63.8638	16.3799	0.0000	0.0000	0.0000	0.0000	83.5480	224.1610	360.1065 (98a)
Solar heating kWh												1498.0895
Solar heating contribution - total per year (kWh/year)	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)
Space heating kWh	345.4540	238.2754	166.3008	63.8638	16.3799	0.0000	0.0000	0.0000	0.0000	83.5480	224.1610	360.1065 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1498.0895
Space heating per m ²										(98c) / (4) =		27.6247 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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
Heat loss rate W												

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Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	553.8138	435.9811	447.0567	0.0000	0.0000	0.0000	0.0000 (100)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.9672	0.9843	0.9752	0.0000	0.0000	0.0000	0.0000 (101)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	535.6682	429.1503	435.9534	0.0000	0.0000	0.0000	0.0000 (102)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	952.5269	910.2554	827.5959	0.0000	0.0000	0.0000	0.0000 (103)
Cooled fraction	0.0000	0.0000	0.0000	0.0000	0.0000	300.1383	357.9422	291.3820	0.0000	0.0000	0.0000	0.0000 (104)
Intermittency factor (Table 10b)									fC = cooled area / (4) =			1.0000 (105)
Space cooling kWh	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500 (106)
Space cooling requirement	0.0000	0.0000	0.0000	0.0000	0.0000	75.0346	89.4856	72.8455	0.0000	0.0000	0.0000	0.0000 (107)
Energy for space heating												237.3656 (107)
Energy for space cooling												27.6247 (99)
Total												4.3770 (108)
Fabric Energy Efficiency (DFEE)												32.0018 (109)
												32.0 (109)

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

1. Overall dwelling characteristics

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	54.2300 (1b)	2.7500 (2b)	149.1325 (1b) - (4)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	54.2300		
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 149.1325 (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	2 * 10 = 20.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)

Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	Air changes per hour
Pressure test		20.0000 / (5) = 0.1341 (8)
Pressure Test Method		Yes
Measured/design AP50		Blower Door
Infiltration rate		5.0000 (17)
Number of sides sheltered		0.3841 (18)
		0 (19)

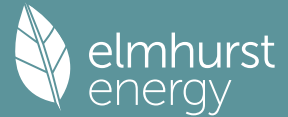
Shelter factor	(20) = 1 - [0.075 x (19)] = 1.0000 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.3841 (21)

	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	0.4897	0.4801	0.4705	0.4225	0.4129	0.3649	0.3649	0.3553	0.3841	0.4129	0.4321	0.4513 (22b)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.0000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												0.0000 (23c)
Effective ac	0.6199	0.6153	0.6107	0.5893	0.5853	0.5666	0.5666	0.5631	0.5738	0.5853	0.5934	0.6018 (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
TER Opaque door			1.8900	1.0000	1.8900		(26)
TER Opening Type (Uw = 1.20)			11.6700	1.1450	13.3626		(27)
EXTERNAL	41.3900	11.6700	29.7200	0.1800	5.3496		(29a)
HALLWAY	26.4600	1.8900	24.5700	0.1800	4.4226		(29a)
FLAT ROOF	7.2800		7.2800	0.1100	0.8008		(30)
Total net area of external elements Aum(A, m ²)			75.1300				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	25.8256		(33)
SOLID			24.8100	0.0000	0.0000		(32)

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

221.7466 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	5.0000	0.0500	0.2500
E3 Sill	7.5000	0.0500	0.3750
E4 Jamb	7.5000	0.0500	0.3750
E5 Ground floor (normal)	9.0000	0.1600	1.4400

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

2.4400 (36)

Point Thermal bridges

(36a) = 0.0000

Total fabric heat loss

(33) + (36) + (36a) = 28.2656 (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	30.5087	30.2795	30.0549	28.9998	28.8023	27.8834	27.8834	27.7132	28.2374	28.8023	29.2017	29.6192 (38)
Average = Sum(39)m / 12 =	58.7743	58.5451	58.3205	57.2653	57.0679	56.1490	56.1490	55.9788	56.5029	57.0679	57.4673	57.8848 (39)
												57.2644

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.0838	1.0796	1.0754	1.0560	1.0523	1.0354	1.0354	1.0322	1.0419	1.0523	1.0597	1.0674 (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												1.8148 (42)
Hot water usage for mixer showers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (42a)
Hot water usage for baths	23.6233	23.2725	22.7784	21.8674	21.1853	20.4290	20.0205	20.5110	21.0452	21.8545	22.7842	23.5434 (42b)
Hot water usage for other uses	33.2150	32.0072	30.7994	29.5915	28.3837	27.1759	27.1759	28.3837	29.5915	30.7994	32.0072	33.2150 (42c)
Average daily hot water use (litres/day)												52.0980 (43)

Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	56.8383	55.2796	53.5778	51.4590	49.5691	47.6049	47.1964	48.8948	50.6368	52.6539	54.7914	56.7584 (44)
Energy content (annual)	90.0180	78.7175	82.3470	70.4448	66.7295	58.5358	57.0799	60.5419	62.4402	71.4509	78.0604	88.8700 (45)
Distribution loss (46)m = 0.15 x (45)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 (46)
Water storage loss:												
Total storage 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 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Primary 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 (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	76.5153	66.9098	69.9950	59.8781	56.7201	49.7554	48.5179	51.4607	53.0742	60.7332	66.3514	75.5395 (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	76.5153	66.9098	69.9950	59.8781	56.7201	49.7554	48.5179	51.4607	53.0742	60.7332	66.3514	75.5395 (64)
Total per year (kWh/year)												735.4504 (64)

12Total per year (kWh/year)

Electric shower(s)

43.7633 38.9934 42.5793 40.6329 41.3954 39.4872 40.8034 41.3954 40.6329 42.5793 41.7787 43.7633 (64a)

Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 497.8045 (64a)

Heat gains from water heating, kWh/month

30.0696 26.4758 28.1436 25.1277 24.5289 22.3106 22.3303 23.2140 23.4268 25.8281 27.0325 29.8257 (65)

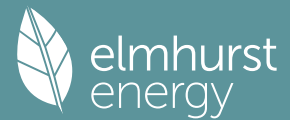
5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts

(66)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382 (66)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	79.8937	88.4538	79.8937	82.5569	79.8937	82.5569	79.8937	79.8937	82.5569	79.8937	82.5569	79.8937 (67)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	158.1990	159.8407	155.7038	146.8971	135.7801	125.3317	118.3516	116.7100	120.8468	129.6535	140.7705	151.2189 (68)
Pumps, fans	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738 (69)
Losses e.g. evaporation (negative values) (Table 5)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (70)
Water heating gains (Table 5)	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906 (71)
Total internal gains	40.4162	39.3985	37.8274	34.8997	32.9689	30.9870	30.0139	31.2016	32.5372	34.7152	37.5452	40.0883 (72)
	328.7304	337.9144	323.6464	314.5751	298.8642	289.0971	278.4807	278.0268	286.1623	294.4840	311.0940	321.4224 (73)

6. Solar gains

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[Jan]				Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	g	Specific data or Table 6c	FF	Access factor Table 6d	Gains W
Southeast				5.8200	36.7938		0.6300		0.7000		65.4440 (77)
Northwest				5.8500	11.2829		0.6300		0.7000		20.1720 (81)
Solar gains	85.6160	152.5361	226.5039	310.4803	374.9922	384.2573	365.4808	315.5210	255.2967	173.3835	72.4799 (83)
Total gains	414.3465	490.4506	550.1503	625.0554	673.8564	673.3543	643.9615	593.5478	541.4590	467.8675	393.9023 (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		Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	56.8338	57.0563	57.2761	58.3314	58.5332	59.4911	59.4911	59.6720	59.1185	58.5332	58.1264	57.7071
alpha	4.7889	4.8038	4.8184	4.8888	4.9022	4.9661	4.9661	4.9781	4.9412	4.9022	4.8751	4.8471
util living area	0.9906	0.9787	0.9520	0.8699	0.7189	0.5224	0.3816	0.4300	0.6737	0.9126	0.9799	0.9925 (86)
MIT	19.7438	19.9816	20.2907	20.6701	20.8975	20.9831	20.9971	20.9949	20.9443	20.6313	20.1328	19.7165 (87)
Th 2	20.0141	20.0176	20.0210	20.0370	20.0400	20.0539	20.0539	20.0565	20.0486	20.0400	20.0339	20.0275 (88)
util rest of house	0.9880	0.9730	0.9392	0.8384	0.6630	0.4498	0.3006	0.3437	0.5970	0.8834	0.9734	0.9904 (89)
MIT 2	18.8830	19.1196	19.4219	19.7854	19.9754	20.0465	20.0532	20.0551	20.0201	19.7623	19.2835	18.8665 (90)
Living area fraction									fLA = Living area / (4) =			
MIT	19.3095	19.5467	19.8524	20.2237	20.4323	20.5106	20.5209	20.5207	20.4780	20.1929	19.7043	19.2877 (92)
Temperature adjustment												0.0000
adjusted MIT	19.3095	19.5467	19.8524	20.2237	20.4323	20.5106	20.5209	20.5207	20.4780	20.1929	19.7043	19.2877 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9856	0.9696	0.9366	0.8451	0.6868	0.4853	0.3408	0.3865	0.6329	0.8886	0.9707	0.9883 (94)
Useful gains	408.3799	475.5285	515.2584	528.2162	462.7718	326.7842	219.4496	229.3925	342.6791	415.7597	402.6896	389.3002 (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	882.1719	857.4918	778.7172	648.4581	498.3343	331.8726	220.1525	230.6734	360.3765	547.4449	724.3364	873.3473 (97)
Space heating kWh	352.5012	256.6794	196.0133	86.5742	26.4585	0.0000	0.0000	0.0000	0.0000	97.9738	231.5858	360.1311 (98a)
Space heating requirement - total per year (kWh/year)												1607.9172
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	352.5012	256.6794	196.0133	86.5742	26.4585	0.0000	0.0000	0.0000	0.0000	97.9738	231.5858	360.1311 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1607.9172
Space heating per m2										(98c) / (4) =		29.6500 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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
Heat loss rate W												
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	527.8004	415.5024	425.4388	0.0000	0.0000	0.0000	0.0000 (100)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.9432	0.9722	0.9588	0.0000	0.0000	0.0000	0.0000 (101)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	497.7985	403.9324	407.9095	0.0000	0.0000	0.0000	0.0000 (102)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	758.1702	725.3954	668.0032	0.0000	0.0000	0.0000	0.0000 (103)
Cooled fraction												
Intermittency factor (Table 10b)									fC = cooled area / (4) =			1.0000 (105)
Space cooling kWh	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500 (106)
Space cooling requirement	0.0000	0.0000	0.0000	0.0000	0.0000	46.8669	59.7921	48.3774	0.0000	0.0000	0.0000	0.0000 (107)
Energy for space heating												155.0364 (107)
Energy for space cooling												29.6500 (99)
Total												2.8589 (108)
Fabric Energy Efficiency (TFEE)												32.5088 (109)
												32.5 (109)

Building Regulations England Part L (BREL) Compliance Report

Approved Document L1 2021 Edition, England assessed by Array SAP 10 program, Array

Date: Wed 12 Apr 2023 06:33:57

Project Information			
Assessed By	Mark Simons	Building Type	Flat, End-terrace
OCDEA Registration	EES/004083	Assessment Date	2023-04-12

Dwelling Details			
Assessment Type	As designed	Total Floor Area	47 m ²
Site Reference	39-41 Richmond	Plot Reference	Flat 4 - Boiler
Address	39-41 Richmond Street, MANCHESTER, M1 3WB		

Client Details	
Name	Mark Simons
Company	EAL Consult
Address	17 Dobree Avenue, London, NW10 2AD

This report covers items included within the SAP calculations. It is not a complete report of regulations compliance.

1a Target emission rate and dwelling emission rate			
Fuel for main heating system	Mains gas		
Target carbon dioxide emission rate	17.83 kgCO ₂ /m ²		
Dwelling carbon dioxide emission rate	21.26 kgCO ₂ /m ²		FAIL
1b Target primary energy rate and dwelling primary energy			
Target primary energy	95.22 kWh _{PE} /m ²		
Dwelling primary energy	117.57 kWh _{PE} /m ²		FAIL
1c Target fabric energy efficiency and dwelling fabric energy efficiency			
Target fabric energy efficiency	44.0 kWh/m ²		
Dwelling fabric energy efficiency	42.3 kWh/m ²		OK

2a Fabric U-values				
Element	Maximum permitted average U-Value [W/m ² K]	Dwelling average U-Value [W/m ² K]	Element with highest individual U-Value	
External walls	0.26	0.12	Walls (1) (0.12)	OK
Party walls	0.2	N/A	N/A	N/A
Curtain walls	1.6	N/A	N/A	N/A
Floors	0.18	N/A	N/A	N/A
Roofs	0.16	0.11	Roof (1) (0.11)	OK
Windows, doors, and roof windows	1.6	1.2	FRONT (1.2)	OK
Rooflights	2.2	N/A	N/A	N/A

2b Envelope elements (better than typically expected values are flagged with a subsequent (!))			
Name	Net area [m ²]	U-Value [W/m ² K]	
Exposed wall: Walls (1)	52.43	0.12 (!)	
Sheltered wall: Walls (2)	20.06	0.12 (!)	
Exposed roof: Roof (1)	46.95	0.11	

2c Openings (better than typically expected values are flagged with a subsequent (!))				
Name	Area [m ²]	Orientation	Frame factor	U-Value [W/m ² K]
FRONT, WINDOWS	8.38	North West	0.7	1.2
REAR, WINDOWS	6.7	South East	0.7	1.2
ENTRANCE DOOR, CORRIDOR DOOR	1.89	North East	N/A	1.2

2d Thermal bridging (better than typically expected values are flagged with a subsequent (!))				
Building part 1 - Main Dwelling: Thermal bridging calculated from linear thermal transmittances for each junction				
Main element	Junction detail	Source	Psi value [W/mK]	Drawing / reference
External wall	E2: Other lintels (including other steel lintels)	Calculated by person with suitable expertise	0.16	
External wall	E3: Sill	Calculated by person with suitable expertise	0.16	

Main element	Junction detail	Source	Psi value [W/mK]	Drawing / reference
External wall	E4: Jamb	Calculated by person with suitable expertise	0.16	
External wall	E5: Ground floor (normal)	Calculated by person with suitable expertise	0.16	

3 Air permeability (better than typically expected values are flagged with a subsequent (!))

Maximum permitted air permeability at 50Pa	8 m ³ /hm ²	
Dwelling air permeability at 50Pa	3 m ³ /hm ² , Design value (!)	OK
Air permeability test certificate reference		

4 Space heating

Main heating system 1: Boiler with radiators or underfloor heating - Mains gas

Efficiency	84.1%
Emitter type	Underfloor
Flow temperature	
System type	Combi boiler
Manufacturer	Vaillant
Model	ecoFIT pure 835
Commissioning	

Secondary heating system: N/A

Fuel	N/A
Efficiency	N/A
Commissioning	

5 Hot water

Cylinder/store - type: N/A

Capacity	N/A
Declared heat loss	N/A
Primary pipework insulated	N/A
Manufacturer	
Model	
Commissioning	

Waste water heat recovery system 1 - type: N/A

Efficiency	
Manufacturer	
Model	

6 Controls

Main heating 1 - type: Time and temperature zone control by arrangement of plumbing and electrical services

Function	
Ecodesign class	
Manufacturer	
Model	

Water heating - type: N/A

Manufacturer	
Model	

7 Lighting

Minimum permitted light source efficacy	75 lm/W	
Lowest light source efficacy	100 lm/W	OK
External lights control	N/A	

8 Mechanical ventilation

System type: N/A

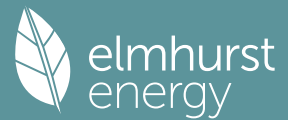
Maximum permitted specific fan power	N/A	
Specific fan power	N/A	N/A
Minimum permitted heat recovery efficiency	N/A	
Heat recovery efficiency	N/A	N/A
Manufacturer/Model		
Commissioning		

9 Local generation

N/A

10 Heat networks	
N/A	
11 Supporting documentary evidence	
N/A	
12 Declarations	
a. Assessor Declaration	
This declaration by the assessor is confirmation that the contents of this BREL Compliance Report are a true and accurate reflection based upon the design information submitted for this dwelling for the purpose of carrying out the "As designed" assessment, and that the supporting documentary evidence (SAP Conventions, Appendix 1 (documentary evidence) schedules the minimum documentary evidence required) has been reviewed in the course of preparing this BREL Compliance Report.	
Signed: Name:	Assessor ID: Date:
b. Client Declaration	
N/A	

Full SAP Calculation Printout



Property Reference	39-41 Richmond				Issued on Date	12/04/2023
Assessment Reference	Flat 4 - Boiler	Prop Type Ref		39-41 Richmond		
Property	39-41 , Richmond Street, MANCHESTER, M1 3WB					
SAP Rating	82 B	DER	21.26	TER	17.83	
Environmental	86 B	% DER < TER				-19.24
CO ₂ Emissions (t/year)	0.93	DFEE	42.29	TFEE	43.99	
Compliance Check	See BREL	% DFEE < TFEE				3.85
% DPER < TPER	-23.47	DPER	117.57	TPER	95.22	
Assessor Details	Mr. Mark Simons				Assessor ID	5542-0001
Client	EALConsult, Mark Simons					

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	46.9500 (1b)	2.7500 (2b)	129.1125 (1b) - (4)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	46.9500		
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 129.1125 (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	2 * 10 = 20.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	Air changes per hour
Pressure test	20.0000 / (5) = 0.1549 (8)
Pressure Test Method	Yes
Measured/design AP50	Blower Door
Infiltration rate	3.0000 (17)
Number of sides sheltered	0.3049 (18)
	0 (19)

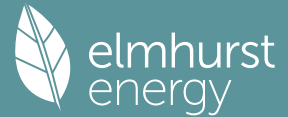
Shelter factor	(20) = 1 - [0.075 x (19)] = 1.0000 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.3049 (21)

	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	0.3888	0.3811	0.3735	0.3354	0.3278	0.2897	0.2897	0.2820	0.3049	0.3278	0.3430	0.3583 (22b)
Effective ac	0.5756	0.5726	0.5698	0.5562	0.5537	0.5420	0.5420	0.5398	0.5465	0.5537	0.5588	0.5642 (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
WINDOWS (Uw = 1.20)			15.0800	1.1450	17.2672		(27)
CORRIDOR DOOR			1.8900	1.2000	2.2680		(26)
EXTERNAL	67.5100	15.0800	52.4300	0.1200	6.2916	70.0000	3670.1000 (29a)
HALLWAY	21.9500	1.8900	20.0600	0.1100	2.2066	70.0000	1404.2000 (29a)
FLAT ROOF	46.9500		46.9500	0.1100	5.1645	9.0000	422.5500 (30)
Total net area of external elements Aum(A, m ²)			136.4100				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) = 33.1979		(33)
FLOORS			46.9500			40.0000	1878.0000 (32d)

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Heat capacity $C_m = \text{Sum}(A \times k)$
Thermal mass parameter (TMP = C_m / TFA) in kJ/m2K

$$(28) \dots (30) + (32) + (32a) \dots (32e) = 7374.8500 \quad (34)$$

$$157.0788 \quad (35)$$

List of Thermal Bridges

K1 Element
E2 Other lintels (including other steel lintels)
E3 Sill
E4 Jamb
E5 Ground floor (normal)

Length	Psi-value	Total
5.0000	0.1600	0.8000
7.5000	0.1600	1.2000
7.5000	0.1600	1.2000
9.0000	0.1600	1.4400

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

Point Thermal bridges

Total fabric heat loss

$$(33) + (36) + (36a) = 37.8379 \quad (37)$$

Ventilation heat loss calculated monthly (38)m = $0.33 \times (25)\text{m} \times (5)$

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	24.5231	24.3981	24.2756	23.7000	23.5923	23.0910	23.0910	22.9981	23.2841	23.5923	23.8101	24.0379	(38)
Heat transfer coeff	62.3610	62.2360	62.1134	61.5379	61.4302	60.9289	60.9289	60.8360	61.1220	61.4302	61.6480	61.8758	(39)
Average = Sum(39)m / 12 =													61.5373

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3282	1.3256	1.3230	1.3107	1.3084	1.2977	1.2977	1.2958	1.3019	1.3084	1.3131	1.3179	(40)
HLP (average)													1.3107
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy

Hot water usage for mixer showers
51.0601 50.2928 49.1746 47.0352 45.4564 43.6957 42.6949 43.8046 45.0211 46.9115 49.0968 50.8645 (42a)

Hot water usage for baths
23.2429 22.8977 22.4116 21.5153 20.8442 20.1000 19.6981 20.1808 20.7063 21.5026 22.4174 23.1643 (42b)

Hot water usage for other uses
32.6569 31.4694 30.2819 29.0944 27.9068 26.7193 26.7193 27.9068 29.0944 30.2819 31.4694 32.6569 (42c)

Average daily hot water use (litres/day)
25.4098 22.3551 23.4851 20.0506 19.0232 16.6948 16.1660 17.0673 17.5387 20.0894 22.0079 25.0566 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	106.9599	104.6599	101.8681	97.6449	94.2074	90.5151	89.1123	91.8922	94.8218	98.6960	102.9836	106.6857	(44)
Energy conte	169.3984	149.0343	156.5675	133.6710	126.8213	111.2988	107.7736	113.7818	116.9247	133.9296	146.7190	167.0440	(45)
Energy content (annual)													
Distribution loss (46)m = $0.15 \times (45)\text{m}$	25.4098	22.3551	23.4851	20.0506	19.0232	16.6948	16.1660	17.0673	17.5387	20.0894	22.0079	25.0566	(46)

Water storage loss:
Total storage 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 (56)

If cylinder contains dedicated solar storage
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (57)

Primary 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 (59)

Combi loss
50.9589 46.0274 50.9589 48.1536 48.0071 44.6376 45.4107 46.8273 46.7614 50.2944 49.3151 50.9589 (61)

Total heat required for water heating calculated for each month
220.3573 195.0617 207.5264 181.8246 174.8284 155.9364 153.1843 160.6091 163.6861 184.2240 196.0341 218.0029 (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
220.3573 195.0617 207.5264 181.8246 174.8284 155.9364 153.1843 160.6091 163.6861 184.2240 196.0341 218.0029 (64)

Total per year (kWh/year) = Sum(64)m = 2211.2751 (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
69.0647 61.0607 64.7984 56.4840 54.1699 48.1662 47.1874 49.5393 50.5678 57.1052 61.1128 68.2819 (65)

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

Metabolic gains (Table 5), Watts

(66)m
80.0414 80.0414 80.0414 80.0414 80.0414 80.0414 80.0414 80.0414 80.0414 80.0414 80.0414 80.0414 (66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
70.2708 77.7998 70.2708 72.6132 70.2708 72.6132 70.2708 70.2708 72.6132 70.2708 72.6132 70.2708 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
139.3197 140.7654 137.1223 129.3665 119.5763 110.3748 104.2276 102.7819 106.4250 114.1808 123.9711 133.1726 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
31.0041 31.0041 31.0041 31.0041 31.0041 31.0041 31.0041 31.0041 31.0041 31.0041 31.0041 31.0041 (69)

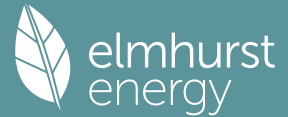
Pumps, fans
3.0000 3.0000 3.0000 3.0000 3.0000 3.0000 3.0000 3.0000 3.0000 3.0000 3.0000 3.0000 (70)

Losses e.g. evaporation (negative values) (Table 5)
-64.0331 -64.0331 -64.0331 -64.0331 -64.0331 -64.0331 -64.0331 -64.0331 -64.0331 -64.0331 -64.0331 -64.0331 (71)

Water heating gains (Table 5)
92.8289 90.8642 87.0946 78.4500 72.8089 66.8976 63.4239 66.5850 70.2331 76.7543 84.8790 91.7767 (72)

Total internal gains
352.4319 359.4419 344.5002 330.4422 312.6684 296.8979 284.9348 286.6502 296.2837 311.2183 331.4757 345.2325 (73)

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6. Solar gains

[Jan]			Area m2		Solar flux Table 6a W/m2		Specific data or Table 6b		g Specific data or Table 6c		FF Access factor Table 6d		Gains W	

Southeast			6.7000		36.7938		0.6300		0.7000		0.7700		75.3393 (77)	
Northwest			8.3800		11.2829		0.6300		0.7000		0.7700		28.8960 (81)	

Solar gains	104.2353	187.1494	281.5603	391.5991	477.6277	491.3303	466.5550	399.7509	319.2536	213.7139	126.5978	88.0727	(83)	
Total gains	456.6672	546.5913	626.0605	722.0413	790.2961	788.2282	751.4898	686.4011	615.5373	524.9322	458.0735	433.3052	(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	32.8502	32.9162	32.9811	33.2896	33.3479	33.6223	33.6223	33.6736	33.5161	33.3479	33.2301	33.1078
alpha	3.1900	3.1944	3.1987	3.2193	3.2232	3.2415	3.2415	3.2449	3.2344	3.2232	3.2153	3.2072
util living area	0.9582	0.9288	0.8783	0.7746	0.6285	0.4678	0.3485	0.3943	0.6056	0.8320	0.9331	0.9639 (86)
MIT	19.5037	19.7570	20.0896	20.4730	20.7309	20.8556	20.8907	20.8837	20.7907	20.4337	19.9049	19.4587 (87)
Th 2	19.8188	19.8209	19.8229	19.8325	19.8342	19.8426	19.8426	19.8442	19.8394	19.8342	19.8306	19.8268 (88)
util rest of house	0.9497	0.9151	0.8555	0.7354	0.5703	0.3921	0.2603	0.3007	0.5261	0.7919	0.9178	0.9565 (89)
MIT 2	18.1063	18.4220	18.8299	19.2862	19.5653	19.6897	19.7151	19.7132	19.6366	19.2587	18.6198	18.0560 (90)
Living area fraction									fLA = Living area / (4) =			0.4175 (91)
MIT	18.6897	18.9793	19.3558	19.7816	20.0519	20.1764	20.2059	20.2018	20.1184	19.7493	19.1563	18.6416 (92)
Temperature adjustment												0.0000
adjusted MIT	18.6897	18.9793	19.3558	19.7816	20.0519	20.1764	20.2059	20.2018	20.1184	19.7493	19.1563	18.6416 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9395	0.9033	0.8450	0.7335	0.5817	0.4146	0.2885	0.3303	0.5463	0.7886	0.9070	0.9469 (94)
Useful gains	429.0400	493.7560	529.0446	529.6115	459.7405	326.7639	216.7982	226.7477	336.2849	413.9546	415.4611	410.3066 (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	897.3552	876.2412	798.5165	669.6330	513.0590	339.7652	219.7006	231.2874	367.8552	562.0400	743.2455	893.5859 (97)
Space heating kWh	348.4265	257.0300	200.4870	100.8155	39.6690	0.0000	0.0000	0.0000	0.0000	110.1755	236.0048	359.5598 (98a)
Space heating requirement - total per year (kWh/year)												1652.1682
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	348.4265	257.0300	200.4870	100.8155	39.6690	0.0000	0.0000	0.0000	0.0000	110.1755	236.0048	359.5598 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1652.1682
Space heating per m2										(98c) / (4) =		35.1900 (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 %)												84.1000 (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	348.4265	257.0300	200.4870	100.8155	39.6690	0.0000	0.0000	0.0000	0.0000	110.1755	236.0048	359.5598 (98)
Space heating efficiency (main heating system 1)	84.1000	84.1000	84.1000	84.1000	84.1000	0.0000	0.0000	0.0000	0.0000	84.1000	84.1000	84.1000 (210)
Space heating fuel (main heating system)	414.3003	305.6243	238.3912	119.8758	47.1688	0.0000	0.0000	0.0000	0.0000	131.0054	280.6240	427.5384 (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	220.3573	195.0617	207.5264	181.8246	174.8284	155.9364	153.1843	160.6091	163.6861	184.2240	196.0341	218.0029 (64)
Efficiency of water heater (217)m	85.5588	85.1740	84.5080	83.3703	81.9631	80.5000	80.5000	80.5000	80.5000	83.5168	84.9806	80.5000 (216)
Fuel for water heating, kWh/month	257.5506	229.0156	245.5700	218.0928	213.3014	193.7098	190.2910	199.5144	203.3368	220.5832	230.6809	254.5384 (219)
Space cooling fuel requirement (221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041 (231)

Full SAP Calculation Printout



Lighting	13.5862	10.8994	9.8137	7.1899	5.5537	4.5374	5.0663	6.5853	8.5537	11.2229	12.6762	13.9638 (232)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)												
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235c)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)												
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235d)
Annual totals kWh/year												
Space heating fuel - main system 1												1964.5282 (211)
Space heating fuel - main system 2												0.0000 (213)
Space heating fuel - secondary												0.0000 (215)
Efficiency of water heater												80.5000
Water heating fuel used												2656.1849 (219)
Space cooling fuel												0.0000 (221)
Electricity for pumps and fans:												
central heating pump												41.0000 (230c)
main heating flue fan												45.0000 (230e)
Total electricity for the above, kWh/year												86.0000 (231)
Electricity for lighting (calculated in Appendix L)												109.6485 (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												4816.3616 (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	1964.5282	0.2100	412.5509 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	2656.1849	0.2100	557.7988 (264)
Space and water heating			970.3497 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	109.6485	0.1443	15.8257 (268)
Total CO2, kg/year			998.1047 (272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			21.2600 (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	1964.5282	1.1300	2219.9168 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	2656.1849	1.1300	3001.4890 (278)
Space and water heating			5221.4058 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	109.6485	1.5338	168.1825 (282)
Total Primary energy kWh/year			5519.6891 (286)
Dwelling Primary energy Rate (DPER)			117.5700 (287)

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

1. Overall dwelling characteristics

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	46.9500 (1b)	x 2.7500 (2b)	= 129.1125 (1b) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	46.9500		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 129.1125 (5)

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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											2 * 10 =	20.0000 (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)+(6g)+(7a)+(7b)+(7c) =											20.0000 / (5) =	0.1549 (8)
Pressure test											Yes	
Pressure Test Method											Blower Door	
Measured/design AP50											5.0000 (17)	
Infiltration rate											0.4049 (18)	
Number of sides sheltered											0 (19)	
Shelter factor											(20) = 1 - [0.075 x (19)] =	1.0000 (20)
Infiltration rate adjusted to include shelter factor											(21) = (18) x (20) =	0.4049 (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	0.5163	0.5061	0.4960	0.4454	0.4353	0.3847	0.3847	0.3745	0.4049	0.4353	0.4555	0.4758 (22b)
Effective ac	0.6333	0.6281	0.6230	0.5992	0.5947	0.5740	0.5740	0.5701	0.5820	0.5947	0.6037	0.6132 (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 Opaque door			1.8900	1.0000	1.8900		(26)					
TER Opening Type (Uw = 1.20)			9.8500	1.1450	11.2786		(27)					
EXTERNAL	67.5100	9.8500	57.6600	0.1800	10.3788		(29a)					
HALLWAY	21.9500	1.8900	20.0600	0.1800	3.6108		(29a)					
FLAT ROOF	46.9500		46.9500	0.1100	5.1645		(30)					
Total net area of external elements Aum(A, m2)			136.4100				(31)					
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	32.3227		(33)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							157.0788 (35)					
List of Thermal Bridges												
K1 Element				Length	Psi-value	Total						
E2 Other lintels (including other steel lintels)				5.0000	0.0500	0.2500						
E3 Sill				7.5000	0.0500	0.3750						
E4 Jamb				7.5000	0.0500	0.3750						
E5 Ground floor (normal)				9.0000	0.1600	1.4400						
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							2.4400 (36)					
Point Thermal bridges						(36a) =	0.0000					
Total fabric heat loss						(33) + (36) + (36a) =	34.7627 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 26.9813	Feb 26.7608	Mar 26.5447	Apr 25.5297	May 25.3398	Jun 24.4557	Jul 24.4557	Aug 24.2920	Sep 24.7962	Oct 25.3398	Nov 25.7240	Dec 26.1256 (38)
Heat transfer coeff	61.7440	61.5236	61.3075	60.2924	60.1025	59.2184	59.2184	59.0547	59.5589	60.1025	60.4867	60.8883 (39)
Average = Sum(39)m / 12 =												60.2915
HLP	Jan 1.3151	Feb 1.3104	Mar 1.3058	Apr 1.2842	May 1.2801	Jun 1.2613	Jul 1.2613	Aug 1.2578	Sep 1.2686	Oct 1.2801	Nov 1.2883	Dec 1.2969 (40)
HLP (average)												1.2842
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.6008 (42)											
Hot water usage for mixer showers	51.0601 50.2928 49.1746 47.0352 45.4564 43.6957 42.6949 43.8046 45.0211 46.9115 49.0968 50.8645 (42a)											
Hot water usage for baths	22.0807 21.7528 21.2910 20.4396 19.8020 19.0950 18.7132 19.1717 19.6710 20.4275 21.2965 22.0061 (42b)											
Hot water usage for other uses	31.0241 29.8959 28.7678 27.6396 26.5115 25.3833 25.3833 26.5115 27.6396 28.7678 29.8959 31.0241 (42c)											
Average daily hot water use (litres/day)	95.7517 (43)											
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	104.1649	101.9415	99.2334	95.1144	91.7699	88.1741	86.7914	89.4879	92.3317	96.1068	100.2893	103.8946 (44)

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Energy content (annual)	164.9718	145.1634	152.5181	130.2069	123.5399	108.4203	104.9667	110.8047	113.8543	130.4160	142.8805	162.6739 (45)
Distribution loss (46)m = 0.15 x (45)m										Total = Sum(45)m =		1590.4163
Water storage loss:	24.7458	21.7745	22.8777	19.5310	18.5310	16.2630	15.7450	16.6207	17.0781	19.5624	21.4321	24.4011 (46)
Total storage 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 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Primary 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 (59)
Combi loss	50.9589	46.0274	50.5683	46.9057	46.7649	43.4831	44.2280	45.6020	45.5335	48.9750	49.3151	50.9589 (61)
Total heat required for water heating calculated for each month												
WWHRS	215.9307	191.1907	203.0863	177.1126	170.3048	151.9034	149.1947	156.4067	159.3877	179.3910	192.1955	213.6328 (62)
PV diverter	-23.3425	-20.6443	-21.6176	-17.9002	-16.6823	-14.2752	-13.3807	-14.2291	-14.7697	-17.4118	-19.7255	-22.9103 (63a)
Solar input	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000 (63b)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63c)
Output from w/h												
	192.5881	170.5464	181.4688	159.2124	153.6225	137.6282	135.8140	142.1776	144.6180	161.9792	172.4701	190.7225 (64)
										Total per year (kWh/year) = Sum(64)m =		1942.8479 (64)
12Total per year (kWh/year)												1943 (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	67.5928	59.7737	63.3543	55.0202	52.7682	46.9205	45.9584	48.2431	49.2399	55.6071	59.8365	66.8288 (65)

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

Metabolic gains (Table 5), Watts												
(66)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	80.0414	80.0414	80.0414	80.0414	80.0414	80.0414	80.0414	80.0414	80.0414	80.0414	80.0414	80.0414 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5												
	70.4683	78.0185	70.4683	72.8173	70.4683	72.8173	70.4683	70.4683	72.8173	70.4683	72.8173	70.4683 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5												
	139.3197	140.7654	137.1223	129.3665	119.5763	110.3748	104.2276	102.7819	106.4250	114.1808	123.9711	133.1726 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												
	31.0041	31.0041	31.0041	31.0041	31.0041	31.0041	31.0041	31.0041	31.0041	31.0041	31.0041	31.0041 (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)												
	-64.0331	-64.0331	-64.0331	-64.0331	-64.0331	-64.0331	-64.0331	-64.0331	-64.0331	-64.0331	-64.0331	-64.0331 (71)
Water heating gains (Table 5)												
	90.8506	88.9489	85.1537	76.4170	70.9251	65.1674	61.7721	64.8428	68.3888	74.7407	83.1063	89.8237 (72)
Total internal gains												
	350.6511	357.7453	342.7567	328.6132	310.9821	295.3719	283.4805	285.1055	294.6435	309.4023	329.9071	343.4770 (73)

6. Solar gains

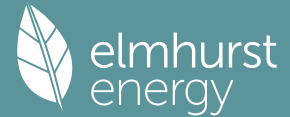
[Jan]		Area	Solar flux									
		m2	Table 6a	Specific data	Specific data							
			W/m2	or Table 6b	or Table 6c							
Southeast		4.3800	36.7938	0.6300	0.7000							49.2517 (77)
Northwest		5.4700	11.2829	0.6300	0.7000							18.8617 (81)
Solar gains	68.1134	122.2874	183.9602	255.8289	312.0093	320.9519	304.7714	261.1462	208.5787	139.6406	82.7251	57.5526 (83)
Total gains	418.7645	480.0327	526.7170	584.4421	622.9914	616.3238	588.2519	546.2517	503.2222	449.0428	412.6322	401.0296 (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	33.1784	33.2973	33.4147	33.9772	34.0846	34.5935	34.5935	34.6894	34.3957	34.0846	33.8681	33.6447
alpha	3.2119	3.2198	3.2276	3.2651	3.2723	3.3062	3.3062	3.3126	3.2930	3.2723	3.2579	3.2430
util living area	0.9664	0.9475	0.9155	0.8424	0.7228	0.5608	0.4257	0.4713	0.6843	0.8739	0.9474	0.9703 (86)
MIT	19.0573	19.3368	19.7357	20.2586	20.6602	20.8952	20.9681	20.9553	20.7911	20.2722	19.5956	19.0255 (87)
Th 2	19.8290	19.8327	19.8363	19.8532	19.8564	19.8713	19.8713	19.8740	19.8655	19.8564	19.8500	19.8433 (88)
util rest of house	0.9594	0.9369	0.8981	0.8100	0.6674	0.4786	0.3237	0.3663	0.6060	0.8405	0.9348	0.9641 (89)
MIT 2	17.6122	17.9642	18.4619	19.1033	19.5577	19.8020	19.8578	19.8536	19.7108	19.1382	18.3059	17.5812 (90)
Living area fraction										fLA = Living area / (4) =		0.4175 (91)
MIT	18.2155	18.5372	18.9936	19.5856	20.0180	20.2584	20.3214	20.3135	20.1618	19.6116	18.8443	18.1842 (92)
Temperature adjustment												0.0000
adjusted MIT	18.2155	18.5372	18.9936	19.5856	20.0180	20.2584	20.3214	20.3135	20.1618	19.6116	18.8443	18.1842 (93)

8. Space heating requirement

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9464	0.9217	0.8826	0.8014	0.6759	0.5080	0.3654	0.4086	0.6280	0.8320	0.9207	0.9520	(94)
Useful gains	396.3350	442.4472	464.8974	468.3600	421.0671	313.0976	214.9291	223.2007	316.0400	373.6163	379.9310	381.7818	(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	859.1990	839.0105	765.9536	644.2621	499.9295	335.0802	220.3726	231.1111	361.0347	541.6191	710.3734	851.4729	(97)
Space heating kWh	344.3708	266.4905	223.9858	126.6495	58.6737	0.0000	0.0000	0.0000	0.0000	124.9941	237.9185	349.4502	(98a)
Space heating requirement - total per year (kWh/year)												1732.5332	
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	344.3708	266.4905	223.9858	126.6495	58.6737	0.0000	0.0000	0.0000	0.0000	124.9941	237.9185	349.4502	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1732.5332	
Space heating per m2										(98c) / (4) =		36.9017	(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 %)													92.4000 (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	344.3708	266.4905	223.9858	126.6495	58.6737	0.0000	0.0000	0.0000	0.0000	124.9941	237.9185	349.4502	(98)
Space heating efficiency (main heating system 1)	92.4000	92.4000	92.4000	92.4000	92.4000	0.0000	0.0000	0.0000	0.0000	92.4000	92.4000	92.4000	(210)
Space heating fuel (main heating system)	372.6957	288.4097	242.4089	137.0665	63.4997	0.0000	0.0000	0.0000	0.0000	135.2750	257.4875	378.1929	(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	192.5881	170.5464	181.4688	159.2124	153.6225	137.6282	135.8140	142.1776	144.6180	161.9792	172.4701	190.7225	(64)
Efficiency of water heater	85.6115	85.3336	84.8336	83.8957	82.5059	80.3000	80.3000	80.3000	80.3000	83.8323	85.0710	85.6608	(216)
Fuel for water heating, kWh/month	224.9560	199.8584	213.9114	189.7742	186.1958	171.3926	169.1332	177.0581	180.0972	193.2181	202.7366	222.6485	(217)
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	(219)
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting	14.6419	11.7463	10.5762	7.7486	5.9852	4.8900	5.4599	7.0970	9.2184	12.0950	13.6612	15.0489	(232)
Electricity generated by PVs (Appendix M) (negative quantity)	-12.7429	-18.9689	-28.7804	-34.2319	-38.5894	-36.6626	-36.2408	-33.3883	-28.6372	-22.5236	-14.3695	-10.9048	(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)	-4.4431	-9.5655	-19.4184	-29.7613	-39.9268	-40.3041	-39.8052	-33.4190	-24.1415	-13.8471	-5.9876	-3.4957	(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												1875.0359	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												80.3000	
Water heating fuel used												2330.9801	(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)												118.1687	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-580.1553	(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												3830.0294	(238)

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

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	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	1875.0359	0.2100	393.7575 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	2330.9801	0.2100	489.5058 (264)
Space and water heating			883.2634 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	118.1687	0.1443	17.0554 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-316.0400	0.1334	-42.1704
PV Unit electricity exported	-264.1153	0.1253	-33.0999
Total			-75.2703 (269)
Total CO2, kg/year			836.9778 (272)
EPC Target Carbon Dioxide Emission Rate (TER)			17.8300 (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	1875.0359	1.1300	2118.7905 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	2330.9801	1.1300	2634.0075 (278)
Space and water heating			4752.7980 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	118.1687	1.5338	181.2512 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-316.0400	1.4931	-471.8738
PV Unit electricity exported	-264.1153	0.4600	-121.4924
Total			-593.3662 (283)
Total Primary energy kWh/year			4470.7838 (286)
Target Primary Energy Rate (TPER)			95.2200 (287)

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022) CALCULATION OF FABRIC ENERGY EFFICIENCY

1. Overall dwelling characteristics

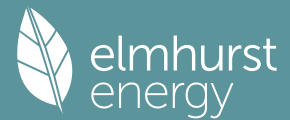
	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	46.9500 (1b)	x 2.7500 (2b)	= 129.1125 (1b) - (4)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	46.9500		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	129.1125 (5)

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	2 * 10 = 20.0000 (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)+(7a)+(7b)+(7c) =	20.0000 / (5) = 0.1549 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	3.0000 (17)
Infiltration rate	0.3049 (18)
Number of sides sheltered	0 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] = 1.0000 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.3049 (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												

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0.3888 0.3811 0.3735 0.3354 0.3278 0.2897 0.2897 0.2820 0.3049 0.3278 0.3430 0.3583 (22b)
 If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)
 If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0.0000 (23b)
 Effective ac 0.5756 0.5726 0.5698 0.5562 0.5537 0.5420 0.5420 0.5398 0.5465 0.5537 0.5588 0.5642 (23c)
 0.5642 (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
WINDOWS (Uw = 1.20)			15.0800	1.1450	17.2672		(27)
CORRIDOR DOOR			1.8900	1.2000	2.2680		(26)
EXTERNAL	67.5100	15.0800	52.4300	0.1200	6.2916	70.0000	3670.1000 (29a)
HALLWAY	21.9500	1.8900	20.0600	0.1100	2.2066	70.0000	1404.2000 (29a)
FLAT ROOF	46.9500		46.9500	0.1100	5.1645	9.0000	422.5500 (30)
Total net area of external elements Aum(A, m2)			136.4100				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	33.1979		(33)
FLOORS			46.9500			40.0000	1878.0000 (32d)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		7374.8500 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							157.0788 (35)
List of Thermal Bridges							
K1 Element				Length	Psi-value	Total	
E2 Other lintels (including other steel lintels)				5.0000	0.1600	0.8000	
E3 Sill				7.5000	0.1600	1.2000	
E4 Jamb				7.5000	0.1600	1.2000	
E5 Ground floor (normal)				9.0000	0.1600	1.4400	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							4.6400 (36)
Point Thermal bridges						(36a) =	0.0000
Total fabric heat loss						(33) + (36) + (36a) =	37.8379 (37)

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

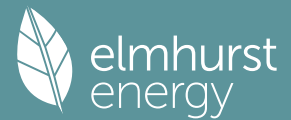
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	24.5231	24.3981	24.2756	23.7000	23.5923	23.0910	23.0910	22.9981	23.2841	23.5923	23.8101	24.0379 (38)
Heat transfer coeff	62.3610	62.2360	62.1134	61.5379	61.4302	60.9289	60.9289	60.8360	61.1220	61.4302	61.6480	61.8758 (39)
Average = Sum(39)m / 12 =												61.5373
HLP	Jan 1.3282	Feb 1.3256	Mar 1.3230	Apr 1.3107	May 1.3084	Jun 1.2977	Jul 1.2977	Aug 1.2958	Sep 1.3019	Oct 1.3084	Nov 1.3131	Dec 1.3179 (40)
HLP (average)												1.3107
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

4. Water heating energy requirements (kWh/year)

Assumed occupancy												1.6008 (42)
Hot water usage for mixer showers												0.0000 (42a)
Hot water usage for baths												22.0061 (42b)
Hot water usage for other uses												31.0241 (42c)
Average daily hot water use (litres/day)												48.6760 (43)
Daily hot water use	Jan 53.1048	Feb 51.6487	Mar 50.0588	Apr 48.0792	May 46.3135	Jun 44.4784	Jul 44.0965	Aug 45.6832	Sep 47.3107	Oct 49.1953	Nov 51.1924	Dec 53.0302 (44)
Energy conte	84.1051	73.5471	76.9385	65.8180	62.3468	54.6913	53.3309	56.5654	58.3388	66.7575	72.9330	83.0324 (45)
Energy content (annual)										Total = Sum(45)m =		808.4049
Distribution loss (46)m = 0.15 x (45)m												0.0000 (46)
Water storage loss:												
Total storage loss												0.0000 (56)
If cylinder contains dedicated solar storage												0.0000 (57)
Primary loss												0.0000 (59)
Combi loss												0.0000 (61)
Total heat required for water heating calculated for each month	71.4893	62.5151	65.3977	55.9453	52.9948	46.4876	45.3313	48.0806	49.5880	56.7439	61.9930	70.5776 (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	71.4893	62.5151	65.3977	55.9453	52.9948	46.4876	45.3313	48.0806	49.5880	56.7439	61.9930	70.5776 (64)
12Total per year (kWh/year)										Total per year (kWh/year) = Sum(64)m =		687.1442 (64)
Electric shower(s)	40.8906	36.4339	39.7844	37.9658	38.6782	36.8952	38.1251	38.6782	37.9658	39.7844	39.0363	40.8906 (64a)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =												465.1285 (64a)
Heat gains from water heating, kWh/month	28.0950	24.7372	26.2955	23.4778	22.9183	20.8457	20.8641	21.6897	21.8884	24.1321	25.2573	27.8671 (65)

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

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Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m	80.0414	80.0414	80.0414	80.0414	80.0414	80.0414	80.0414	80.0414	80.0414	80.0414	80.0414	80.0414 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	70.2708	77.7998	70.2708	72.6132	70.2708	72.6132	70.2708	70.2708	72.6132	70.2708	72.6132	70.2708 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	139.3197	140.7654	137.1223	129.3665	119.5763	110.3748	104.2276	102.7819	106.4250	114.1808	123.9711	133.1726 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	31.0041	31.0041	31.0041	31.0041	31.0041	31.0041	31.0041	31.0041	31.0041	31.0041	31.0041	31.0041 (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)	-64.0331	-64.0331	-64.0331	-64.0331	-64.0331	-64.0331	-64.0331	-64.0331	-64.0331	-64.0331	-64.0331	-64.0331 (71)
Water heating gains (Table 5)	37.7621	36.8114	35.3435	32.6080	30.8041	28.9524	28.0431	29.1528	30.4006	32.4356	35.0796	37.4557 (72)
Total internal gains	294.3651	302.3891	289.7490	281.6002	267.6636	258.9528	249.5540	249.2180	256.4512	263.8996	278.6763	287.9115 (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	
Southeast		6.7000		36.7938		0.6300		0.7000		0.7700		75.3393 (77)	
Northwest		8.3800		11.2829		0.6300		0.7000		0.7700		28.8960 (81)	
Solar gains	104.2353	187.1494	281.5603	391.5991	477.6277	491.3303	466.5550	399.7509	319.2536	213.7139	126.5978	88.0727 (83)	
Total gains	398.6004	489.5385	571.3093	673.1993	745.2913	750.2830	716.1090	648.9689	575.7048	477.6136	405.2742	375.9842 (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	32.8502	32.9162	32.9811	33.2896	33.3479	33.6223	33.6223	33.6736	33.5161	33.3479	33.2301	33.1078
alpha	3.1900	3.1944	3.1987	3.2193	3.2232	3.2415	3.2415	3.2449	3.2344	3.2232	3.2153	3.2072
util living area	0.9706	0.9454	0.8999	0.7999	0.6540	0.4878	0.3645	0.4147	0.6348	0.8603	0.9504	0.9752 (86)
MIT	18.9768	19.3322	19.8037	20.3601	20.7393	20.9254	20.9780	20.9667	20.8249	20.2918	19.5364	18.9148 (87)
Th 2	19.8188	19.8209	19.8229	19.8325	19.8342	19.8426	19.8426	19.8442	19.8394	19.8342	19.8306	19.8268 (88)
util rest of house	0.9644	0.9344	0.8800	0.7627	0.5957	0.4100	0.2728	0.3172	0.5547	0.8242	0.9384	0.9699 (89)
MIT 2	18.0156	18.3633	18.8177	19.3380	19.6613	19.8057	19.8357	19.8328	19.7415	19.2950	18.5756	17.9604 (90)
Living area fraction	fLA = Living area / (4) = 0.4175 (91)											
MIT	18.4168	18.7678	19.2293	19.7647	20.1113	20.2732	20.3126	20.3062	20.1937	19.7111	18.9767	18.3588 (92)
Temperature adjustment	0.0000											
adjusted MIT	18.4168	18.7678	19.2293	19.7647	20.1113	20.2732	20.3126	20.3062	20.1937	19.7111	18.9767	18.3588 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9547	0.9220	0.8682	0.7604	0.6103	0.4398	0.3107	0.3571	0.5806	0.8198	0.9273	0.9610 (94)
Useful gains	380.5299	451.3741	496.0115	511.8780	454.8810	329.9565	222.4837	231.7702	334.2670	391.5531	375.8229	361.3296 (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	880.3395	863.0760	790.6625	668.5896	516.7092	345.6603	226.2044	237.6347	372.4615	559.6961	732.1737	876.0888 (97)
Space heating kWh	371.8583	276.6637	219.2204	112.8323	46.0002	0.0000	0.0000	0.0000	0.0000	125.0983	256.5726	382.9809 (98a)
Space heating requirement - total per year (kWh/year)	1791.2267											
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	371.8583	276.6637	219.2204	112.8323	46.0002	0.0000	0.0000	0.0000	0.0000	125.0983	256.5726	382.9809 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)	1791.2267											
Space heating per m2	(98c) / (4) = 38.1518 (99)											

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	572.7312	450.8735	462.3537	0.0000	0.0000	0.0000	0.0000 (100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8890	0.9284	0.9047	0.0000	0.0000	0.0000	0.0000 (101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	509.1754	418.5846	418.2736	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	852.3438	813.7968	736.6580	0.0000	0.0000	0.0000	0.0000 (103)
Space cooling kWh												

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Cooled fraction	0.0000	0.0000	0.0000	0.0000	0.0000	247.0812	294.0378	236.8780	0.0000	0.0000	0.0000	0.0000 (104)
Intermittency factor (Table 10b)	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	1.0000 (105)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	61.7703	73.5095	59.2195	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling requirement												194.4993 (107)
Energy for space heating												38.1518 (99)
Energy for space cooling												4.1427 (108)
Total												42.2945 (109)
Fabric Energy Efficiency (DFEE)												42.3 (109)

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

1. Overall dwelling characteristics

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	46.9500 (1b)	x 2.7500 (2b)	= 129.1125 (1b) - (4)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	46.9500		
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 129.1125 (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	2 * 10 = 20.0000 (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) =	20.0000 / (5) = 0.1549 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	5.0000 (17)
Infiltration rate	0.4049 (18)
Number of sides sheltered	0 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] = 1.0000 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.4049 (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	0.5163	0.5061	0.4960	0.4454	0.4353	0.3847	0.3847	0.3745	0.4049	0.4353	0.4555	0.4758 (22b)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.0000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												0.0000 (23c)
Effective ac	0.6333	0.6281	0.6230	0.5992	0.5947	0.5740	0.5740	0.5701	0.5820	0.5947	0.6037	0.6132 (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
TER Opaque door			1.8900	1.0000	1.8900		(26)
TER Opening Type (Uw = 1.20)			9.8500	1.1450	11.2786		(27)
EXTERNAL	67.5100	9.8500	57.6600	0.1800	10.3788		(29a)
HALLWAY	21.9500	1.8900	20.0600	0.1800	3.6108		(29a)
FLAT ROOF	46.9500		46.9500	0.1100	5.1645		(30)
Total net area of external elements Aum(A, m ²)			136.4100				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) = 32.3227		(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							157.0788 (35)
List of Thermal Bridges							
K1 Element				Length	Psi-value	Total	
E2 Other lintels (including other steel lintels)				5.0000	0.0500	0.2500	
E3 Sill				7.5000	0.0500	0.3750	

4. Water heating energy requirements (kwh/year)												

Assumed occupancy											1.6008 (42)	
Hot water usage for mixer showers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (42a)
Hot water usage for baths	22.0807	21.7528	21.2910	20.4396	19.8020	19.0950	18.7132	19.1717	19.6710	20.4275	21.2965	22.0061 (42b)
Hot water usage for other uses	31.0241	29.8959	28.7678	27.6396	26.5115	25.3833	25.3833	26.5115	27.6396	28.7678	29.8959	31.0241 (42c)
Average daily hot water use (litres/day)											48.6760 (43)	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	53.1048	51.6487	50.0588	48.0792	46.3135	44.4784	44.0965	45.6832	47.3107	49.1953	51.1924	53.0302 (44)
Energy content (annual)	84.1051	73.5471	76.9385	65.8180	62.3468	54.6913	53.3309	56.5654	58.3388	66.7575	72.9330	83.0324 (45)
Distribution loss (46)m = 0.15 x (45)m											808.4049	
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (46)
Water storage loss:												
Total storage 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 (56)
If cylinder contains dedicated solar storage												
Primary 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 (57)
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 (59)
Total heat required for water heating calculated for each month												
	71.4893	62.5151	65.3977	55.9453	52.9948	46.4876	45.3313	48.0806	49.5880	56.7439	61.9930	70.5776 (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	71.4893	62.5151	65.3977	55.9453	52.9948	46.4876	45.3313	48.0806	49.5880	56.7439	61.9930	70.5776 (64)
Total per year (kwh/year) = Sum(64)m =											687.1442 (64)	
Electric shower(s)											687 (64)	
	40.8906	36.4339	39.7844	37.9658	38.6782	36.8952	38.1251	38.6782	37.9658	39.7844	39.0363	40.8906 (64a)
Total Energy used by instantaneous electric shower(s) (kwh/year) = Sum(64a)m =											465.1285 (64a)	
Heat gains from water heating, kWh/month												
	28.0950	24.7372	26.2955	23.4778	22.9183	20.8457	20.8641	21.6897	21.8884	24.1321	25.2573	27.8671 (65)

Metabolic gains (Table 5), Watts												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m	80.0414	80.0414	80.0414	80.0414	80.0414	80.0414	80.0414	80.0414	80.0414	80.0414	80.0414	80.0414 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	70.4683	78.0185	70.4683	72.8173	70.4683	72.8173	70.4683	70.4683	72.8173	70.4683	72.8173	70.4683 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	139.3197	140.7654	137.1223	129.3665	119.5763	110.3748	104.2276	102.7819	106.4250	114.1808	123.9711	133.1726 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	31.0041	31.0041	31.0041	31.0041	31.0041	31.0041	31.0041	31.0041	31.0041	31.0041	31.0041	31.0041 (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)	-64.0331	-64.0331	-64.0331	-64.0331	-64.0331	-64.0331	-64.0331	-64.0331	-64.0331	-64.0331	-64.0331	-64.0331 (71)
Water heating gains (Table 5)	37.7621	36.8114	35.3435	32.6080	30.8041	28.9524	28.0431	29.1528	30.4006	32.4356	35.0796	37.4557 (72)
Total internal gains	294.5626	302.6078	289.9465	281.8043	267.8611	259.1569	249.7515	249.4155	256.6553	264.0972	278.8804	288.1091 (73)

[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
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Southeast			4.3800		36.7938		0.6300		0.7000		0.7700		49.2517 (77)
Northwest			5.4700		11.2829		0.6300		0.7000		0.7700		18.8617 (81)

Solar gains	68.1134	122.2874	183.9602	255.8289	312.0093	320.9519	304.7714	261.1462	208.5787	139.6406	82.7251	57.5526 (83)
Total gains	362.6760	424.8952	473.9068	537.6331	579.8705	580.1088	554.5229	510.5617	465.2340	403.7377	361.6055	345.6617 (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	33.1784	33.2973	33.4147	33.9772	34.0846	34.5935	34.5935	34.6894	34.3957	34.0846	33.8681	33.6447	
alpha	3.2119	3.2198	3.2276	3.2651	3.2723	3.3062	3.3062	3.3126	3.2930	3.2723	3.2579	3.2430	
util living area	0.9771	0.9615	0.9341	0.8666	0.7517	0.5873	0.4486	0.4991	0.7174	0.8998	0.9625	0.9802 (86)	
MIT	18.9013	19.1930	19.6128	20.1762	20.6150	20.8797	20.9628	20.9471	20.7579	20.1811	19.4618	18.8688 (87)	
Th 2	19.8290	19.8327	19.8363	19.8532	19.8564	19.8713	19.8713	19.8740	19.8655	19.8564	19.8500	19.8433 (88)	
util rest of house	0.9722	0.9533	0.9197	0.8374	0.6981	0.5037	0.3422	0.3899	0.6405	0.8712	0.9531	0.9759 (89)	
MIT 2	17.9489	18.2379	18.6496	19.1964	19.5892	19.8085	19.8589	19.8548	19.7231	19.2164	18.5183	17.9269 (90)	
Living area fraction									fLA = Living area / (4) =			0.4175 (91)	
MIT	18.3465	18.6366	19.0517	19.6054	20.0174	20.2557	20.3197	20.3108	20.1551	19.6191	18.9122	18.3201 (92)	
Temperature adjustment												0.0000	
adjusted MIT	18.3465	18.6366	19.0517	19.6054	20.0174	20.2557	20.3197	20.3108	20.1551	19.6191	18.9122	18.3201 (93)	

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9637	0.9425	0.9078	0.8301	0.7063	0.5335	0.3857	0.4338	0.6619	0.8641	0.9432	0.9682 (94)	
Useful gains	349.5137	400.4712	430.1961	446.3017	409.5496	309.5111	213.8843	221.5065	307.9175	348.8662	341.0504	334.6667 (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	867.2878	845.1268	769.5137	645.4547	499.8970	334.9207	220.2774	230.9505	360.6329	542.0711	714.4803	859.7498 (97)	
Space heating kWh	385.2239	298.8085	252.4524	143.3902	67.2185	0.0000	0.0000	0.0000	0.0000	143.7444	268.8695	390.6618 (98a)	
Space heating requirement - total per year (kWh/year)												1950.3693	
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	385.2239	298.8085	252.4524	143.3902	67.2185	0.0000	0.0000	0.0000	0.0000	143.7444	268.8695	390.6618 (98c)	
Space heating requirement after solar contribution - total per year (kWh/year)												1950.3693	
Space heating per m2										(98c) / (4) =		41.5414 (99)	

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	556.6530	438.2162	448.8157	0.0000	0.0000	0.0000	0.0000 (100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8250	0.8819	0.8527	0.0000	0.0000	0.0000	0.0000 (101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	459.2551	386.4684	382.7093	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	653.2175	624.7177	574.6767	0.0000	0.0000	0.0000	0.0000 (103)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	139.6530	177.2575	142.8237	0.0000	0.0000	0.0000	0.0000 (104)
Cooled fraction									fC = cooled area / (4) =			1.0000 (105)
Intermittency factor (Table 10b)	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500 (106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	34.9132	44.3144	35.7059	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling requirement												114.9335 (107)
Energy for space heating												41.5414 (99)
Energy for space cooling												2.4480 (108)
Total												43.9894 (109)
Fabric Energy Efficiency (TFEE)												44.0 (109)

Building Regulations England Part L (BREL) Compliance Report

Approved Document L1 2021 Edition, England assessed by Array SAP 10 program, Array

Date: Wed 12 Apr 2023 06:34:34

Project Information			
Assessed By	Mark Simons	Building Type	Flat, End-terrace
OCDEA Registration	EES/004083	Assessment Date	2023-04-12

Dwelling Details			
Assessment Type	As designed	Total Floor Area	45 m ²
Site Reference	39-41 Richmond	Plot Reference	Flat 1 - Heatpump
Address	39-41 Richmond Street, MANCHESTER, M1 3WB		

Client Details	
Name	Mark Simons
Company	EAL Consult
Address	17 Dobree Avenue, London, NW10 2AD

This report covers items included within the SAP calculations. It is not a complete report of regulations compliance.

1a Target emission rate and dwelling emission rate			
Fuel for main heating system	Electricity		
Target carbon dioxide emission rate	17.7 kgCO ₂ /m ²		
Dwelling carbon dioxide emission rate	4.32 kgCO ₂ /m ²		OK
1b Target primary energy rate and dwelling primary energy			
Target primary energy	94.6 kWh _{PE} /m ²		
Dwelling primary energy	45.52 kWh _{PE} /m ²		OK
1c Target fabric energy efficiency and dwelling fabric energy efficiency			
Target fabric energy efficiency	43.9 kWh/m ²		
Dwelling fabric energy efficiency	43.6 kWh/m ²		OK

2a Fabric U-values				
Element	Maximum permitted average U-Value [W/m ² K]	Dwelling average U-Value [W/m ² K]	Element with highest individual U-Value	
External walls	0.26	0.12	Walls (1) (0.12)	OK
Party walls	0.2	0	Party Wall (1) (0)	N/A
Curtain walls	1.6	0	N/A	N/A
Floors	0.18	0.1	UNHEATED (0.1)	OK
Roofs	0.16	N/A	N/A	N/A
Windows, doors, and roof windows	1.6	1.2	FRONT (1.2)	OK
Rooflights	2.2	N/A	N/A	N/A

2b Envelope elements (better than typically expected values are flagged with a subsequent (!))		
Name	Net area [m ²]	U-Value [W/m ² K]
Exposed wall: Walls (1)	14.87	0.12 (!)
Sheltered wall: Walls (2)	21.49	0.12 (!)
Party wall: Party Wall (1)	24.81	0 (!)
Ground floor: UNHEATED, UNHEATED	44.76	0.1 (!)

2c Openings (better than typically expected values are flagged with a subsequent (!))				
Name	Area [m ²]	Orientation	Frame factor	U-Value [W/m ² K]
FRONT, WINDOWS	8.38	North West	0.7	1.2
REAR, WINDOWS	4.53	South East	0.7	1.2
ENTRANCE DOOR, CORRIDOR DOOR	1.89	North East	N/A	1.2

2d Thermal bridging (better than typically expected values are flagged with a subsequent (!))				
Building part 1 - Main Dwelling: Thermal bridging calculated from linear thermal transmittances for each junction				
Main element	Junction detail	Source	Psi value [W/mK]	Drawing / reference
External wall	E2: Other lintels (including other steel lintels)	Calculated by person with suitable expertise	0.16	
External wall	E3: Sill	Calculated by person with suitable expertise	0.16	

Main element	Junction detail	Source	Psi value [W/mK]	Drawing / reference
External wall	E4: Jamb	Calculated by person with suitable expertise	0.16	
External wall	E5: Ground floor (normal)	Calculated by person with suitable expertise	0.16	

3 Air permeability (better than typically expected values are flagged with a subsequent (!))

Maximum permitted air permeability at 50Pa	8 m ³ /hm ²	
Dwelling air permeability at 50Pa	3 m ³ /hm ² , Design value (!)	OK
Air permeability test certificate reference		

4 Space heating

Main heating system 1: Heat pump with radiators or underfloor heating - Electricity

Efficiency	343.8%
Emitter type	Underfloor
Flow temperature	45°C
System type	Heat Pump
Manufacturer	Midea
Model	MHC-V6W/D2N8-B
Commissioning	

Secondary heating system: N/A

Fuel	N/A
Efficiency	N/A
Commissioning	

5 Hot water

Cylinder/store - type: Cylinder

Capacity	200 litres
Declared heat loss	2.1 kWh/day
Primary pipework insulated	Yes
Manufacturer	
Model	
Commissioning	

Waste water heat recovery system 1 - type: N/A

Efficiency	
Manufacturer	
Model	

6 Controls

Main heating 1 - type: Time and temperature zone control by arrangement of plumbing and electrical services

Function	
Ecodesign class	
Manufacturer	
Model	

Water heating - type: Cylinder thermostat and HW separately timed

Manufacturer	
Model	

7 Lighting

Minimum permitted light source efficacy	75 lm/W	
Lowest light source efficacy	100 lm/W	OK
External lights control	N/A	

8 Mechanical ventilation

System type: N/A

Maximum permitted specific fan power	N/A	
Specific fan power	N/A	N/A
Minimum permitted heat recovery efficiency	N/A	
Heat recovery efficiency	N/A	N/A
Manufacturer/Model		
Commissioning		

9 Local generation

N/A

10 Heat networks	
N/A	
11 Supporting documentary evidence	
N/A	
12 Declarations	
a. Assessor Declaration	
This declaration by the assessor is confirmation that the contents of this BREL Compliance Report are a true and accurate reflection based upon the design information submitted for this dwelling for the purpose of carrying out the "As designed" assessment, and that the supporting documentary evidence (SAP Conventions, Appendix 1 (documentary evidence) schedules the minimum documentary evidence required) has been reviewed in the course of preparing this BREL Compliance Report.	
Signed: Name:	Assessor ID: Date:
b. Client Declaration	
N/A	

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Property Reference	39-41 Richmond				Issued on Date	12/04/2023
Assessment Reference	Flat 1 - Heatpump		Prop Type Ref	39-41 Richmond		
Property	39-41 , Richmond Street, MANCHESTER, M1 3WB					
SAP Rating	86 B	DER	4.32	TER	17.70	
Environmental	97 A	% DER < TER				75.59
CO ₂ Emissions (t/year)	0.18	DFEE	43.58	TFEE	43.90	
Compliance Check	See BREL	% DFEE < TFEE				0.74
% DPER < TPER	51.88	DPER	45.52	TPER	94.60	
Assessor Details	Mr. Mark Simons				Assessor ID	5542-0001
Client	EAI Consult, Mark Simons					

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	44.7600 (1b)	2.7500 (2b)	123.0900 (1b) - (4)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	44.7600		
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 123.0900 (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	2 * 10 = 20.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	Air changes per hour
Pressure test	20.0000 / (5) = 0.1625 (8)
Pressure Test Method	Yes
Measured/design AP50	Blower Door
Infiltration rate	3.0000 (17)
Number of sides sheltered	0.3125 (18)
	0 (19)

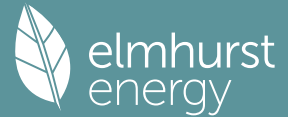
Shelter factor	(20) = 1 - [0.075 x (19)] = 1.0000 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.3125 (21)

	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	0.3984	0.3906	0.3828	0.3437	0.3359	0.2969	0.2969	0.2890	0.3125	0.3359	0.3515	0.3672 (22b)
Effective ac	0.5794	0.5763	0.5733	0.5591	0.5564	0.5441	0.5441	0.5418	0.5488	0.5564	0.5618	0.5674 (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
WINDOWS (U _w = 1.20)			12.9100	1.1450	14.7824		(27)
CORRIDOR DOOR			1.8900	1.2000	2.2680		(26)
UNHEATED			44.7600	0.1000	4.4760	110.0000	4923.6000 (28a)
EXTERNAL	27.7800	12.9100	14.8700	0.1200	1.7844	70.0000	1040.9000 (29a)
HALLWAY	23.3800	1.8900	21.4900	0.1100	2.3639	70.0000	1504.3000 (29a)
Total net area of external elements A _{um} (A, m ²)			95.9200				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		25.6747		(33)
SOLID			24.8100	0.0000	0.0000	180.0000	4465.8000 (32)

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CEILING 44.7600 30.0000 1342.8000 (32b)

Heat capacity $C_m = \text{Sum}(A \times k)$ (28)...(30) + (32) + (32a)...(32e) = 13277.4000 (34)
Thermal mass parameter (TMP = C_m / TFA) in kJ/m²K 296.6354 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element	5.0000	0.1600	0.8000
E2 Other lintels (including other steel lintels)	15.0000	0.1600	2.4000
E3 Sill	15.0000	0.1600	2.4000
E4 Jamb	25.0000	0.1600	4.0000
E5 Ground floor (normal)			

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 9.6000 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 35.2747 (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	23.5337	23.4085	23.2858	22.7095	22.6016	22.0997	22.0997	22.0067	22.2930	22.6016	22.8198	23.0479	(38)
Heat transfer coeff	58.8085	58.6833	58.5606	57.9842	57.8764	57.3744	57.3744	57.2814	57.5678	57.8764	58.0945	58.3226	(39)
Average = Sum(39)m / 12 =												57.9837	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3139	1.3111	1.3083	1.2954	1.2930	1.2818	1.2818	1.2797	1.2861	1.2930	1.2979	1.3030	(40)
HLP (average)												1.2954	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy													1.5378 (42)
Hot water usage for mixer showers	50.0033	49.2519	48.1569	46.0618	44.5156	42.7914	41.8113	42.8980	44.0893	45.9406	48.0807	49.8118	(42a)
Hot water usage for baths	22.7645	22.4264	21.9504	21.0725	20.4152	19.6864	19.2927	19.7654	20.2802	21.0601	21.9560	22.6876	(42b)
Hot water usage for other uses	31.9775	30.8147	29.6519	28.4891	27.3262	26.1634	26.1634	27.3262	28.4891	29.6519	30.8147	31.9775	(42c)
Average daily hot water use (litres/day)												96.2782	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	104.7454	102.4930	99.7591	95.6233	92.2571	88.6412	87.2674	89.9897	92.8585	96.6526	100.8514	104.4768	(44)
Energy conte	165.8911	145.9487	153.3260	130.9036	124.1958	108.9946	105.5424	111.4261	114.5039	131.1566	143.6813	163.5855	(45)
Energy content (annual)												1599.1556	
Distribution loss (46)m = 0.15 x (45)m	24.8837	21.8923	22.9989	19.6355	18.6294	16.3492	15.8314	16.7139	17.1756	19.6735	21.5522	24.5378	(46)

Water storage loss:
Store volume 200.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): 2.1000 (48)
Temperature factor from Table 2b 0.5400 (49)
Enter (49) or (54) in (55) 1.1340 (55)
Total storage loss

35.1540	31.7520	35.1540	34.0200	35.1540	34.0200	35.1540	35.1540	34.0200	35.1540	34.0200	35.1540	35.1540	(56)
If cylinder contains dedicated solar storage													
35.1540	31.7520	35.1540	34.0200	35.1540	34.0200	35.1540	35.1540	34.0200	35.1540	34.0200	35.1540	35.1540	(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	224.3075	198.7119	211.7424	187.4356	182.6122	165.5266	163.9588	169.8425	171.0359	189.5730	200.2133	222.0019	(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	224.3075	198.7119	211.7424	187.4356	182.6122	165.5266	163.9588	169.8425	171.0359	189.5730	200.2133	222.0019	(64)

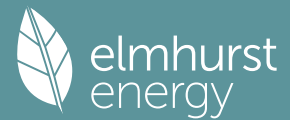
12Total per year (kWh/year) = Sum(64)m = 2286.9616 (64)
Electric shower(s) 2287 (64)
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (64a)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 0.0000 (64a)

Heat gains from water heating, kWh/month 101.8919 90.7385 97.7140 88.7510 88.0282 81.4663 81.8260 83.7823 83.2981 90.3427 92.9996 101.1253 (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	76.8902	76.8902	76.8902	76.8902	76.8902	76.8902	76.8902	76.8902	76.8902	76.8902	76.8902	76.8902	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	67.4175	74.6408	67.4175	69.6647	67.4175	69.6647	67.4175	67.4175	69.6647	67.4175	69.6647	67.4175	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	133.6626	135.0496	131.5545	124.1136	114.7208	105.8930	99.9954	98.6084	102.1036	109.5445	118.9372	127.7651	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	30.6890	30.6890	30.6890	30.6890	30.6890	30.6890	30.6890	30.6890	30.6890	30.6890	30.6890	30.6890	(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)	-61.5121	-61.5121	-61.5121	-61.5121	-61.5121	-61.5121	-61.5121	-61.5121	-61.5121	-61.5121	-61.5121	-61.5121	(71)
Water heating gains (Table 5)	136.9515	135.0275	131.3361	123.2653	118.3175	113.1477	109.9811	112.6106	115.6919	121.4284	129.1662	135.9211	(72)
Total internal gains													

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384.0986 390.7850 376.3750 363.1107 346.5228 334.7724 323.4611 324.7035 333.5272 344.4574 363.8352 377.1707 (73)

6. Solar gains

[Jan]	Area m2		Solar flux Table 6a W/m2		Specific data or Table 6b		Specific data or Table 6c		Access factor Table 6d		Gains W	
Southeast	4.5300		36.7938		0.6300		0.7000		0.7700		50.9384 (77)	
Northwest	8.3800		11.2829		0.6300		0.7000		0.7700		28.8960 (81)	
Solar gains	79.8344	145.5856	224.6908	321.1351	398.7021	412.9755	391.0126	330.5212	257.6760	167.7770	97.3711	67.1906 (83)
Total gains	463.9330	536.3706	601.0658	684.2458	745.2249	747.7479	714.4737	655.2248	591.2033	512.2344	461.2063	444.3613 (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	62.7149	62.8487	62.9804	63.6064	63.7249	64.2824	64.2824	64.3868	64.0665	63.7249	63.4856	63.2374
alpha	5.1810	5.1899	5.1987	5.2404	5.2483	5.2855	5.2855	5.2925	5.2711	5.2483	5.2324	5.2158
util living area	0.9891	0.9764	0.9451	0.8501	0.6804	0.4852	0.3524	0.4002	0.6423	0.8994	0.9764	0.9911 (86)
Living	20.1419	20.2976	20.5112	20.7573	20.8932	20.9346	20.9403	20.9395	20.9144	20.7248	20.3945	20.1162
Non living	18.8599	19.0563	19.3188	19.6061	19.7379	19.7769	19.7796	19.7811	19.7624	19.5824	19.1885	18.8344
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	20.5610	20.2976	20.5112	20.7573	20.8932	20.9346	20.9403	20.9395	20.9144	20.7248	20.3945	20.2398 (87)
Th 2	19.8300	19.8322	19.8343	19.8444	19.8463	19.8551	19.8551	19.8567	19.8517	19.8463	19.8425	19.8385 (88)
util rest of house	0.9851	0.9681	0.9264	0.8065	0.6104	0.4012	0.2612	0.3018	0.5481	0.8577	0.9665	0.9878 (89)
MIT 2	19.4433	19.0563	19.3188	19.6061	19.7379	19.7769	19.7796	19.7811	19.7624	19.5824	19.1885	19.0153 (90)
Living area fraction	fLA = Living area / (4) =											
MIT	20.1125	19.7995	20.0328	20.2954	20.4296	20.4701	20.4746	20.4747	20.4522	20.2664	19.9106	19.7485 (92)
Temperature adjustment	0.0000											
adjusted MIT	20.1125	19.7995	20.0328	20.2954	20.4296	20.4701	20.4746	20.4747	20.4522	20.2664	19.9106	19.7485 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9862	0.9678	0.9300	0.8247	0.6468	0.4467	0.3107	0.3552	0.5988	0.8746	0.9672	0.9875 (94)
Useful gains	457.5100	519.1168	558.9932	564.3189	482.0324	334.0416	221.9822	232.7649	354.0202	447.9856	446.0963	438.8065 (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	929.9101	874.3527	792.4860	660.7530	505.2393	336.7922	222.3024	233.4031	365.6806	559.4571	744.2239	906.8297 (97)
Space heating kWh	351.4657	238.7185	173.7186	69.4326	17.2659	0.0000	0.0000	0.0000	0.0000	82.9349	214.6518	348.2093 (98a)
Space heating requirement - total per year (kWh/year)												1496.3972
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	351.4657	238.7185	173.7186	69.4326	17.2659	0.0000	0.0000	0.0000	0.0000	82.9349	214.6518	348.2093 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1496.3972
Space heating per m2	(98c) / (4) =											33.4316 (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 %)												343.7824 (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	351.4657	238.7185	173.7186	69.4326	17.2659	0.0000	0.0000	0.0000	0.0000	82.9349	214.6518	348.2093 (98)
Space heating efficiency (main heating system 1)	343.7824	343.7824	343.7824	343.7824	343.7824	0.0000	0.0000	0.0000	0.0000	343.7824	343.7824	343.7824 (210)
Space heating fuel (main heating system)	102.2349	69.4388	50.5316	20.1967	5.0223	0.0000	0.0000	0.0000	0.0000	24.1242	62.4383	101.2877 (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)

elmhurst
energy

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP			
	Energy kWh/year	Emission factor kg CO ₂ /kWh	Emissions kg CO ₂ /year
Space heating - main system 1	435.2745	0.1569	68.2759 (261)
Total CO ₂ associated with community systems			0.0000 (373)
Water heating (other fuel)	781.5378	0.1407	109.9750 (264)
Space and water heating			178.2509 (265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (267)
Energy for lighting	105.1962	0.1443	15.1831 (268)
Total CO ₂ , kg/year			193.4340 (272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			4.3200 (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	435.2745	1.5807	688.0261 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	781.5378	1.5203	1188.1784 (278)
Space and water heating			1876.2046 (279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (281)
Energy for lighting	105.1962	1.5338	161.3534 (282)
Total Primary energy kWh/year			2037.5580 (286)
Dwelling Primary energy Rate (DPER)			45.5200 (287)

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1. Overall dwelling characteristics

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	44.7600 (1b)	x 2.7500 (2b)	= 123.0900 (1b) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	44.7600		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 123.0900 (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	2 * 10 = 20.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	Air changes per hour 20.0000 / (5) = 0.1625 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	5.0000 (17)
Infiltration rate	0.4125 (18)
Number of sides sheltered	0 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] = 1.0000 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.4125 (21)
Wind speed	Jan 5.1000 Feb 5.0000 Mar 4.9000 Apr 4.4000 May 4.3000 Jun 3.8000 Jul 3.8000 Aug 3.7000 Sep 4.0000 Oct 4.3000 Nov 4.5000 Dec 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	0.5259 0.5156 0.5053 0.4537 0.4434 0.3919 0.3919 0.3815 0.4125 0.4434 0.4640 0.4847 (22b)
Effective ac	0.6383 0.6329 0.6277 0.6029 0.5983 0.5768 0.5768 0.5728 0.5851 0.5983 0.6077 0.6175 (25)

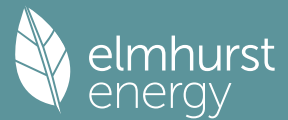
3. Heat losses and heat loss parameter

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
TER Opaque door			1.8900	1.0000	1.8900		(26)
TER Opening Type (Uw = 1.20)			9.3000	1.1450	10.6489		(27)
UNHEATED			44.7600	0.1300	5.8188		(28a)
EXTERNAL	27.7800	9.3000	18.4800	0.1800	3.3264		(29a)
HALLWAY	23.3800	1.8900	21.4900	0.1800	3.8682		(29a)
Total net area of external elements Aum(A, m ²)			95.9200				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		25.5523		(33)
SOLID			24.8100	0.0000	0.0000		(32)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							306.6354 (35)
List of Thermal Bridges							
K1 Element				Length	Psi-value	Total	
E2 Other lintels (including other steel lintels)				5.0000	0.0500	0.2500	
E3 Sill				15.0000	0.0500	0.7500	
E4 Jamb				15.0000	0.0500	0.7500	
E5 Ground floor (normal)				25.0000	0.1600	4.0000	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							5.7500 (36)
Point Thermal bridges						(36a) =	0.0000
Total fabric heat loss						(33) + (36) + (36a) =	31.3023 (37)
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)							
(38)m	Jan 25.9273 Feb 25.7092 Mar 25.4953 Apr 24.4911 May 24.3032 Jun 23.4285 Jul 23.4285 Aug 23.2665 Sep 23.7654 Oct 24.3032 Nov 24.6833 Dec 25.0807 (38)						
Heat transfer coeff	57.2295 57.0114 56.7976 55.7933 55.6054 54.7307 54.7307 54.5688 55.0677 55.6054 55.9855 56.3829 (39)						
Average = Sum(39)m / 12 =							55.7924
HLP	Jan 1.2786 Feb 1.2737 Mar 1.2689 Apr 1.2465 May 1.2423 Jun 1.2228 Jul 1.2228 Aug 1.2191 Sep 1.2303 Oct 1.2423 Nov 1.2508 Dec 1.2597 (40)						
HLP (average)							1.2465
Days in mont	31 28 31 30 31 30 31 31 30 31 30 31						

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.5378 (42)
Hot water usage for mixer showers	50.0033 49.2519 48.1569 46.0618 44.5156 42.7914 41.8113 42.8980 44.0893 45.9406 48.0807 49.8118 (42a)

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Hot water usage for baths	21.6263	21.3051	20.8528	20.0189	19.3944	18.7020	18.3280	18.7772	19.2662	20.0071	20.8582	21.5532 (42b)
Hot water usage for other uses	30.3786	29.2740	28.1693	27.0646	25.9599	24.8553	24.8553	25.9599	27.0646	28.1693	29.2740	30.3786 (42c)
Average daily hot water use (litres/day)												93.7693 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy content (annual)	102.0083	99.8310	97.1790	93.1453	89.8700	86.3487	84.9946	87.6351	90.4201	94.1170	98.2129	101.7436 (44)
Distribution loss (46)m = 0.15 x (45)m	161.5562	142.1580	149.3605	127.5112	120.9823	106.1758	102.7936	108.5106	111.4970	127.7159	139.9223	159.3059 (45)
	24.2334	21.3237	22.4041	19.1267	18.1473	15.9264	15.4190	16.2766	16.7246	19.1574	20.9883	23.8959 (46)
Water storage loss:												
Store volume												200.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.6525 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.8924 (55)
Total storage loss	27.6637	24.9865	27.6637	26.7713	27.6637	26.7713	27.6637	27.6637	26.7713	27.6637	26.7713	27.6637 (56)
If cylinder contains dedicated solar storage	27.6637	24.9865	27.6637	26.7713	27.6637	26.7713	27.6637	27.6637	26.7713	27.6637	26.7713	27.6637 (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	212.4823	188.1557	200.2866	176.7945	171.9084	155.4591	153.7197	159.4367	160.7803	178.6419	189.2056	210.2320 (62)
WWHRS	-22.8594	-20.2171	-21.1702	-17.5297	-16.3371	-13.9798	-13.1038	-13.9346	-14.4640	-17.0514	-19.3172	-22.4361 (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	189.6228	167.9386	179.1164	159.2648	155.5713	141.4793	140.6159	145.5021	146.3163	161.5905	169.8883	187.7958 (64)
												1944.7022 (64)
12Total per year (kWh/year)												1945 (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	94.4583	84.0657	90.4032	81.8241	80.9675	74.7301	74.9197	76.8206	76.4994	83.2064	85.9508	93.7101 (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	76.8902	76.8902	76.8902	76.8902	76.8902	76.8902	76.8902	76.8902	76.8902	76.8902	76.8902	76.8902 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	67.6558	74.9046	67.6558	69.9110	67.6558	69.9110	67.6558	67.6558	69.9110	67.6558	69.9110	67.6558 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	133.6626	135.0496	131.5545	124.1136	114.7208	105.8930	99.9954	98.6084	102.1036	109.5445	118.9372	127.7651 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	30.6890	30.6890	30.6890	30.6890	30.6890	30.6890	30.6890	30.6890	30.6890	30.6890	30.6890	30.6890 (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)	-61.5121	-61.5121	-61.5121	-61.5121	-61.5121	-61.5121	-61.5121	-61.5121	-61.5121	-61.5121	-61.5121	-61.5121 (71)
Water heating gains (Table 5)	126.9601	125.0978	121.5097	113.6446	108.8272	103.7918	100.6986	103.2535	106.2492	111.8365	119.3761	125.9544 (72)
Total internal gains	377.3456	384.1191	369.7870	356.7362	340.2709	325.6628	314.4168	315.5848	324.3308	338.1039	357.2914	370.4423 (73)

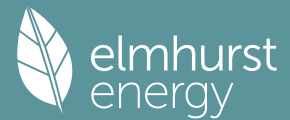
6. Solar gains

[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
Southeast			3.2600		36.7938		0.6300		0.7000		0.7700		36.6576 (77)
Northwest			6.0400		11.2829		0.6300		0.7000		0.7700		20.8272 (81)
Solar gains	57.4848	104.8359	161.8164	231.2982	287.1860	297.4750	281.6516	238.0663	185.5799	120.8205	70.1134		48.3798 (83)
Total gains	434.8304	488.9550	531.6034	588.0345	627.4569	623.1378	596.0684	553.6511	509.9108	458.9243	427.4048		418.8222 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	66.6177	66.8726	67.1243	68.3325	68.5634	69.6592	69.6592	69.8660	69.2330	68.5634	68.0979	67.6180
alpha	5.4412	5.4582	5.4750	5.5555	5.5709	5.6439	5.6439	5.6577	5.6155	5.5709	5.5399	5.5079
util living area	0.9924	0.9847	0.9657	0.8994	0.7556	0.5524	0.4026	0.4505	0.7027	0.9271	0.9834	0.9937 (86)
MIT	19.9560	20.1302	20.3813	20.7074	20.9138	20.9878	20.9983	20.9968	20.9566	20.6940	20.2842	19.9394 (87)
Th 2	19.8576	19.8615	19.8652	19.8830	19.8863	19.9018	19.9018	19.9047	19.8958	19.8863	19.8796	19.8726 (88)
util rest of house												

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MIT 2	0.9895	0.9790	0.9527	0.8644	0.6875	0.4623	0.3029	0.3449	0.6083	0.8931	0.9760	0.9913 (89)
Living area fraction	18.6819	18.9042	19.2186	19.6146	19.8252	19.8965	19.9014	19.9039	19.8727	19.6126	19.1139	18.6719 (90)
MIT	19.4448	19.6383	19.9148	20.2689	20.4770	20.5499	20.5582	20.5583	20.5216	20.2600	19.8146	0.5987 (91)
Temperature adjustment												19.4308 (92)
adjusted MIT	19.4448	19.6383	19.9148	20.2689	20.4770	20.5499	20.5582	20.5583	20.5216	20.2600	19.8146	0.0000
												19.4308 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9882	0.9776	0.9533	0.8776	0.7251	0.5161	0.3627	0.4083	0.6636	0.9060	0.9755	0.9901	(94)
Useful gains	429.6902	477.9786	506.7972	516.0791	454.9519	321.5985	216.1772	226.0503	338.3927	415.7746	416.9126	414.6721	(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	866.7282	840.2496	761.9266	634.3098	488.0480	325.6423	216.6334	226.9139	353.6249	537.1512	711.8350	858.7559	(97)
Space heating kWh	325.1563	243.4462	189.8163	85.1261	24.6235	0.0000	0.0000	0.0000	0.0000	90.3042	212.3442	330.3983	(98a)
Space heating requirement - total per year (kWh/year)												1501.2151	
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	325.1563	243.4462	189.8163	85.1261	24.6235	0.0000	0.0000	0.0000	0.0000	90.3042	212.3442	330.3983	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1501.2151	
Space heating per m2										(98c) / (4) =		33.5392	(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	325.1563	243.4462	189.8163	85.1261	24.6235	0.0000	0.0000	0.0000	0.0000	90.3042	212.3442	330.3983	(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)	352.2820	263.7553	205.6515	92.2276	26.6776	0.0000	0.0000	0.0000	0.0000	97.8377	230.0587	357.9613	(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	189.6228	167.9386	179.1164	159.2648	155.5713	141.4793	140.6159	145.5021	146.3163	161.5905	169.8883	187.7958	(64)
Efficiency of water heater (217)m	85.2580	84.8915	84.1901	82.7202	80.9207	79.8000	79.8000	79.8000	79.8000	82.8088	84.5612	79.8000	(216)
Fuel for water heating, kWh/month	222.4105	197.8273	212.7523	192.5342	192.2515	177.2924	176.2104	182.3335	183.3538	195.1368	200.9059	220.1256	(219)
Space cooling fuel requirement (221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting	14.0575	11.2775	10.1541	7.4393	5.7464	4.6948	5.2420	6.8138	8.8504	11.6122	13.1160	14.4482	(232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-12.1681	-18.1239	-27.5152	-32.7495	-36.9407	-35.1075	-34.7066	-31.9656	-27.4013	-21.5327	-13.7260	-10.4119	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity) (234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity) (235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) (235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity) (233b)m	-4.2163	-9.0795	-18.4353	-28.2587	-37.9131	-38.2691	-37.7922	-31.7254	-22.9155	-13.1415	-5.6815	-3.3169	(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												1626.4518	(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												2353.1341	(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)												113.4524	(232)

Energy saving/generation technologies (Appendices M ,N and Q)

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PV generation	-553.0938 (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	3625.9446 (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	1626.4518	0.2100	341.5549 (261)
Total CO2 associated with community systems			0.0000 (273)
Water heating (other fuel)	2353.1341	0.2100	494.1582 (264)
Space and water heating			835.7131 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	113.4524	0.1443	16.3747 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-302.3490	0.1334	-40.3391
PV Unit electricity exported	-250.7448	0.1253	-31.4237
Total			-71.7628 (269)
Total CO2, kg/year			792.2542 (272)
EPC Target Carbon Dioxide Emission Rate (TER)			17.7000 (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	1626.4518	1.1300	1837.8906 (275)
Total CO2 associated with community systems			0.0000 (273)
Water heating (other fuel)	2353.1341	1.1300	2659.0416 (278)
Space and water heating			4496.9322 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	113.4524	1.5338	174.0171 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-302.3490	1.4930	-451.4151
PV Unit electricity exported	-250.7448	0.4600	-115.3402
Total			-566.7553 (283)
Total Primary energy kWh/year			4234.2947 (286)
Target Primary Energy Rate (TPER)			94.6000 (287)

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022) CALCULATION OF FABRIC ENERGY EFFICIENCY

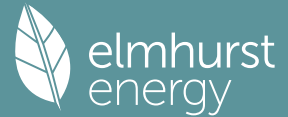
1. Overall dwelling characteristics

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	44.7600 (1b)	x 2.7500 (2b)	= 123.0900 (1b) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	44.7600		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 123.0900 (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	2 * 10 = 20.0000 (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) = 20.0000 / (5) = 0.1625 (8)
Pressure test	Yes

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Pressure Test Method
Measured/design AP50
Infiltration rate
Number of sides sheltered

Blower Door
3.0000 (17)
0.3125 (18)
0 (19)

Shelter factor
Infiltration rate adjusted to include shelter factor

(20) = 1 - [0.075 x (19)] = 1.0000 (20)
(21) = (18) x (20) = 0.3125 (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	0.3984	0.3906	0.3828	0.3437	0.3359	0.2969	0.2969	0.2890	0.3125	0.3359	0.3515	0.3672	(22b)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.0000	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												0.0000	(23c)
Effective ac	0.5794	0.5763	0.5733	0.5591	0.5564	0.5441	0.5441	0.5418	0.5488	0.5564	0.5618	0.5674	(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	
WINDOWS (Uw = 1.20)			12.9100	1.1450	14.7824			(27)
CORRIDOR DOOR			1.8900	1.2000	2.2680			(26)
UNHEATED			44.7600	0.1000	4.4760	110.0000	4923.6000	(28a)
EXTERNAL	27.7800	12.9100	14.8700	0.1200	1.7844	70.0000	1040.9000	(29a)
HALLWAY	23.3800	1.8900	21.4900	0.1100	2.3639	70.0000	1504.3000	(29a)
Total net area of external elements Aum(A, m2)			95.9200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	25.6747			(33)
SOLID			24.8100	0.0000	0.0000	180.0000	4465.8000	(32)
CEILING			44.7600			40.0000	1790.4000	(32b)

Heat capacity Cm = Sum(A x k)

(28)...(30) + (32) + (32a)...(32e) = 13725.0000 (34)

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

306.6354 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total	
E2 Other lintels (including other steel lintels)	5.0000	0.1600	0.8000	9.6000 (36)
E3 Sill	15.0000	0.1600	2.4000	0.0000 (36a)
E4 Jamb	15.0000	0.1600	2.4000	
E5 Ground floor (normal)	25.0000	0.1600	4.0000	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)				(33) + (36) + (36a) = 35.2747 (37)
Point Thermal bridges				
Total fabric heat loss				

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

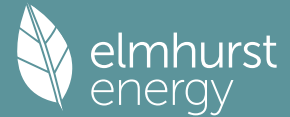
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	23.5337	23.4085	23.2858	22.7095	22.6016	22.0997	22.0997	22.0067	22.2930	22.6016	22.8198	23.0479	(38)
Heat transfer coeff	58.8085	58.6833	58.5606	57.9842	57.8764	57.3744	57.3744	57.2814	57.5678	57.8764	58.0945	58.3226	(39)
Average = Sum(39)m / 12 =												57.9837	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3139	1.3111	1.3083	1.2954	1.2930	1.2818	1.2818	1.2797	1.2861	1.2930	1.2979	1.3030	(40)
HLP (average)												1.2954	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy													1.5378 (42)
Hot water usage for mixer showers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42a)
Hot water usage for baths	21.6263	21.3051	20.8528	20.0189	19.3944	18.7020	18.3280	18.7772	19.2662	20.0071	20.8582	21.5532	(42b)
Hot water usage for other uses	30.3786	29.2740	28.1693	27.0646	25.9599	24.8553	24.8553	25.9599	27.0646	28.1693	29.2740	30.3786	(42c)
Average daily hot water use (litres/day)												47.6679	(43)
Daily hot water use	52.0049	50.5791	49.0221	47.0835	45.3544	43.5573	43.1833	44.7371	46.3308	48.1764	50.1322	51.9318	(44)
Energy conte	82.3631	72.0239	75.3452	64.4550	61.0557	53.5588	52.2264	55.3939	57.1305	65.3749	71.4224	81.3127	(45)
Energy content (annual)										Total = Sum(45)m =		791.6625	
Distribution loss (46)m = 0.15 x (45)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	(46)
Water storage loss:													
Total storage 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	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary 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	(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	70.0087	61.2204	64.0434	54.7867	51.8974	45.5250	44.3925	47.0848	48.5609	55.5686	60.7091	69.1158	(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)

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Output from w/h	70.0087	61.2204	64.0434	54.7867	51.8974	45.5250	44.3925	47.0848	48.5609	55.5686	60.7091	69.1158 (64)
12Total per year (kWh/year)	Total per year (kWh/year) = Sum(64)m =											672.9131 (64)
Electric shower(s)	40.0443	35.6798	38.9610	37.1800	37.8777	36.1316	37.3360	37.8777	37.1800	38.9610	38.2284	40.0443 (64a)
Heat gains from water heating, kWh/month	27.5132	24.2250	25.7511	22.9917	22.4438	20.4141	20.4321	21.2406	21.4352	23.6324	24.7344	27.2900 (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	76.8902	76.8902	76.8902	76.8902	76.8902	76.8902	76.8902	76.8902	76.8902	76.8902	76.8902	76.8902 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	67.4175	74.6408	67.4175	69.6647	67.4175	69.6647	67.4175	67.4175	69.6647	67.4175	69.6647	67.4175 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	133.6626	135.0496	131.5545	124.1136	114.7208	105.8930	99.9954	98.6084	102.1036	109.5445	118.9372	127.7651 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	30.6890	30.6890	30.6890	30.6890	30.6890	30.6890	30.6890	30.6890	30.6890	30.6890	30.6890	30.6890 (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)	-61.5121	-61.5121	-61.5121	-61.5121	-61.5121	-61.5121	-61.5121	-61.5121	-61.5121	-61.5121	-61.5121	-61.5121 (71)
Water heating gains (Table 5)	36.9802	36.0492	34.6117	31.9329	30.1663	28.3530	27.4625	28.5492	29.7712	31.7640	34.3533	36.6802 (72)
Total internal gains	284.1273	291.8066	279.6507	271.7782	258.3717	249.9777	240.9425	240.6422	247.6065	254.7930	269.0223	277.9298 (73)

6. Solar gains

[Jan]		Area m2		Solar flux Table 6a W/m2		Specific data or Table 6b		Specific data or Table 6c		Access factor Table 6d		Gains W	
Southeast		4.5300		36.7938		0.6300		0.7000		0.7700		50.9384 (77)	
Northwest		8.3800		11.2829		0.6300		0.7000		0.7700		28.8960 (81)	
Solar gains		79.8344	145.5856	224.6908	321.1351	398.7021	412.9755	391.0126	330.5212	257.6760	167.7770	97.3711	67.1906 (83)
Total gains		363.9617	437.3922	504.3415	592.9133	657.0738	662.9532	631.9551	571.1634	505.2826	422.5700	366.3934	345.1203 (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	64.8291	64.9674	65.1035	65.7506	65.8732	66.4495	66.4495	66.5573	66.2263	65.8732	65.6258	65.3692
alpha	5.3219	5.3312	5.3402	5.3834	5.3915	5.4300	5.4300	5.4372	5.4151	5.3915	5.3751	5.3579
util living area	0.9968	0.9911	0.9739	0.9049	0.7490	0.5437	0.3978	0.4576	0.7280	0.9506	0.9921	0.9976 (86)
MIT	19.7731	19.9867	20.2903	20.6721	20.9084	20.9865	20.9979	20.9958	20.9416	20.6021	20.1183	19.7389 (87)
Th 2	19.8300	19.8322	19.8343	19.8444	19.8463	19.8551	19.8551	19.8567	19.8517	19.8463	19.8425	19.8385 (88)
util rest of house	0.9955	0.9875	0.9634	0.8705	0.6791	0.4513	0.2952	0.3460	0.6308	0.9244	0.9883	0.9966 (89)
MIT 2	18.7385	18.9516	19.2495	19.6091	19.7961	19.8505	19.8547	19.8559	19.8270	19.5591	19.0916	18.7111 (90)
Living area fraction	19.3580	19.5713	19.8727	20.2456	20.4621	20.5307	20.5392	20.5384	20.4944	20.1836	19.7063	19.3265 (91)
Temperature adjustment	19.3580	19.5713	19.8727	20.2456	20.4621	20.5307	20.5392	20.5384	20.4944	20.1836	19.7063	19.3265 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	0.9948	0.9865	0.9638	0.8837	0.7179	0.5065	0.3568	0.4130	0.6876	0.9333	0.9878	0.9960 (94)
Useful gains	362.0665	431.4921	486.0954	523.9398	471.7259	335.7800	225.4640	235.8867	347.4161	394.3996	361.9136	343.7411 (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	885.5374	860.9616	783.1112	657.8638	507.1180	340.2703	226.0107	237.0534	368.1107	554.6649	732.3582	882.2186 (97)
Space heating kWh	389.4624	288.6035	220.9797	96.4252	26.3317	0.0000	0.0000	0.0000	0.0000	119.2374	266.7202	400.6272 (98a)
Space heating requirement - total per year (kWh/year)												1808.3873
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	389.4624	288.6035	220.9797	96.4252	26.3317	0.0000	0.0000	0.0000	0.0000	119.2374	266.7202	400.6272 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1808.3873
Space heating per m2												(98c) / (4) =
												40.4019 (99)

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8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	539.3193	424.5706	435.3389	0.0000	0.0000	0.0000	0.0000 (100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9471	0.9754	0.9588	0.0000	0.0000	0.0000	0.0000 (101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	510.8112	414.1256	417.4071	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	751.5203	716.6317	646.8552	0.0000	0.0000	0.0000	0.0000 (103)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	173.3105	225.0646	170.7094	0.0000	0.0000	0.0000	0.0000 (104)
Cooled fraction									fC = cooled area / (4) =			1.0000 (105)
Intermittency factor (Table 10b)	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500 (106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	43.3276	56.2661	42.6773	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling requirement												142.2711 (107)
Energy for space heating												40.4019 (99)
Energy for space cooling												3.1785 (108)
Total												43.5804 (109)
Fabric Energy Efficiency (DFEE)												43.6 (109)

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

1. Overall dwelling characteristics

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	44.7600 (1b)	x 2.7500 (2b)	= 123.0900 (1b) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	44.7600		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	123.0900 (5)

2. Ventilation rate

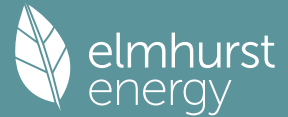
	m ³ per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	2 * 10 = 20.0000 (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)+(7a)+(7b)+(7c) =	Air changes per hour 20.0000 / (5) = 0.1625 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	5.0000 (17)
Infiltration rate	0.4125 (18)
Number of sides sheltered	0 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] = 1.0000 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.4125 (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	0.5259	0.5156	0.5053	0.4537	0.4434	0.3919	0.3919	0.3815	0.4125	0.4434	0.4640	0.4847 (22b)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.0000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												0.0000 (23c)
Effective ac	0.6383	0.6329	0.6277	0.6029	0.5983	0.5768	0.5768	0.5728	0.5851	0.5983	0.6077	0.6175 (25)

3. Heat losses and heat loss parameter

Element	Gross	Openings	NetArea	U-value	A x U	K-value	A x K
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	m2	m2	m2	W/m2K	W/K	kJ/m2K	kJ/K	
TER Opaque door			1.8900	1.0000	1.8900			(26)
TER Opening Type (Uw = 1.20)			9.3000	1.1450	10.6489			(27)
UNHEATED			44.7600	0.1300	5.8188			(28a)
EXTERNAL	27.7800	9.3000	18.4800	0.1800	3.3264			(29a)
HALLWAY	23.3800	1.8900	21.4900	0.1800	3.8682			(29a)
Total net area of external elements Aum(A, m2)			95.9200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		25.5523			(33)
SOLID			24.8100	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 306.6354 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total	
E2 Other lintels (including other steel lintels)	5.0000	0.0500	0.2500	
E3 Sill	15.0000	0.0500	0.7500	
E4 Jamb	15.0000	0.0500	0.7500	
E5 Ground floor (normal)	25.0000	0.1600	4.0000	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)				5.7500 (36)
Point Thermal bridges			(36a) =	0.0000
Total fabric heat loss			(33) + (36) + (36a) =	31.3023 (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	25.9273	25.7092	25.4953	24.4911	24.3032	23.4285	23.4285	23.2665	23.7654	24.3032	24.6833	25.0807	(38)
Heat transfer coeff	57.2295	57.0114	56.7976	55.7933	55.6054	54.7307	54.7307	54.5688	55.0677	55.6054	55.9855	56.3829	(39)
Average = Sum(39)m / 12 =												55.7924	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2786	1.2737	1.2689	1.2465	1.2423	1.2228	1.2228	1.2191	1.2303	1.2423	1.2508	1.2597	(40)
HLP (average)												1.2465	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

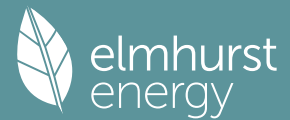
4. Water heating energy requirements (kWh/year)

Assumed occupancy													1.5378 (42)
Hot water usage for mixer showers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42a)
Hot water usage for baths	21.6263	21.3051	20.8528	20.0189	19.3944	18.7020	18.3280	18.7772	19.2662	20.0071	20.8582	21.5532	(42b)
Hot water usage for other uses	30.3786	29.2740	28.1693	27.0646	25.9599	24.8553	24.8553	25.9599	27.0646	28.1693	29.2740	30.3786	(42c)
Average daily hot water use (litres/day)												47.6679	(43)
Daily hot water use	52.0049	50.5791	49.0221	47.0835	45.3544	43.5573	43.1833	44.7371	46.3308	48.1764	50.1322	51.9318	(44)
Energy conte	82.3631	72.0239	75.3452	64.4550	61.0557	53.5588	52.2264	55.3939	57.1305	65.3749	71.4224	81.3127	(45)
Energy content (annual)													
Distribution loss (46)m = 0.15 x (45)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	(46)
Water storage loss:													
Total storage 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	(56)
If cylinder contains dedicated solar storage													
Primary 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	(57)
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	70.0087	61.2204	64.0434	54.7867	51.8974	45.5250	44.3925	47.0848	48.5609	55.5686	60.7091	69.1158	(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	70.0087	61.2204	64.0434	54.7867	51.8974	45.5250	44.3925	47.0848	48.5609	55.5686	60.7091	69.1158	(64)
12Total per year (kWh/year)												672.9131	(64)
Electric shower(s)	40.0443	35.6798	38.9610	37.1800	37.8777	36.1316	37.3360	37.8777	37.1800	38.9610	38.2284	40.0443	(64a)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =												455.5021	(64a)
Heat gains from water heating, kWh/month	27.5132	24.2250	25.7511	22.9917	22.4438	20.4141	20.4321	21.2406	21.4352	23.6324	24.7344	27.2900	(65)

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

Metabolic gains (Table 5), Watts													
(66)m	76.8902	76.8902	76.8902	76.8902	76.8902	76.8902	76.8902	76.8902	76.8902	76.8902	76.8902	76.8902	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	67.6558	74.9046	67.6558	69.9110	67.6558	69.9110	67.6558	67.6558	69.9110	67.6558	69.9110	67.6558	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	133.6626	135.0496	131.5545	124.1136	114.7208	105.8930	99.9954	98.6084	102.1036	109.5445	118.9372	127.7651	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	30.6890	30.6890	30.6890	30.6890	30.6890	30.6890	30.6890	30.6890	30.6890	30.6890	30.6890	30.6890	(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)	-61.5121	-61.5121	-61.5121	-61.5121	-61.5121	-61.5121	-61.5121	-61.5121	-61.5121	-61.5121	-61.5121	-61.5121	(71)

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Water heating gains (Table 5)	36.9802	36.0492	34.6117	31.9329	30.1663	28.3530	27.4625	28.5492	29.7712	31.7640	34.3533	36.6802 (72)
Total internal gains	284.3657	292.0705	279.8890	272.0245	258.6100	250.2240	241.1808	240.8805	247.8528	255.0313	269.2686	278.1681 (73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	Specific data or Table 6c	Access factor Table 6d	Gains W
Southeast	3.2600	36.7938	0.6300	0.7000	0.7700	36.6576 (77)
Northwest	6.0400	11.2829	0.6300	0.7000	0.7700	20.8272 (81)

Solar gains	57.4848	104.8359	161.8164	231.2982	287.1860	297.4750	281.6516	238.0663	185.5799	120.8205	70.1134	48.3798 (83)
Total gains	341.8505	396.9064	441.7054	503.3228	545.7960	547.6991	522.8324	478.9468	433.4328	375.8518	339.3820	326.5479 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	66.6177	66.8726	67.1243	68.3325	68.5634	69.6592	69.6592	69.8660	69.2330	68.5634	68.0979	67.6180
alpha	5.4412	5.4582	5.4750	5.5555	5.5709	5.6439	5.6439	5.6577	5.6155	5.5709	5.5399	5.5079
util living area	0.9976	0.9941	0.9844	0.9417	0.8240	0.6200	0.4575	0.5176	0.7878	0.9663	0.9943	0.9981 (86)
MIT	19.7758	19.9570	20.2246	20.5975	20.8651	20.9786	20.9967	20.9937	20.9228	20.5692	20.1185	19.7591 (87)
Th 2	19.8576	19.8615	19.8652	19.8830	19.8863	19.9018	19.9018	19.9047	19.8958	19.8863	19.8796	19.8726 (88)
util rest of house	0.9966	0.9917	0.9778	0.9174	0.7617	0.5228	0.3451	0.3980	0.6963	0.9471	0.9915	0.9974 (89)
MIT 2	18.7629	18.9460	19.2126	19.5807	19.8073	19.8941	19.9012	19.9034	19.8610	19.5651	19.1216	18.7581 (90)
Living area fraction	fLA = Living area / (4) =											
MIT	19.3694	19.5513	19.8186	20.1895	20.4406	20.5434	20.5571	20.5562	20.4967	20.1663	19.7185	19.3574 (92)
Temperature adjustment	0.0000											
adjusted MIT	19.3694	19.5513	19.8186	20.1895	20.4406	20.5434	20.5571	20.5562	20.4967	20.1663	19.7185	19.3574 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9961	0.9909	0.9774	0.9250	0.7947	0.5808	0.4126	0.4699	0.7491	0.9528	0.9910	0.9969 (94)
Useful gains	340.5046	393.2884	431.7373	465.5546	433.7251	318.0828	215.6978	225.0496	324.6702	358.1127	336.3193	325.5378 (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	862.4127	835.2926	756.4619	629.8794	486.0268	325.2880	216.5775	226.8006	352.2529	531.9372	706.4529	854.6205 (97)
Space heating kWh	388.2997	297.0268	241.5951	118.3139	38.9125	0.0000	0.0000	0.0000	0.0000	129.3255	266.4962	393.6375 (98a)
Space heating requirement - total per year (kWh/year)	1873.6071											
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	388.2997	297.0268	241.5951	118.3139	38.9125	0.0000	0.0000	0.0000	0.0000	129.3255	266.4962	393.6375 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)	1873.6071											
Space heating per m2	(98c) / (4) = 41.8590 (99)											

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	514.4690	405.0075	414.7226	0.0000	0.0000	0.0000	0.0000 (100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9148	0.9588	0.9365	0.0000	0.0000	0.0000	0.0000 (101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	470.6307	388.3231	388.3938	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	616.5406	588.8297	538.8202	0.0000	0.0000	0.0000	0.0000 (103)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	105.0552	149.1769	111.9173	0.0000	0.0000	0.0000	0.0000 (104)
Cooled fraction	fC = cooled area / (4) =											
Intermittency factor (Table 10b)	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500 (105)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	26.2638	37.2942	27.9793	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling requirement	91.5373 (107)											
Energy for space heating	41.8590 (99)											
Energy for space cooling	2.0451 (108)											
Total	43.9040 (109)											
Fabric Energy Efficiency (TFEE)	43.9 (109)											

Building Regulations England Part L (BREL) Compliance Report

Approved Document L1 2021 Edition, England assessed by Array SAP 10 program, Array

Date: Wed 12 Apr 2023 06:35:07

Project Information			
Assessed By	Mark Simons	Building Type	Flat, End-terrace
OCDEA Registration	EES/004083	Assessment Date	2023-04-12

Dwelling Details			
Assessment Type	As designed	Total Floor Area	54 m ²
Site Reference	39-41 Richmond	Plot Reference	Flat 2 - Heatpump
Address	39-41 Richmond Street, MANCHESTER, M1 3WB		

Client Details	
Name	Mark Simons
Company	EAL Consult
Address	17 Dobree Avenue, London, NW10 2AD

This report covers items included within the SAP calculations. It is not a complete report of regulations compliance.

1a Target emission rate and dwelling emission rate			
Fuel for main heating system	Electricity		
Target carbon dioxide emission rate	13.91 kgCO ₂ /m ²		
Dwelling carbon dioxide emission rate	3.5 kgCO ₂ /m ²		OK
1b Target primary energy rate and dwelling primary energy			
Target primary energy	74.0 kWh _{PE} /m ²		
Dwelling primary energy	37.03 kWh _{PE} /m ²		OK
1c Target fabric energy efficiency and dwelling fabric energy efficiency			
Target fabric energy efficiency	31.7 kWh/m ²		
Dwelling fabric energy efficiency	31.2 kWh/m ²		OK

2a Fabric U-values				
Element	Maximum permitted average U-Value [W/m ² K]	Dwelling average U-Value [W/m ² K]	Element with highest individual U-Value	
External walls	0.26	0.12	Walls (1) (0.12)	OK
Party walls	0.2	0	Party Wall (1) (0)	N/A
Curtain walls	1.6	0	N/A	N/A
Floors	0.18	N/A	N/A	N/A
Roofs	0.16	N/A	N/A	N/A
Windows, doors, and roof windows	1.6	1.2	FRONT (1.2)	OK
Rooflights	2.2	N/A	N/A	N/A

2b Envelope elements (better than typically expected values are flagged with a subsequent (!))			
Name	Net area [m ²]	U-Value [W/m ² K]	
Exposed wall: Walls (1)	24.67	0.12 (!)	
Sheltered wall: Walls (2)	24.57	0.12 (!)	
Party wall: Party Wall (1)	24.81	0 (!)	

2c Openings (better than typically expected values are flagged with a subsequent (!))				
Name	Area [m ²]	Orientation	Frame factor	U-Value [W/m ² K]
FRONT, WINDOWS	8.38	North West	0.7	1.2
REAR, WINDOWS	8.34	South East	0.7	1.2
ENTRANCE DOOR, CORRIDOR DOOR	1.89	North East	N/A	1.2

2d Thermal bridging (better than typically expected values are flagged with a subsequent (!))				
Building part 1 - Main Dwelling: Thermal bridging calculated from linear thermal transmittances for each junction				
Main element	Junction detail	Source	Psi value [W/mK]	Drawing / reference
External wall	E2: Other lintels (including other steel lintels)	Calculated by person with suitable expertise	0.16	
External wall	E3: Sill	Calculated by person with suitable expertise	0.16	

Main element	Junction detail	Source	Psi value [W/mK]	Drawing / reference
External wall	E4: Jamb	Calculated by person with suitable expertise	0.16	
External wall	E5: Ground floor (normal)	Calculated by person with suitable expertise	0.16	

3 Air permeability (better than typically expected values are flagged with a subsequent (!))

Maximum permitted air permeability at 50Pa	8 m ³ /hm ²	
Dwelling air permeability at 50Pa	3 m ³ /hm ² , Design value (!)	OK
Air permeability test certificate reference		

4 Space heating

Main heating system 1: Heat pump with radiators or underfloor heating - Electricity

Efficiency	344.8%
Emitter type	Underfloor
Flow temperature	45°C
System type	Heat Pump
Manufacturer	Midea
Model	MHC-V6W/D2N8-B
Commissioning	

Secondary heating system: N/A

Fuel	N/A
Efficiency	N/A
Commissioning	

5 Hot water

Cylinder/store - type: Cylinder

Capacity	200 litres
Declared heat loss	2.1 kWh/day
Primary pipework insulated	Yes
Manufacturer	
Model	
Commissioning	

Waste water heat recovery system 1 - type: N/A

Efficiency	
Manufacturer	
Model	

6 Controls

Main heating 1 - type: Time and temperature zone control by arrangement of plumbing and electrical services

Function	
Ecodesign class	
Manufacturer	
Model	

Water heating - type: Cylinder thermostat and HW separately timed

Manufacturer	
Model	

7 Lighting

Minimum permitted light source efficacy	75 lm/W	
Lowest light source efficacy	100 lm/W	OK
External lights control	N/A	

8 Mechanical ventilation

System type: N/A

Maximum permitted specific fan power	N/A	
Specific fan power	N/A	N/A
Minimum permitted heat recovery efficiency	N/A	
Heat recovery efficiency	N/A	N/A
Manufacturer/Model		
Commissioning		

9 Local generation

N/A

10 Heat networks	
N/A	
11 Supporting documentary evidence	
N/A	
12 Declarations	
a. Assessor Declaration	
This declaration by the assessor is confirmation that the contents of this BREL Compliance Report are a true and accurate reflection based upon the design information submitted for this dwelling for the purpose of carrying out the "As designed" assessment, and that the supporting documentary evidence (SAP Conventions, Appendix 1 (documentary evidence) schedules the minimum documentary evidence required) has been reviewed in the course of preparing this BREL Compliance Report.	
Signed: Name:	Assessor ID: Date:
b. Client Declaration	
N/A	

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Property Reference	39-41 Richmond				Issued on Date	12/04/2023
Assessment Reference	Flat 2 - Heatpump		Prop Type Ref	39-41 Richmond		
Property	39-41 , Richmond Street, MANCHESTER, M1 3WB					
SAP Rating	88 B	DER	3.50	TER	13.91	
Environmental	98 A	% DER < TER				74.84
CO ₂ Emissions (t/year)	0.18	DFEE	31.24	TFEE	31.71	
Compliance Check	See BREL	% DFEE < TFEE				1.50
% DPER < TPER	49.96	DPER	37.03	TPER	74.00	
Assessor Details	Mr. Mark Simons				Assessor ID	5542-0001
Client	EAL Consult, Mark Simons					

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	54.2300 (1b)	x 2.7500 (2b)	= 149.1325 (1b) - (4)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	54.2300		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 149.1325 (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	2 * 10 = 20.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	Air changes per hour
Pressure test	20.0000 / (5) = 0.1341 (8)
Pressure Test Method	Yes
Measured/design AP50	Blower Door
Infiltration rate	3.0000 (17)
Number of sides sheltered	0.2841 (18)
	0 (19)

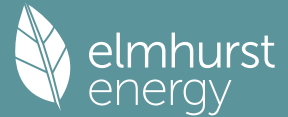
Shelter factor	(20) = 1 - [0.075 x (19)] = 1.0000 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.2841 (21)

	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	0.3622	0.3551	0.3480	0.3125	0.3054	0.2699	0.2699	0.2628	0.2841	0.3054	0.3196	0.3338 (22b)
Effective ac	0.5656	0.5631	0.5606	0.5488	0.5466	0.5364	0.5364	0.5345	0.5404	0.5466	0.5511	0.5557 (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
WINDOWS (U _w = 1.20)			16.7200	1.1450	19.1450		(27)
CORRIDOR DOOR			1.8900	1.2000	2.2680		(26)
EXTERNAL	41.3900	16.7200	24.6700	0.1200	2.9604	70.0000	1726.9000 (29a)
HALLWAY	26.4600	1.8900	24.5700	0.1100	2.7027	70.0000	1719.9000 (29a)
Total net area of external elements A _{um} (A, m ²)			67.8500				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		27.0761		(33)
SOLID			24.8100	0.0000	0.0000	180.0000	4465.8000 (32)
FLOORS			54.2300			40.0000	2169.2000 (32a)

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CEILING 54.2300 30.0000 1626.9000 (32b)

Heat capacity $C_m = \text{Sum}(A \times k)$ (28)...(30) + (32) + (32a)...(32e) = 11708.7000 (34)
Thermal mass parameter (TMP = C_m / TFA) in kJ/m²K 215.9082 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element	5.0000	0.1600	0.8000
E2 Other lintels (including other steel lintels)	7.5000	0.1600	1.2000
E3 Sill	7.5000	0.1600	1.2000
E4 Jamb	9.0000	0.1600	1.4400
E5 Ground floor (normal)			
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			4.6400 (36)
Point Thermal bridges			0.0000
Total fabric heat loss		(33) + (36) + (36a) =	31.7161 (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	27.8357	27.7103	27.5874	27.0102	26.9022	26.3994	26.3994	26.3063	26.5931	26.9022	27.1207	27.3491 (38)
Heat transfer coeff	59.5518	59.4265	59.3036	58.7263	58.6183	58.1156	58.1156	58.0225	58.3092	58.6183	58.8368	59.0652 (39)
Average = Sum(39)m / 12 =												58.7258
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.0981	1.0958	1.0936	1.0829	1.0809	1.0716	1.0716	1.0699	1.0752	1.0809	1.0849	1.0892 (40)
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

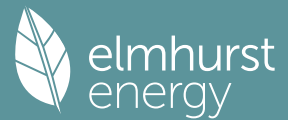
4. Water heating energy requirements (kWh/year)

Assumed occupancy												1.8148 (42)
Hot water usage for mixer showers	54.6471	53.8259	52.6292	50.3395	48.6498	46.7654	45.6943	46.8820	48.1839	50.2071	52.5460	54.4378 (42a)
Hot water usage for baths	24.8666	24.4973	23.9773	23.0184	22.3004	21.5042	21.0742	21.5906	22.1529	23.0048	23.9834	24.7826 (42b)
Hot water usage for other uses	34.9632	33.6918	32.4204	31.1490	29.8776	28.6062	28.6062	29.8776	31.1490	32.4204	33.6918	34.9632 (42c)
Average daily hot water use (litres/day)												105.2228 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	114.4769	112.0150	109.0268	104.5069	100.8277	96.8758	95.3747	98.3502	101.4857	105.6323	110.2212	114.1835 (44)
Energy conte	181.3035	159.5079	167.5702	143.0647	135.7335	119.1201	115.3475	121.7781	125.1421	143.3420	157.0303	178.7837 (45)
Energy content (annual)										Total = Sum(45)m =		1747.7235
Distribution loss (46)m = 0.15 x (45)m	27.1955	23.9262	25.1355	21.4597	20.3600	17.8680	17.3021	18.2667	18.7713	21.5013	23.5545	26.8176 (46)
Water storage loss:												
Store volume												200.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												2.1000 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												1.1340 (55)
Total storage loss	35.1540	31.7520	35.1540	34.0200	35.1540	34.0200	35.1540	35.1540	34.0200	35.1540	34.0200	35.1540 (56)
If cylinder contains dedicated solar storage	35.1540	31.7520	35.1540	34.0200	35.1540	34.0200	35.1540	35.1540	34.0200	35.1540	34.0200	35.1540 (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	239.7199	212.2711	225.9866	199.5967	194.1499	175.6521	173.7639	180.1945	181.6741	201.7584	213.5623	237.2001 (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	239.7199	212.2711	225.9866	199.5967	194.1499	175.6521	173.7639	180.1945	181.6741	201.7584	213.5623	237.2001 (64)
12Total per year (kWh/year)										Total per year (kWh/year) = Sum(64)m =		2435.5295 (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	107.0165	95.2469	102.4502	92.7946	91.8645	84.8330	85.0861	87.2243	86.8353	94.3943	97.4382	106.1787 (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	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	79.7932	88.3425	79.7932	82.4530	79.7932	82.4530	79.7932	79.7932	82.4530	79.7932	82.4530	79.7932 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	158.1990	159.8407	155.7038	146.8971	135.7801	125.3317	118.3516	116.7100	120.8468	129.6535	140.7705	151.2189 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738 (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)	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906 (71)
Water heating gains (Table 5)	143.8394	141.7365	137.7019	128.8814	123.4738	117.8237	114.3631	117.2370	120.6046	126.8741	135.3308	142.7133 (72)
Total internal gains												

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432.0532 440.1411 423.4205 408.4530 389.2686 375.8299 362.7294 363.9617 374.1259 386.5423 408.7758 423.9469 (73)

6. Solar gains

[Jan]	Area m2		Solar flux Table 6a W/m2		Specific data or Table 6b		Specific data or Table 6c		Access factor Table 6d		Gains W	
Southeast	8.3400		36.7938		0.6300		0.7000		0.7700		93.7806 (77)	
Northwest	8.3800		11.2829		0.6300		0.7000		0.7700		28.8960 (81)	
Solar gains	122.6766	218.5617	324.5400	444.8530	537.2765	550.5477	523.6470	452.0720	365.7915	248.4312	148.6862	103.8546 (83)
Total gains	554.7298	658.7029	747.9604	853.3060	926.5451	926.3776	886.3764	816.0337	739.9174	634.9735	557.4620	527.8015 (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	54.6149	54.7301	54.8435	55.3826	55.4846	55.9646	55.9646	56.0544	55.7788	55.4846	55.2786	55.0648
alpha	4.6410	4.6487	4.6562	4.6922	4.6990	4.7310	4.7310	4.7370	4.7186	4.6990	4.6852	4.6710
util living area	0.9694	0.9375	0.8754	0.7416	0.5673	0.3983	0.2879	0.3260	0.5293	0.8073	0.9404	0.9748 (86)
Living	20.1662	20.3634	20.5887	20.8030	20.9013	20.9295	20.9337	20.9331	20.9164	20.7707	20.4395	20.1298
Non living	19.0516	19.2952	19.5647	19.8096	19.9068	19.9373	19.9398	19.9411	19.9259	19.7850	19.4004	19.0122
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	20.5735	20.3634	20.5887	20.8030	20.9013	20.9295	20.9337	20.9331	20.9164	20.7707	20.4395	20.2515 (87)
Th 2	20.0024	20.0042	20.0061	20.0148	20.0164	20.0241	20.0241	20.0255	20.0211	20.0164	20.0131	20.0097 (88)
util rest of house	0.9620	0.9235	0.8502	0.6996	0.5136	0.3389	0.2244	0.2575	0.4597	0.7623	0.9246	0.9685 (89)
MIT 2	19.6233	19.2952	19.5647	19.8096	19.9068	19.9373	19.9398	19.9411	19.9259	19.7850	19.4004	19.1920 (90)
Living area fraction	fLA = Living area / (4) =											
MIT	20.0941	19.8245	20.0721	20.3018	20.3996	20.4290	20.4323	20.4326	20.4167	20.2734	19.9153	19.7170 (92)
Temperature adjustment	0.0000											
adjusted MIT	20.0941	19.8245	20.0721	20.3018	20.3996	20.4290	20.4323	20.4326	20.4167	20.2734	19.9153	19.7170 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9627	0.9207	0.8520	0.7123	0.5349	0.3637	0.2510	0.2862	0.4883	0.7749	0.9228	0.9663 (94)
Useful gains	534.0497	606.4483	637.2490	607.8386	495.6164	336.9057	222.4726	233.5326	361.3094	492.0333	514.4332	510.0229 (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	940.5681	886.9077	804.8724	669.5854	509.9532	338.7531	222.7148	233.9822	368.3190	567.0371	754.0094	916.5121 (97)
Space heating kWh	302.4496	188.4687	124.7119	44.4577	10.6666	0.0000	0.0000	0.0000	0.0000	55.8028	172.4949	302.4279 (98a)
Space heating requirement - total per year (kWh/year)												1201.4802
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	302.4496	188.4687	124.7119	44.4577	10.6666	0.0000	0.0000	0.0000	0.0000	55.8028	172.4949	302.4279 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1201.4802
Space heating per m2												(98c) / (4) = 22.1553 (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 %)												344.7768 (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	302.4496	188.4687	124.7119	44.4577	10.6666	0.0000	0.0000	0.0000	0.0000	55.8028	172.4949	302.4279 (98)
Space heating efficiency (main heating system 1)	344.7768	344.7768	344.7768	344.7768	344.7768	0.0000	0.0000	0.0000	0.0000	344.7768	344.7768	344.7768 (210)
Space heating fuel (main heating system)	87.7233	54.6640	36.1718	12.8946	3.0938	0.0000	0.0000	0.0000	0.0000	16.1852	50.0309	87.7170 (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)

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Water heating													
Water heating requirement	239.7199	212.2711	225.9866	199.5967	194.1499	175.6521	173.7639	180.1945	181.6741	201.7584	213.5623	237.2001	(64)
Efficiency of water heater												292.6202	(216)
(217)m	292.6202	292.6202	292.6202	292.6202	292.6202	292.6202	292.6202	292.6202	292.6202	292.6202	292.6202	292.6202	(217)
Fuel for water heating, kWh/month	81.9218	72.5415	77.2286	68.2101	66.3488	60.0273	59.3820	61.5796	62.0853	68.9489	72.9827	81.0607	(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	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(231)
Lighting	15.4273	12.3763	11.1435	8.1642	6.3063	5.1523	5.7528	7.4777	9.7128	12.7437	14.3940	15.8561	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)
Annual totals kWh/year													
Space heating fuel - main system 1												348.4806	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												292.6202	
Water heating fuel used												832.3175	(219)
Space cooling fuel												0.0000	(221)
Electricity for pumps and fans:													
Total electricity for the above, kWh/year												0.0000	(231)
Electricity for lighting (calculated in Appendix L)												124.5070	(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												1305.3051	(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	348.4806	0.1575	54.8855	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	832.3175	0.1408	117.1643	(264)
Space and water heating			172.0498	(265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(267)
Energy for lighting	124.5070	0.1443	17.9702	(268)
Total CO2, kg/year			190.0200	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			3.5000	(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	348.4806	1.5830	551.6478	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	832.3175	1.5205	1265.5434	(278)
Space and water heating			1817.1911	(279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(281)
Energy for lighting	124.5070	1.5338	190.9730	(282)
Total Primary energy kWh/year			2008.1641	(286)
Dwelling Primary energy Rate (DPER)			37.0300	(287)

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1. Overall dwelling characteristics

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	54.2300 (1b)	x 2.7500 (2b)	= 149.1325 (1b) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	54.2300		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 149.1325 (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	2 * 10 = 20.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	Air changes per hour 20.0000 / (5) = 0.1341 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	5.0000 (17)
Infiltration rate	0.3841 (18)
Number of sides sheltered	0 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] = 1.0000 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.3841 (21)
Wind speed	Jan 5.1000 Feb 5.0000 Mar 4.9000 Apr 4.4000 May 4.3000 Jun 3.8000 Jul 3.8000 Aug 3.7000 Sep 4.0000 Oct 4.3000 Nov 4.5000 Dec 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	0.4897 0.4801 0.4705 0.4225 0.4129 0.3649 0.3649 0.3553 0.3841 0.4129 0.4321 0.4513 (22b)
Effective ac	0.6199 0.6153 0.6107 0.5893 0.5853 0.5666 0.5666 0.5631 0.5738 0.5853 0.5934 0.6018 (25)

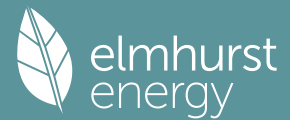
3. Heat losses and heat loss parameter

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
TER Opaque door			1.8900	1.0000	1.8900		(26)
TER Opening Type (Uw = 1.20)			11.6700	1.1450	13.3626		(27)
EXTERNAL	41.3900	11.6700	29.7200	0.1800	5.3496		(29a)
HALLWAY	26.4600	1.8900	24.5700	0.1800	4.4226		(29a)
Total net area of external elements Aum(A, m ²)			67.8500				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		25.0248		(33)
SOLID			24.8100	0.0000	0.0000		(32)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							225.9082 (35)
List of Thermal Bridges							
K1 Element				Length	Psi-value	Total	
E2 Other lintels (including other steel lintels)				5.0000	0.0500	0.2500	
E3 Sill				7.5000	0.0500	0.3750	
E4 Jamb				7.5000	0.0500	0.3750	
E5 Ground floor (normal)				9.0000	0.1600	1.4400	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							2.4400 (36)
Point Thermal bridges						(36a) =	0.0000
Total fabric heat loss						(33) + (36) + (36a) =	27.4648 (37)
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)							
(38)m	Jan 30.5087 Feb 30.2795 Mar 30.0549 Apr 28.9998 May 28.8023 Jun 27.8834 Jul 27.8834 Aug 27.7132 Sep 28.2374 Oct 28.8023 Nov 29.2017 Dec 29.6192 (38)						
Heat transfer coeff	57.9735 57.7443 57.5197 56.4645 56.2671 55.3482 55.3482 55.1780 55.7021 56.2671 56.6665 57.0840 (39)						
Average = Sum(39)m / 12 =							56.4636
HLP	Jan 1.0690 Feb 1.0648 Mar 1.0607 Apr 1.0412 May 1.0376 Jun 1.0206 Jul 1.0206 Aug 1.0175 Sep 1.0271 Oct 1.0376 Nov 1.0449 Dec 1.0526 (40)						
HLP (average)							1.0412
Days in mont	31 28 31 30 31 30 31 31 30 31 30 31						

4. Water heating energy requirements (kWh/year)

Assumed occupancy												1.8148 (42)
Hot water usage for mixer showers												
54.6471 53.8259 52.6292 50.3395 48.6498 46.7654 45.6943 46.8820 48.1839 50.2071 52.5460 54.4378 (42a)												
Hot water usage for baths												

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Hot water usage for other uses	23.6233	23.2725	22.7784	21.8674	21.1853	20.4290	20.0205	20.5110	21.0452	21.8545	22.7842	23.5434 (42b)
Average daily hot water use (litres/day)	33.2150	32.0072	30.7994	29.5915	28.3837	27.1759	27.1759	28.3837	29.5915	30.7994	32.0072	33.2150 (42c)
												102.4808 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy content (annual)	111.4854	109.1055	106.2070	101.7985	98.2189	94.3703	92.8907	95.7768	98.8206	102.8610	107.3374	111.1962 (44)
Distribution loss (46)m = 0.15 x (45)m	176.5657	155.3648	163.2361	139.3571	132.2215	116.0393	112.3432	118.5916	121.8557	139.5814	152.9218	174.1064 (45)
										Total = Sum(45)m =		1702.1847
Water storage loss:	26.4849	23.3047	24.4854	20.9036	19.8332	17.4059	16.8515	17.7887	18.2784	20.9372	22.9383	26.1160 (46)
Store volume												200.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.6525 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.8924 (55)
Total storage loss	27.6637	24.9865	27.6637	26.7713	27.6637	26.7713	27.6637	27.6637	26.7713	27.6637	26.7713	27.6637 (56)
If cylinder contains dedicated solar storage	27.6637	24.9865	27.6637	26.7713	27.6637	26.7713	27.6637	27.6637	26.7713	27.6637	26.7713	27.6637 (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	227.4918	201.3626	214.1622	188.6404	183.1475	165.3226	163.2693	169.5177	171.1390	190.5075	202.2051	225.0325 (62)
WWHRS	-24.9824	-22.0946	-23.1362	-19.1577	-17.8543	-15.2780	-14.3207	-15.2287	-15.8073	-18.6350	-21.1112	-24.5198 (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	202.5094	179.2679	191.0260	169.4827	165.2932	150.0446	148.9486	154.2890	155.3318	171.8725	181.0939	200.5127 (64)
12Total per year (kWh/year)										Total per year (kWh/year) = Sum(64)m =		2069.6722 (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	99.4489	88.4570	95.0169	85.7629	84.7045	78.0097	78.0950	80.1726	79.9437	87.1517	90.2731	98.6312 (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	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	79.8937	88.4538	79.8937	82.5569	79.8937	82.5569	79.8937	79.8937	82.5569	79.8937	82.5569	79.8937 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	158.1990	159.8407	155.7038	146.8971	135.7801	125.3317	118.3516	116.7100	120.8468	129.6535	140.7705	151.2189 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738 (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)	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906 (71)
Water heating gains (Table 5)	133.6679	131.6324	127.7109	119.1151	113.8501	108.3468	104.9664	107.7588	111.0329	117.1394	125.3794	132.5689 (72)
Total internal gains	424.9822	433.1483	416.5299	401.7905	382.7454	366.4569	353.4331	354.5840	364.6580	379.9081	401.9282	416.9029 (73)

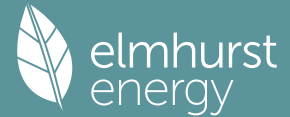
6. Solar gains

[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				
Southeast			5.8200	36.7938	0.6300	0.7000	0.7700	65.4440 (77)				
Northwest			5.8500	11.2829	0.6300	0.7000	0.7700	20.1720 (81)				
Solar gains	85.6160	152.5361	226.5039	310.4803	374.9922	384.2573	365.4808	315.5210	255.2967	173.3835	103.7685	72.4799 (83)
Total gains	510.5982	585.6845	643.0338	712.2708	757.7376	750.7141	718.9140	670.1050	619.9547	553.2916	505.6967	489.3829 (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	58.7002	58.9332	59.1633	60.2689	60.4803	61.4845	61.4845	61.6741	61.0938	60.4803	60.0541	59.6149
alpha	4.9133	4.9289	4.9442	5.0179	5.0320	5.0990	5.0990	5.1116	5.0729	5.0320	5.0036	4.9743
util living area	0.9791	0.9594	0.9196	0.8160	0.6534	0.4664	0.3379	0.3771	0.5979	0.8567	0.9581	0.9824 (86)
MIT	19.9819	20.1997	20.4713	20.7769	20.9384	20.9910	20.9986	20.9976	20.9700	20.7567	20.3376	19.9567 (87)
Th 2	20.0262	20.0297	20.0331	20.0491	20.0521	20.0662	20.0662	20.0688	20.0608	20.0521	20.0461	20.0397 (88)
util rest of house	0.9737	0.9494	0.9004	0.7785	0.5977	0.4007	0.2666	0.3016	0.5249	0.8173	0.9459	0.9778 (89)

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MIT 2	18.8695	19.1427	19.4757	19.8386	20.0042	20.0612	20.0657	20.0679	20.0421	19.8285	19.3304	18.8481 (90)
Living area fraction									fLA = Living area / (4) =			0.4955 (91)
MIT	19.4207	19.6664	19.9690	20.3035	20.4671	20.5219	20.5279	20.5285	20.5019	20.2884	19.8294	19.3974 (92)
Temperature adjustment												0.0000
adjusted MIT	19.4207	19.6664	19.9690	20.3035	20.4671	20.5219	20.5279	20.5285	20.5019	20.2884	19.8294	19.3974 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9694	0.9449	0.8990	0.7891	0.6227	0.4330	0.3019	0.3390	0.5599	0.8280	0.9426	0.9739	(94)
Useful gains	494.9797	553.4034	578.0575	562.0613	471.8293	325.0502	217.0630	227.1986	347.1064	458.1066	476.6896	476.5986	(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	876.5987	852.6749	774.7321	643.8942	493.2976	327.7666	217.4040	227.8047	356.5975	545.1399	721.3323	867.5270	(97)
Space heating kWh	283.9245	201.1104	146.3259	58.9197	15.9725	0.0000	0.0000	0.0000	0.0000	64.7528	176.1427	290.8507	(98a)
Space heating requirement - total per year (kWh/year)												1237.9992	
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	283.9245	201.1104	146.3259	58.9197	15.9725	0.0000	0.0000	0.0000	0.0000	64.7528	176.1427	290.8507	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1237.9992	
Space heating per m2										(98c) / (4) =		22.8287	(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	283.9245	201.1104	146.3259	58.9197	15.9725	0.0000	0.0000	0.0000	0.0000	64.7528	176.1427	290.8507	(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)	307.6105	217.8878	158.5329	63.8350	17.3049	0.0000	0.0000	0.0000	0.0000	70.1547	190.8372	315.1145	(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	202.5094	179.2679	191.0260	169.4827	165.2932	150.0446	148.9486	154.2890	155.3318	171.8725	181.0939	200.5127	(64)
Efficiency of water heater	84.8176	84.3182	83.4694	81.9424	80.5191	79.8000	79.8000	79.8000	79.8000	82.0764	83.9976	84.8929	(216)
Fuel for water heating, kWh/month	238.7587	212.6087	228.8575	206.8315	205.2845	188.0258	186.6524	193.3447	194.6513	209.4055	215.5940	236.1948	(217)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting	16.6003	13.3174	11.9909	8.7850	6.7858	5.5441	6.1902	8.0463	10.4513	13.7127	15.4885	17.0617	(232)
Electricity generated by PVs (Appendix M) (negative quantity)	-14.6530	-21.7766	-32.9837	-39.1560	-44.0652	-41.8269	-41.3350	-38.1121	-32.7416	-25.8155	-16.5075	-12.5425	(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)	-5.1979	-11.1823	-22.6887	-34.7599	-46.6256	-47.0741	-46.5026	-39.0542	-28.2208	-16.1949	-7.0060	-4.0909	(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												1341.2776	(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												2516.2094	(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)												133.9743	(232)
Energy saving/generation technologies (Appendices M, N and Q)													
PV generation												-670.1134	(233)

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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	3407.3479 (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	1341.2776	0.2100	281.6683 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	2516.2094	0.2100	528.4040 (264)
Space and water heating			810.0723 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	133.9743	0.1443	19.3366 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-361.5156	0.1335	-48.2535
PV Unit electricity exported	-308.5978	0.1253	-38.6761
Total			-86.9297 (269)
Total CO2, kg/year			754.4085 (272)
EPC Target Carbon Dioxide Emission Rate (TER)			13.9100 (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	1341.2776	1.1300	1515.6437 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	2516.2094	1.1300	2843.3166 (278)
Space and water heating			4358.9603 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	133.9743	1.5338	205.4942 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-361.5156	1.4932	-539.8295
PV Unit electricity exported	-308.5978	0.4600	-141.9599
Total			-681.7895 (283)
Total Primary energy kWh/year			4012.7659 (286)
Target Primary Energy Rate (TPER)			74.0000 (287)

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022) CALCULATION OF FABRIC ENERGY EFFICIENCY

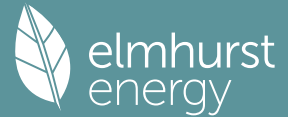
1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	54.2300 (1b)	x 2.7500 (2b)	= 149.1325 (1b) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	54.2300		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	149.1325 (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	2 * 10 = 20.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =
Pressure test	20.0000 / (5) = 0.1341 (8)
Pressure Test Method	Yes Blower Door

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Measured/design AP50 3.0000 (17)
Infiltration rate 0.2841 (18)
Number of sides sheltered 0 (19)

Shelter factor (20) = $1 - [0.075 \times (19)] = 1.0000$ (20)
Infiltration rate adjusted to include shelter factor (21) = $(18) \times (20) = 0.2841$ (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	0.3622	0.3551	0.3480	0.3125	0.3054	0.2699	0.2699	0.2628	0.2841	0.3054	0.3196	0.3338	(22b)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)													0.0000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =													0.0000 (23c)
Effective ac	0.5656	0.5631	0.5606	0.5488	0.5466	0.5364	0.5364	0.5345	0.5404	0.5466	0.5511	0.5557	(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	
WINDOWS (Uw = 1.20)			16.7200	1.1450	19.1450			(27)
CORRIDOR DOOR			1.8900	1.2000	2.2680			(26)
EXTERNAL	41.3900	16.7200	24.6700	0.1200	2.9604	70.0000	1726.9000	(29a)
HALLWAY	26.4600	1.8900	24.5700	0.1100	2.7027	70.0000	1719.9000	(29a)
Total net area of external elements Aum(A, m2)			67.8500					(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	27.0761		(33)
SOLID			24.8100	0.0000	0.0000	180.0000	4465.8000	(32)
FLOORS			54.2300			40.0000	2169.2000	(32d)
CEILING			54.2300			40.0000	2169.2000	(32b)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 12251.0000 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 225.9082 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total	
E2 Other lintels (including other steel lintels)	5.0000	0.1600	0.8000	
E3 Sill	7.5000	0.1600	1.2000	
E4 Jamb	7.5000	0.1600	1.2000	
E5 Ground floor (normal)	9.0000	0.1600	1.4400	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)				4.6400 (36)
Point Thermal bridges				0.0000 (36a) =
Total fabric heat loss				(33) + (36) + (36a) = 31.7161 (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	27.8357	27.7103	27.5874	27.0102	26.9022	26.3994	26.3994	26.3063	26.5931	26.9022	27.1207	27.3491	(38)
Heat transfer coeff	59.5518	59.4265	59.3036	58.7263	58.6183	58.1156	58.1156	58.0225	58.3092	58.6183	58.8368	59.0652	(39)
Average = Sum(39)m / 12 =													58.7258

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0981	1.0958	1.0936	1.0829	1.0809	1.0716	1.0716	1.0699	1.0752	1.0809	1.0849	1.0892	(40)
HLP (average)													1.0829
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy 1.8148 (42)
Hot water usage for mixer showers 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (42a)
Hot water usage for baths 23.6233 23.2725 22.7784 21.8674 21.1853 20.4290 20.0205 20.5110 21.0452 21.8545 22.7842 23.5434 (42b)
Hot water usage for other uses 33.2150 32.0072 30.7994 29.5915 28.3837 27.1759 27.1759 28.3837 29.5915 30.7994 32.0072 33.2150 (42c)
Average daily hot water use (litres/day) 52.0980 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	56.8383	55.2796	53.5778	51.4590	49.5691	47.6049	47.1964	48.8948	50.6368	52.6539	54.7914	56.7584	(44)
Energy conte	90.0180	78.7175	82.3470	70.4448	66.7295	58.5358	57.0799	60.5419	62.4402	71.4509	78.0604	88.8700	(45)
Energy content (annual)										Total = Sum(45)m =			865.2358
Distribution loss (46)m = 0.15 x (45)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	(46)
Water storage loss:													
Total storage 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	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary 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	(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	76.5153	66.9098	69.9950	59.8781	56.7201	49.7554	48.5179	51.4607	53.0742	60.7332	66.3514	75.5395	(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													

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76.5153	66.9098	69.9950	59.8781	56.7201	49.7554	48.5179	51.4607	53.0742	60.7332	66.3514	75.5395 (64)
Total per year (kWh/year) = Sum(64)m =											735.4504 (64)
Electric shower(s)											735 (64)
43.7633	38.9934	42.5793	40.6329	41.3954	39.4872	40.8034	41.3954	40.6329	42.5793	41.7787	43.7633 (64a)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =											497.8045 (64a)
Heat gains from water heating, kWh/month											
30.0696	26.4758	28.1436	25.1277	24.5289	22.3106	22.3303	23.2140	23.4268	25.8281	27.0325	29.8257 (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	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5												
	79.7932	88.3425	79.7932	82.4530	79.7932	82.4530	79.7932	79.7932	82.4530	79.7932	82.4530	79.7932 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5												
	158.1990	159.8407	155.7038	146.8971	135.7801	125.3317	118.3516	116.7100	120.8468	129.6535	140.7705	151.2189 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												
	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738 (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)												
	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906 (71)
Water heating gains (Table 5)												
	40.4162	39.3985	37.8274	34.8997	32.9689	30.9870	30.0139	31.2016	32.5372	34.7152	37.5452	40.0883 (72)
Total internal gains												
	328.6299	337.8032	323.5459	314.4712	298.7637	288.9932	278.3802	277.9263	286.0584	294.3835	310.9901	321.3219 (73)

6. Solar gains

[Jan]			Area	Solar flux	g	FF	Access	Gains				
			m2	Table 6a	Specific data	Specific data	factor	W				
				W/m2	or Table 6b	or Table 6c	Table 6d					
Southeast			8.3400	36.7938	0.6300	0.7000	0.7700	93.7806 (77)				
Northwest			8.3800	11.2829	0.6300	0.7000	0.7700	28.8960 (81)				
Solar gains	122.6766	218.5617	324.5400	444.8530	537.2765	550.5477	523.6470	452.0720	365.7915	248.4312	148.6862	103.8546 (83)
Total gains	451.3065	556.3649	648.0859	759.3242	836.0402	839.5410	802.0272	729.9983	651.8499	542.8147	459.6763	425.1765 (84)

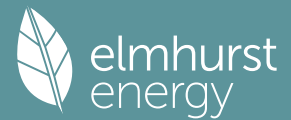
7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, n _{l,m} (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	57.1444	57.2650	57.3837	57.9477	58.0545	58.5567	58.5567	58.6507	58.3622	58.0545	57.8389	57.6152
alpha	4.8096	4.8177	4.8256	4.8632	4.8703	4.9038	4.9038	4.9100	4.8908	4.8703	4.8559	4.8410
util living area												
	0.9877	0.9679	0.9221	0.8008	0.6213	0.4384	0.3180	0.3640	0.5935	0.8740	0.9724	0.9905 (86)
MIT												
	19.8136	20.0954	20.4324	20.7777	20.9442	20.9916	20.9986	20.9974	20.9665	20.7067	20.1962	19.7630 (87)
Th 2												
	20.0024	20.0042	20.0061	20.0148	20.0164	20.0241	20.0241	20.0255	20.0211	20.0164	20.0131	20.0097 (88)
util rest of house												
	0.9842	0.9595	0.9031	0.7613	0.5648	0.3735	0.2479	0.2877	0.5183	0.8365	0.9637	0.9878 (89)
MIT 2												
	18.9411	19.2176	19.5394	19.8529	19.9832	20.0205	20.0237	20.0247	20.0050	19.8041	19.3265	18.8969 (90)
Living area fraction												
									f _{LA} = Living area / (4) =			0.4955 (91)
MIT												
	19.3734	19.6525	19.9819	20.3111	20.4593	20.5017	20.5068	20.5067	20.4814	20.2513	19.7574	19.3261 (92)
Temperature adjustment												
												0.0000
adjusted MIT												
	19.3734	19.6525	19.9819	20.3111	20.4593	20.5017	20.5068	20.5067	20.4814	20.2513	19.7574	19.3261 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	0.9815	0.9560	0.9026	0.7738	0.5908	0.4055	0.2827	0.3255	0.5544	0.8463	0.9609	0.9854 (94)
Useful gains	442.9355	531.8938	584.9468	587.5889	493.8995	340.4511	226.7087	237.6197	361.4109	459.4076	441.7126	418.9745 (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												
	897.6491	876.6892	799.5227	670.1335	513.4579	342.9800	227.0430	238.2783	372.0932	565.7425	744.7202	893.4244 (97)
Space heating kWh												
	338.3069	231.7025	159.6445	59.4321	14.5514	0.0000	0.0000	0.0000	0.0000	79.1131	218.1655	352.9908 (98a)
Space heating requirement - total per year (kWh/year)												1453.9069
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												
	338.3069	231.7025	159.6445	59.4321	14.5514	0.0000	0.0000	0.0000	0.0000	79.1131	218.1655	352.9908 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1453.9069
Space heating per m2												
										(98c) / (4) =		26.8100 (99)

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8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	546.2863	430.0551	440.9707	0.0000	0.0000	0.0000	0.0000 (100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9710	0.9865	0.9782	0.0000	0.0000	0.0000	0.0000 (101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	530.4413	424.2456	431.3749	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	952.5269	910.2554	827.5959	0.0000	0.0000	0.0000	0.0000 (103)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	303.9016	361.5913	294.7884	0.0000	0.0000	0.0000	0.0000 (104)
Cooled fraction									fC = cooled area / (4) =			1.0000 (105)
Intermittency factor (Table 10b)	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500 (106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	75.9754	90.3978	73.6971	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling requirement												240.0703 (107)
Energy for space heating												26.8100 (99)
Energy for space cooling												4.4269 (108)
Total												31.2369 (109)
Fabric Energy Efficiency (DFEE)												31.2 (109)

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

1. Overall dwelling characteristics

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	54.2300 (1b)	x	2.7500 (2b) = 149.1325 (1b) - (4)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	54.2300		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	149.1325 (5)

2. Ventilation rate

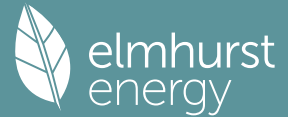
	m ³ per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	2 * 10 = 20.0000 (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) =	20.0000 / (5) = 0.1341 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	5.0000 (17)
Infiltration rate	0.3841 (18)
Number of sides sheltered	0 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] = 1.0000 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.3841 (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	0.4897	0.4801	0.4705	0.4225	0.4129	0.3649	0.3649	0.3553	0.3841	0.4129	0.4321	0.4513 (22b)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.0000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												0.0000 (23c)
Effective ac	0.6199	0.6153	0.6107	0.5893	0.5853	0.5666	0.5666	0.5631	0.5738	0.5853	0.5934	0.6018 (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
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TER Opaque door			1.8900	1.0000	1.8900	(26)
TER Opening Type (Uw = 1.20)			11.6700	1.1450	13.3626	(27)
EXTERNAL	41.3900	11.6700	29.7200	0.1800	5.3496	(29a)
HALLWAY	26.4600	1.8900	24.5700	0.1800	4.4226	(29a)
Total net area of external elements Aum(A, m2)			67.8500			(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		25.0248	(33)
SOLID			24.8100	0.0000	0.0000	(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 225.9082 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total	
E2 Other lintels (including other steel lintels)	5.0000	0.0500	0.2500	
E3 Sill	7.5000	0.0500	0.3750	
E4 Jamb	7.5000	0.0500	0.3750	
E5 Ground floor (normal)	9.0000	0.1600	1.4400	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)				2.4400 (36)
Point Thermal bridges			(36a) =	0.0000
Total fabric heat loss			(33) + (36) + (36a) =	27.4648 (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	
	30.5087	30.2795	30.0549	28.9998	28.8023	27.8834	27.8834	27.7132	28.2374	28.8023	29.2017	29.6192	(38)
Heat transfer coeff	57.9735	57.7443	57.5197	56.4645	56.2671	55.3482	55.3482	55.1780	55.7021	56.2671	56.6665	57.0840	(39)
Average = Sum(39)m / 12 =												56.4636	

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP (average)	1.0690	1.0648	1.0607	1.0412	1.0376	1.0206	1.0206	1.0175	1.0271	1.0376	1.0449	1.0526	(40)
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

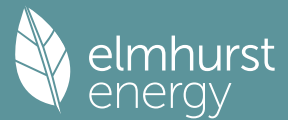
4. Water heating energy requirements (kWh/year)

Assumed occupancy													1.8148 (42)
Hot water usage for mixer showers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42a)
Hot water usage for baths	23.6233	23.2725	22.7784	21.8674	21.1853	20.4290	20.0205	20.5110	21.0452	21.8545	22.7842	23.5434	(42b)
Hot water usage for other uses	33.2150	32.0072	30.7994	29.5915	28.3837	27.1759	27.1759	28.3837	29.5915	30.7994	32.0072	33.2150	(42c)
Average daily hot water use (litres/day)												52.0980	(43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	56.8383	55.2796	53.5778	51.4590	49.5691	47.6049	47.1964	48.8948	50.6368	52.6539	54.7914	56.7584	(44)
Energy conte	90.0180	78.7175	82.3470	70.4448	66.7295	58.5358	57.0799	60.5419	62.4402	71.4509	78.0604	88.8700	(45)
Energy content (annual)										Total = Sum(45)m =		865.2358	
Distribution loss (46)m = 0.15 x (45)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	(46)
Water storage loss:													
Total storage 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	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary 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	(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	76.5153	66.9098	69.9950	59.8781	56.7201	49.7554	48.5179	51.4607	53.0742	60.7332	66.3514	75.5395	(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	76.5153	66.9098	69.9950	59.8781	56.7201	49.7554	48.5179	51.4607	53.0742	60.7332	66.3514	75.5395	(64)
12Total per year (kWh/year)										Total per year (kWh/year) = Sum(64)m =		735.4504	(64)
Electric shower(s)	43.7633	38.9934	42.5793	40.6329	41.3954	39.4872	40.8034	41.3954	40.6329	42.5793	41.7787	43.7633	(64a)
												497.8045	(64a)
Heat gains from water heating, kWh/month	30.0696	26.4758	28.1436	25.1277	24.5289	22.3106	22.3303	23.2140	23.4268	25.8281	27.0325	29.8257	(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	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	79.8937	88.4538	79.8937	82.5569	79.8937	82.5569	79.8937	79.8937	82.5569	79.8937	82.5569	79.8937	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	158.1990	159.8407	155.7038	146.8971	135.7801	125.3317	118.3516	116.7100	120.8468	129.6535	140.7705	151.2189	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	(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)	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	(71)
Water heating gains (Table 5)	40.4162	39.3985	37.8274	34.8997	32.9689	30.9870	30.0139	31.2016	32.5372	34.7152	37.5452	40.0883	(72)

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Total internal gains
328.7304 337.9144 323.6464 314.5751 298.8642 289.0971 278.4807 278.0268 286.1623 294.4840 311.0940 321.4224 (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				
Southeast			5.8200	36.7938	0.6300	0.7000	0.7700	65.4440 (77)				
Northwest			5.8500	11.2829	0.6300	0.7000	0.7700	20.1720 (81)				
Solar gains	85.6160	152.5361	226.5039	310.4803	374.9922	384.2573	365.4808	315.5210	255.2967	173.3835	103.7685	72.4799 (83)
Total gains	414.3465	490.4506	550.1503	625.0554	673.8564	673.3543	643.9615	593.5478	541.4590	467.8675	414.8625	393.9023 (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	58.7002	58.9332	59.1633	60.2689	60.4803	61.4845	61.4845	61.6741	61.0938	60.4803	60.0541	59.6149
alpha	4.9133	4.9289	4.9442	5.0179	5.0320	5.0990	5.0990	5.1116	5.0729	5.0320	5.0036	4.9743
util living area	0.9911	0.9793	0.9525	0.8686	0.7144	0.5164	0.3765	0.4244	0.6685	0.9122	0.9804	0.9929 (86)
MIT	19.7878	20.0220	20.3247	20.6932	20.9084	20.9858	20.9977	20.9958	20.9509	20.6534	20.1677	19.7611 (87)
Th 2	20.0262	20.0297	20.0331	20.0491	20.0521	20.0662	20.0662	20.0688	20.0608	20.0521	20.0461	20.0397 (88)
util rest of house	0.9886	0.9737	0.9396	0.8368	0.6586	0.4451	0.2975	0.3401	0.5923	0.8828	0.9741	0.9909 (89)
MIT 2	18.9344	19.1676	19.4635	19.8163	19.9949	20.0599	20.0656	20.0676	20.0359	19.7921	19.3261	18.9186 (90)
Living area fraction	19.3572	19.5910	19.8902	20.2508	20.4475	20.5187	20.5274	20.5275	20.4893	20.2189	19.7431	19.3360 (92)
MIT	19.3572	19.5910	19.8902	20.2508	20.4475	20.5187	20.5274	20.5275	20.4893	20.2189	19.7431	19.3360 (93)
Temperature adjustment												0.0000
adjusted MIT	19.3572	19.5910	19.8902	20.2508	20.4475	20.5187	20.5274	20.5275	20.4893	20.2189	19.7431	19.3360 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9863	0.9705	0.9374	0.8441	0.6827	0.4801	0.3367	0.3819	0.6282	0.8886	0.9716	0.9890 (94)
Useful gains	408.6826	475.9941	515.7085	527.6092	460.0557	323.2659	216.8070	226.6959	340.1525	415.7468	403.0716	389.5558 (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	872.9206	848.3197	770.2025	640.9176	492.1979	327.5883	217.3746	227.7479	355.8966	541.2268	716.4405	864.0259 (97)
Space heating kWh	345.3931	250.2028	189.3436	81.5820	23.9137	0.0000	0.0000	0.0000	0.0000	93.3571	225.6255	353.0057 (98a)
Space heating requirement - total per year (kWh/year)												1562.4236
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	345.3931	250.2028	189.3436	81.5820	23.9137	0.0000	0.0000	0.0000	0.0000	93.3571	225.6255	353.0057 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1562.4236
Space heating per m2										(98c) / (4) =		28.8111 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	520.2728	409.5765	419.3528	0.0000	0.0000	0.0000	0.0000 (100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9489	0.9756	0.9634	0.0000	0.0000	0.0000	0.0000 (101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	493.6632	399.6009	404.0127	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	758.1702	725.3954	668.0032	0.0000	0.0000	0.0000	0.0000 (103)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	190.4450	242.3911	196.4089	0.0000	0.0000	0.0000	0.0000 (104)
Cooled fraction	fc = cooled area / (4) =											1.0000 (105)
Intermittency factor (Table 10b)	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500 (106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	47.6113	60.5978	49.1022	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling requirement												157.3113 (107)
Energy for space heating												28.8111 (99)
Energy for space cooling												2.9008 (108)
Total												31.7119 (109)
Fabric Energy Efficiency (TFEE)												31.7 (109)

Building Regulations England Part L (BREL) Compliance Report

Approved Document L1 2021 Edition, England assessed by Array SAP 10 program, Array

Date: Wed 12 Apr 2023 06:35:35

Project Information			
Assessed By	Mark Simons	Building Type	Flat, End-terrace
OCDEA Registration	EES/004083	Assessment Date	2023-04-12

Dwelling Details			
Assessment Type	As designed	Total Floor Area	54 m ²
Site Reference	39-41 Richmond	Plot Reference	Flat 3 - Heatpump
Address	39-41 Richmond Street, MANCHESTER, M1 3WB		

Client Details	
Name	Mark Simons
Company	EAL Consult
Address	17 Dobree Avenue, London, NW10 2AD

This report covers items included within the SAP calculations. It is not a complete report of regulations compliance.

1a Target emission rate and dwelling emission rate			
Fuel for main heating system	Electricity		
Target carbon dioxide emission rate	14.09 kgCO ₂ /m ²		
Dwelling carbon dioxide emission rate	3.61 kgCO ₂ /m ²		OK
1b Target primary energy rate and dwelling primary energy			
Target primary energy	74.95 kWh _{PE} /m ²		
Dwelling primary energy	38.14 kWh _{PE} /m ²		OK
1c Target fabric energy efficiency and dwelling fabric energy efficiency			
Target fabric energy efficiency	32.5 kWh/m ²		
Dwelling fabric energy efficiency	32.0 kWh/m ²		OK

2a Fabric U-values				
Element	Maximum permitted average U-Value [W/m ² K]	Dwelling average U-Value [W/m ² K]	Element with highest individual U-Value	
External walls	0.26	0.12	Walls (1) (0.12)	OK
Party walls	0.2	0	Party Wall (1) (0)	N/A
Curtain walls	1.6	0	N/A	N/A
Floors	0.18	N/A	N/A	N/A
Roofs	0.16	0.11	Roof (1) (0.11)	OK
Windows, doors, and roof windows	1.6	1.2	FRONT (1.2)	OK
Rooflights	2.2	N/A	N/A	N/A

2b Envelope elements (better than typically expected values are flagged with a subsequent (!))			
Name	Net area [m ²]	U-Value [W/m ² K]	
Exposed wall: Walls (1)	24.67	0.12 (!)	
Sheltered wall: Walls (2)	24.57	0.12 (!)	
Party wall: Party Wall (1)	24.81	0 (!)	
Exposed roof: Roof (1)	7.28	0.11	

2c Openings (better than typically expected values are flagged with a subsequent (!))				
Name	Area [m ²]	Orientation	Frame factor	U-Value [W/m ² K]
FRONT, WINDOWS	8.38	North West	0.7	1.2
REAR, WINDOWS	8.34	South East	0.7	1.2
ENTRANCE DOOR, CORRIDOR DOOR	1.89	North East	N/A	1.2

2d Thermal bridging (better than typically expected values are flagged with a subsequent (!))				
Building part 1 - Main Dwelling: Thermal bridging calculated from linear thermal transmittances for each junction				
Main element	Junction detail	Source	Psi value [W/mK]	Drawing / reference
External wall	E2: Other lintels (including other steel lintels)	Calculated by person with suitable expertise	0.16	
External wall	E3: Sill	Calculated by person with suitable expertise	0.16	

Main element	Junction detail	Source	Psi value [W/mK]	Drawing / reference
External wall	E4: Jamb	Calculated by person with suitable expertise	0.16	
External wall	E5: Ground floor (normal)	Calculated by person with suitable expertise	0.16	

3 Air permeability (better than typically expected values are flagged with a subsequent (!))

Maximum permitted air permeability at 50Pa	8 m ³ /hm ²	
Dwelling air permeability at 50Pa	3 m ³ /hm ² , Design value (!)	OK
Air permeability test certificate reference		

4 Space heating

Main heating system 1: Heat pump with radiators or underfloor heating - Electricity

Efficiency	345.1%
Emitter type	Underfloor
Flow temperature	45°C
System type	Heat Pump
Manufacturer	Midea
Model	MHC-V6W/D2N8-B
Commissioning	

Secondary heating system: N/A

Fuel	N/A
Efficiency	N/A
Commissioning	

5 Hot water

Cylinder/store - type: Cylinder

Capacity	200 litres
Declared heat loss	2.1 kWh/day
Primary pipework insulated	Yes
Manufacturer	
Model	
Commissioning	

Waste water heat recovery system 1 - type: N/A

Efficiency	
Manufacturer	
Model	

6 Controls

Main heating 1 - type: Time and temperature zone control by arrangement of plumbing and electrical services

Function	
Ecodesign class	
Manufacturer	
Model	

Water heating - type: Cylinder thermostat

Manufacturer	
Model	

7 Lighting

Minimum permitted light source efficacy	75 lm/W	
Lowest light source efficacy	100 lm/W	OK
External lights control	N/A	

8 Mechanical ventilation

System type: N/A

Maximum permitted specific fan power	N/A	
Specific fan power	N/A	N/A
Minimum permitted heat recovery efficiency	N/A	
Heat recovery efficiency	N/A	N/A
Manufacturer/Model		
Commissioning		

9 Local generation

N/A

10 Heat networks	
N/A	
11 Supporting documentary evidence	
N/A	
12 Declarations	
a. Assessor Declaration	
This declaration by the assessor is confirmation that the contents of this BREL Compliance Report are a true and accurate reflection based upon the design information submitted for this dwelling for the purpose of carrying out the "As designed" assessment, and that the supporting documentary evidence (SAP Conventions, Appendix 1 (documentary evidence) schedules the minimum documentary evidence required) has been reviewed in the course of preparing this BREL Compliance Report.	
Signed: Name:	Assessor ID: Date:
b. Client Declaration	
N/A	

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Property Reference	39-41 Richmond				Issued on Date	12/04/2023
Assessment Reference	Flat 3 - Heatpump		Prop Type Ref	39-41 Richmond		
Property	39-41 , Richmond Street, MANCHESTER, M1 3WB					
SAP Rating	87 B	DER	3.61	TER	14.09	
Environmental	97 A	% DER < TER				74.38
CO ₂ Emissions (t/year)	0.18	DFEE	32.00	TFEE	32.51	
Compliance Check	See BREL	% DFEE < TFEE				1.56
% DPER < TPER	49.11	DPER	38.14	TPER	74.95	
Assessor Details	Mr. Mark Simons				Assessor ID	5542-0001
Client	EAL Consult, Mark Simons					

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	54.2300 (1b)	x 2.7500 (2b)	= 149.1325 (1b) - (4)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	54.2300		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 149.1325 (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	2 * 10 = 20.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	Air changes per hour
Pressure test	20.0000 / (5) = 0.1341 (8)
Pressure Test Method	Yes
Measured/design AP50	Blower Door
Infiltration rate	3.0000 (17)
Number of sides sheltered	0.2841 (18)
	0 (19)

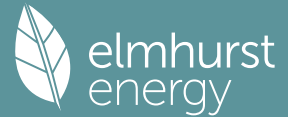
Shelter factor	(20) = 1 - [0.075 x (19)] = 1.0000 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.2841 (21)

	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	0.3622	0.3551	0.3480	0.3125	0.3054	0.2699	0.2699	0.2628	0.2841	0.3054	0.3196	0.3338 (22b)
Effective ac	0.5656	0.5631	0.5606	0.5488	0.5466	0.5364	0.5364	0.5345	0.5404	0.5466	0.5511	0.5557 (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
WINDOWS (Uw = 1.20)			16.7200	1.1450	19.1450		(27)
CORRIDOR DOOR			1.8900	1.2000	2.2680		(26)
EXTERNAL	41.3900	16.7200	24.6700	0.1200	2.9604	70.0000	1726.9000 (29a)
HALLWAY	26.4600	1.8900	24.5700	0.1100	2.7027	70.0000	1719.9000 (29a)
FLAT ROOF	7.2800		7.2800	0.1100	0.8008	9.0000	65.5200 (30)
Total net area of external elements Aum(A, m ²)			75.1300				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	27.8769		(33)
SOLID			24.8100	0.0000	0.0000	180.0000	4465.8000 (32)

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FLOORS 54.2300 40.0000 2169.2000 (32d)
CEILING 46.9500 30.0000 1408.5000 (32b)

Heat capacity $C_m = \text{Sum}(A \times k)$ (28)...(30) + (32) + (32a)...(32e) = 11555.8200 (34)
Thermal mass parameter (TMP = C_m / TFA) in kJ/m²K 213.0891 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	5.0000	0.1600	0.8000
E3 Sill	7.5000	0.1600	1.2000
E4 Jamb	7.5000	0.1600	1.2000
E5 Ground floor (normal)	9.0000	0.1600	1.4400

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 4.6400 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 32.5169 (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	27.8357	27.7103	27.5874	27.0102	26.9022	26.3994	26.3994	26.3063	26.5931	26.9022	27.1207	27.3491 (38)
Heat transfer coeff	60.3526	60.2273	60.1044	59.5271	59.4191	58.9164	58.9164	58.8233	59.1100	59.4191	59.6376	59.8660 (39)
Average = Sum(39)m / 12 =												59.5266

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.1129	1.1106	1.1083	1.0977	1.0957	1.0864	1.0864	1.0847	1.0900	1.0957	1.0997	1.1039 (40)
HLP (average)												1.0977
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

4. Water heating energy requirements (kWh/year)

Assumed occupancy 1.8148 (42)
Hot water usage for mixer showers 54.6471 53.8259 52.6292 50.3395 48.6498 46.7654 45.6943 46.8820 48.1839 50.2071 52.5460 54.4378 (42a)
Hot water usage for baths 24.8666 24.4973 23.9773 23.0184 22.3004 21.5042 21.0742 21.5906 22.1529 23.0048 23.9834 24.7826 (42b)
Hot water usage for other uses 34.9632 33.6918 32.4204 31.1490 29.8776 28.6062 28.6062 29.8776 31.1490 32.4204 33.6918 34.9632 (42c)
Average daily hot water use (litres/day) 105.2228 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	114.4769	112.0150	109.0268	104.5069	100.8277	96.8758	95.3747	98.3502	101.4857	105.6323	110.2212	114.1835 (44)
Energy conte	181.3035	159.5079	167.5702	143.0647	135.7335	119.1201	115.3475	121.7781	125.1421	143.3420	157.0303	178.7837 (45)
Energy content (annual)												1747.7235
Distribution loss (46)m = 0.15 x (45)m	27.1955	23.9262	25.1355	21.4597	20.3600	17.8680	17.3021	18.2667	18.7713	21.5013	23.5545	26.8176 (46)

Water storage loss:
Store volume 200.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): 2.1000 (48)
Temperature factor from Table 2b 0.6000 (49)
Enter (49) or (54) in (55) 1.2600 (55)
Total storage loss 39.0600 35.2800 39.0600 37.8000 39.0600 37.8000 39.0600 39.0600 37.8000 39.0600 37.8000 39.0600 (56)

If cylinder contains dedicated solar storage 39.0600 35.2800 39.0600 37.8000 39.0600 37.8000 39.0600 39.0600 37.8000 39.0600 37.8000 39.0600 (57)
Primary loss 31.1612 28.1456 31.1612 30.1560 31.1612 22.5120 23.2624 23.2624 22.5120 31.1612 30.1560 31.1612 (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 251.5247 222.9335 237.7914 211.0207 205.9547 179.4321 177.6699 184.1005 185.4541 213.5632 224.9863 249.0049 (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 251.5247 222.9335 237.7914 211.0207 205.9547 179.4321 177.6699 184.1005 185.4541 213.5632 224.9863 249.0049 (64)
Total per year (kWh/year) = Sum(64)m = 2543.4359 (64)
2543 (64)

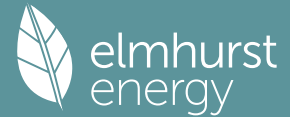
12Total per year (kWh/year)
Electric shower(s) 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (64a)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 0.0000 (64a)

Heat gains from water heating, kWh/month 116.4604 103.7768 111.8940 101.9338 101.3084 87.8570 88.2109 90.3491 89.8593 103.8382 106.5774 115.6226 (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 90.7382 90.7382 90.7382 90.7382 90.7382 90.7382 90.7382 90.7382 90.7382 90.7382 90.7382 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 79.7932 88.3425 79.7932 82.4530 79.7932 82.4530 79.7932 79.7932 82.4530 79.7932 82.4530 79.7932 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 158.1990 159.8407 155.7038 146.8971 135.7801 125.3317 118.3516 116.7100 120.8468 129.6535 140.7705 151.2189 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 32.0738 32.0738 32.0738 32.0738 32.0738 32.0738 32.0738 32.0738 32.0738 32.0738 32.0738 32.0738 (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) -72.5906 -72.5906 -72.5906 -72.5906 -72.5906 -72.5906 -72.5906 -72.5906 -72.5906 -72.5906 -72.5906 -72.5906 (71)
Water heating gains (Table 5) 156.5327 154.4298 150.3952 141.5747 136.1671 122.0237 118.5631 121.4370 124.8046 139.5674 148.0241 155.4067 (72)

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Total internal gains
444.7465 452.8345 436.1138 421.1463 401.9620 380.0299 366.9294 368.1617 378.3259 399.2357 421.4691 436.6403 (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
Southeast				8.3400	36.7938		0.6300		0.7000		0.7700		93.7806 (77)
Northwest				8.3800	11.2829		0.6300		0.7000		0.7700		28.8960 (81)
Solar gains	122.6766	218.5617	324.5400	444.8530	537.2765	550.5477	523.6470	452.0720	365.7915	248.4312	148.6862	103.8546	(83)
Total gains	567.4231	671.3962	760.6537	865.9993	939.2384	930.5776	890.5764	820.2337	744.1174	647.6669	570.1553	540.4948	(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	53.1866	53.2973	53.4063	53.9242	54.0222	54.4832	54.4832	54.5694	54.3047	54.0222	53.8243	53.6189	
alpha	4.5458	4.5532	4.5604	4.5949	4.6015	4.6322	4.6322	4.6380	4.6203	4.6015	4.5883	4.5746	
util living area	0.9665	0.9337	0.8711	0.7384	0.5661	0.4015	0.2904	0.3286	0.5322	0.8017	0.9360	0.9721	(86)
Living	20.1548	20.3520	20.5785	20.7956	20.8973	20.9274	20.9322	20.9315	20.9129	20.7651	20.4318	20.1184	
Non living	19.0282	19.2713	19.5421	19.7901	19.8910	19.9230	19.9259	19.9271	19.9106	19.7675	19.3810	18.9889	
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	20.5676	20.3520	20.5785	20.7956	20.8973	20.9274	20.9322	20.9315	20.9129	20.7651	20.4318	20.2418	(87)
Th 2	19.9903	19.9922	19.9940	20.0027	20.0044	20.0119	20.0119	20.0133	20.0090	20.0044	20.0011	19.9976	(88)
util rest of house	0.9585	0.9192	0.8454	0.6962	0.5121	0.3411	0.2255	0.2588	0.4617	0.7561	0.9194	0.9653	(89)
MIT 2	19.6067	19.2713	19.5421	19.7901	19.8910	19.9230	19.9259	19.9271	19.9106	19.7675	19.3810	19.1707	(90)
Living area fraction									fLA = Living area / (4) =			0.4955	(91)
MIT	20.0829	19.8068	20.0556	20.2883	20.3896	20.4206	20.4245	20.4247	20.4072	20.2618	19.9016	19.7014	(92)
Temperature adjustment												0.0000	
adjusted MIT	20.0829	19.8068	20.0556	20.2883	20.3896	20.4206	20.4245	20.4247	20.4072	20.2618	19.9016	19.7014	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9593	0.9161	0.8471	0.7088	0.5334	0.3662	0.2527	0.2880	0.4905	0.7687	0.9175	0.9630	(94)
Useful gains	544.3447	615.0934	644.3778	613.8359	500.9748	340.7989	225.0349	236.2188	365.0245	497.8470	523.1404	520.4744	(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	952.5368	897.7950	814.7515	677.9108	516.3276	342.9313	225.3244	236.7483	372.8202	574.0973	763.4585	928.0062	(97)
Space heating kWh	303.6949	189.9755	126.7581	46.1339	11.4225	0.0000	0.0000	0.0000	0.0000	56.7302	173.0290	303.2036	(98a)
Space heating requirement - total per year (kWh/year)												1210.9477	
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	303.6949	189.9755	126.7581	46.1339	11.4225	0.0000	0.0000	0.0000	0.0000	56.7302	173.0290	303.2036	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1210.9477	
Space heating per m2										(98c) / (4) =		22.3298	(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 %)													345.1312 (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	303.6949	189.9755	126.7581	46.1339	11.4225	0.0000	0.0000	0.0000	0.0000	56.7302	173.0290	303.2036	(98)
Space heating efficiency (main heating system 1)	345.1312	345.1312	345.1312	345.1312	345.1312	0.0000	0.0000	0.0000	0.0000	345.1312	345.1312	345.1312	(210)
Space heating fuel (main heating system)	87.9941	55.0444	36.7275	13.3671	3.3096	0.0000	0.0000	0.0000	0.0000	16.4373	50.1343	87.8517	(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)

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Water heating													
Water heating requirement	251.5247	222.9335	237.7914	211.0207	205.9547	179.4321	177.6699	184.1005	185.4541	213.5632	224.9863	249.0049 (64)	
Efficiency of water heater												292.6170 (216)	
(217)m	292.6170	292.6170	292.6170	292.6170	292.6170	292.6170	292.6170	292.6170	292.6170	292.6170	292.6170	292.6170 (217)	
Fuel for water heating, kWh/month	85.9570	76.1861	81.2637	72.1150	70.3837	61.3198	60.7175	62.9152	63.3777	72.9839	76.8876	85.0959 (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	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (231)	
Lighting	15.4273	12.3763	11.1435	8.1642	6.3063	5.1523	5.7528	7.4777	9.7128	12.7437	14.3940	15.8561 (232)	
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (233a)	
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234a)	
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235a)	
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235c)	
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (233b)	
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234b)	
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235b)	
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235d)	
Annual totals kWh/year													
Space heating fuel - main system 1												350.8659 (211)	
Space heating fuel - main system 2												0.0000 (213)	
Space heating fuel - secondary												0.0000 (215)	
Efficiency of water heater												292.6170	
Water heating fuel used												869.2031 (219)	
Space cooling fuel												0.0000 (221)	
Electricity for pumps and fans:													
Total electricity for the above, kWh/year												0.0000 (231)	
Electricity for lighting (calculated in Appendix L)												124.5070 (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												1344.5760 (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	350.8659	0.1574	55.2434 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	869.2031	0.1410	122.5203 (264)
Space and water heating			177.7637 (265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (267)
Energy for lighting	124.5070	0.1443	17.9702 (268)
Total CO2, kg/year			195.7339 (272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			3.6100 (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	350.8659	1.5828	555.3590 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	869.2031	1.5212	1322.2450 (278)
Space and water heating			1877.6040 (279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (281)
Energy for lighting	124.5070	1.5338	190.9730 (282)
Total Primary energy kWh/year			2068.5770 (286)
Dwelling Primary energy Rate (DPER)			38.1400 (287)

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1. Overall dwelling characteristics

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	54.2300 (1b)	x 2.7500 (2b)	= 149.1325 (1b) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	54.2300		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 149.1325 (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	2 * 10 = 20.0000 (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)+(6g)+(7a)+(7b)+(7c) =	20.0000 / (5) = 0.1341 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	5.0000 (17)
Infiltration rate	0.3841 (18)
Number of sides sheltered	0 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] = 1.0000 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.3841 (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												
Effective ac	0.4897	0.4801	0.4705	0.4225	0.4129	0.3649	0.3649	0.3553	0.3841	0.4129	0.4321	0.4513 (22b)
	0.6199	0.6153	0.6107	0.5893	0.5853	0.5666	0.5666	0.5631	0.5738	0.5853	0.5934	0.6018 (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
TER Opaque door			1.8900	1.0000	1.8900		(26)
TER Opening Type (Uw = 1.20)			11.6700	1.1450	13.3626		(27)
EXTERNAL	41.3900	11.6700	29.7200	0.1800	5.3496		(29a)
HALLWAY	26.4600	1.8900	24.5700	0.1800	4.4226		(29a)
FLAT ROOF	7.2800		7.2800	0.1100	0.8008		(30)
Total net area of external elements Aum(A, m ²)			75.1300				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	25.8256		(33)
SOLID			24.8100	0.0000	0.0000		(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m²K 221.7466 (35)

List of Thermal Bridges

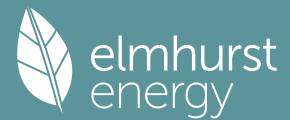
	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	5.0000	0.0500	0.2500
E3 Sill	7.5000	0.0500	0.3750
E4 Jamb	7.5000	0.0500	0.3750
E5 Ground floor (normal)	9.0000	0.1600	1.4400
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			2.4400 (36)
Point Thermal bridges		(36a) =	0.0000
Total fabric heat loss		(33) + (36) + (36a) =	28.2656 (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	30.5087	30.2795	30.0549	28.9998	28.8023	27.8834	27.8834	27.7132	28.2374	28.8023	29.2017	29.6192 (38)
Average = Sum(39)m / 12 =	58.7743	58.5451	58.3205	57.2653	57.0679	56.1490	56.1490	55.9788	56.5029	57.0679	57.4673	57.8848 (39)
												57.2644
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.0838	1.0796	1.0754	1.0560	1.0523	1.0354	1.0354	1.0322	1.0419	1.0523	1.0597	1.0674 (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	1.8148 (42)
Hot water usage for mixer showers	

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Hot water usage for baths	54.6471	53.8259	52.6292	50.3395	48.6498	46.7654	45.6943	46.8820	48.1839	50.2071	52.5460	54.4378 (42a)
Hot water usage for other uses	23.6233	23.2725	22.7784	21.8674	21.1853	20.4290	20.0205	20.5110	21.0452	21.8545	22.7842	23.5434 (42b)
Average daily hot water use (litres/day)	33.2150	32.0072	30.7994	29.5915	28.3837	27.1759	27.1759	28.3837	29.5915	30.7994	32.0072	33.2150 (42c)
												102.4808 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy content (annual)	111.4854	109.1055	106.2070	101.7985	98.2189	94.3703	92.8907	95.7768	98.8206	102.8610	107.3374	111.1962 (44)
Distribution loss (46)m = 0.15 x (45)m	176.5657	155.3648	163.2361	139.3571	132.2215	116.0393	112.3432	118.5916	121.8557	139.5814	152.9218	174.1064 (45)
Water storage loss:												
Store volume												200.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.6525 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.8924 (55)
Total storage loss												
If cylinder contains dedicated solar storage	27.6637	24.9865	27.6637	26.7713	27.6637	26.7713	27.6637	27.6637	26.7713	27.6637	26.7713	27.6637 (56)
Primary loss	27.6637	24.9865	27.6637	26.7713	27.6637	26.7713	27.6637	27.6637	26.7713	27.6637	26.7713	27.6637 (57)
Combi 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)
Total heat required for water heating calculated for each month	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (61)
WWHRS	227.4918	201.3626	214.1622	188.6404	183.1475	165.3226	163.2693	169.5177	171.1390	190.5075	202.2051	225.0325 (62)
PV diverter	-24.9824	-22.0946	-23.1362	-19.1577	-17.8543	-15.2780	-14.3207	-15.2287	-15.8073	-18.6350	-21.1112	-24.5198 (63a)
Solar input	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000 (63b)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63c)
Output from w/h	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63d)
	202.5094	179.2679	191.0260	169.4827	165.2932	150.0446	148.9486	154.2890	155.3318	171.8725	181.0939	200.5127 (64)
12Total per year (kWh/year)												2069.6722 (64)
Electric shower(s)												2070 (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)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =												0.0000 (64a)
Heat gains from water heating, kWh/month	99.4489	88.4570	95.0169	85.7629	84.7045	78.0097	78.0950	80.1726	79.9437	87.1517	90.2731	98.6312 (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	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	79.8937	88.4538	79.8937	82.5569	79.8937	82.5569	79.8937	79.8937	82.5569	79.8937	82.5569	79.8937 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	158.1990	159.8407	155.7038	146.8971	135.7801	125.3317	118.3516	116.7100	120.8468	129.6535	140.7705	151.2189 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738 (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)	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906 (71)
Water heating gains (Table 5)	133.6679	131.6324	127.7109	119.1151	113.8501	108.3468	104.9664	107.7588	111.0329	117.1394	125.3794	132.5689 (72)
Total internal gains	424.9822	433.1483	416.5299	401.7905	382.7454	366.4569	353.4331	354.5840	364.6580	379.9081	401.9282	416.9029 (73)

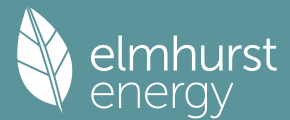
6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	Specific data or Table 6c	FF	Access factor Table 6d	Gains W					
Southeast				5.8200	36.7938	0.6300	0.7000		0.7700	65.4440 (77)					
Northwest				5.8500	11.2829	0.6300	0.7000		0.7700	20.1720 (81)					
Solar gains				85.6160	152.5361	226.5039	310.4803	374.9922	384.2573	365.4808	315.5210	255.2967	173.3835	103.7685	72.4799 (83)
Total gains				510.5982	585.6845	643.0338	712.2708	757.7376	750.7141	718.9140	670.1050	619.9547	553.2916	505.6967	489.3829 (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, n11,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	56.8338	57.0563	57.2761	58.3314	58.5332	59.4911	59.4911	59.6720	59.1185	58.5332	58.1264	57.7071
alpha	4.7889	4.8038	4.8184	4.8888	4.9022	4.9661	4.9661	4.9781	4.9412	4.9022	4.8751	4.8471
util living area	0.9785	0.9589	0.9197	0.8185	0.6587	0.4722	0.3425	0.3822	0.6037	0.8583	0.9576	0.9819 (86)
MIT	19.9399	20.1612	20.4397	20.7569	20.9300	20.9891	20.9982	20.9970	20.9654	20.7374	20.3047	19.9142 (87)
Th 2	20.0141	20.0176	20.0210	20.0370	20.0400	20.0539	20.0539	20.0565	20.0486	20.0400	20.0339	20.0275 (88)

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util rest of house												
MIT 2	0.9730	0.9488	0.9006	0.7813	0.6026	0.4051	0.2695	0.3049	0.5298	0.8193	0.9454	0.9771 (89)
Living area fraction	18.8094	19.0870	19.4288	19.8063	19.9850	20.0479	20.0533	20.0554	20.0267	19.7973	19.2817	18.7871 (90)
MIT	19.3695	19.6193	19.9297	20.2773	20.4532	20.5143	20.5215	20.5220	fLA = Living area / (4) =	20.2631	19.7886	0.4955 (91)
Temperature adjustment									20.4918	20.2631	19.7886	19.3456 (92)
adjusted MIT	19.3695	19.6193	19.9297	20.2773	20.4532	20.5143	20.5215	20.5220	20.4918	20.2631	19.7886	0.0000 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9684	0.9439	0.8986	0.7912	0.6274	0.4380	0.3057	0.3432	0.5650	0.8292	0.9417	0.9729 (94)
Useful gains	494.4665	552.8409	577.8402	563.5324	475.3886	328.8306	219.7597	229.9911	350.2745	458.7828	476.2382	476.1343 (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	885.7017	861.7425	783.2258	651.5242	499.5281	332.0802	220.1886	230.7420	361.1548	551.4549	729.1779	876.6979 (97)
Space heating kWh	291.0790	207.5819	152.8069	63.3541	17.9598	0.0000	0.0000	0.0000	0.0000	68.9480	182.1166	298.0193 (98a)
Space heating requirement - total per year (kWh/year)												1281.8656
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	291.0790	207.5819	152.8069	63.3541	17.9598	0.0000	0.0000	0.0000	0.0000	68.9480	182.1166	298.0193 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1281.8656
Space heating per m2										(98c) / (4) =		23.6376 (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	291.0790	207.5819	152.8069	63.3541	17.9598	0.0000	0.0000	0.0000	0.0000	68.9480	182.1166	298.0193 (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)	315.3619	224.8991	165.5546	68.6393	19.4581	0.0000	0.0000	0.0000	0.0000	74.6999	197.3094	322.8811 (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	202.5094	179.2679	191.0260	169.4827	165.2932	150.0446	148.9486	154.2890	155.3318	171.8725	181.0939	200.5127 (64)
Efficiency of water heater (217)m	84.8728	84.3895	83.5640	82.0631	80.6006	79.8000	79.8000	79.8000	79.8000	82.1848	84.0724	79.8000 (216)
Fuel for water heating, kWh/month	238.6035	212.4292	228.5986	206.5273	205.0769	188.0258	186.6524	193.3447	194.6513	209.1293	215.4023	236.0454 (219)
Space cooling fuel requirement (221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041 (231)
Lighting	16.6003	13.3174	11.9909	8.7850	6.7858	5.5441	6.1902	8.0463	10.4513	13.7127	15.4885	17.0617 (232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-14.6530	-21.7766	-32.9837	-39.1560	-44.0652	-41.8269	-41.3350	-38.1121	-32.7416	-25.8155	-16.5075	-12.5425 (233a)
Electricity generated by wind turbines (Appendix M) (negative quantity) (234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity) (235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) (235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235c)
Electricity generated by PVs (Appendix M) (negative quantity) (233b)m	-5.1979	-11.1823	-22.6887	-34.7599	-46.6256	-47.0741	-46.5026	-39.0542	-28.2208	-16.1949	-7.0060	-4.0909 (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												1388.8035 (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												2514.4865 (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)												133.9743 (232)

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Energy saving/generation technologies (Appendices M ,N and Q)

PV generation	-670.1134 (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	3453.1509 (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	1388.8035	0.2100	291.6487 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	2514.4865	0.2100	528.0422 (264)
Space and water heating			819.6909 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	133.9743	0.1443	19.3366 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-361.5156	0.1335	-48.2535
PV Unit electricity exported	-308.5978	0.1253	-38.6761
Total			-86.9297 (269)
Total CO2, kg/year			764.0271 (272)
EPC Target Carbon Dioxide Emission Rate (TER)			14.0900 (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	1388.8035	1.1300	1569.3479 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	2514.4865	1.1300	2841.3698 (278)
Space and water heating			4410.7177 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	133.9743	1.5338	205.4942 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-361.5156	1.4932	-539.8295
PV Unit electricity exported	-308.5978	0.4600	-141.9599
Total			-681.7895 (283)
Total Primary energy kWh/year			4064.5232 (286)
Target Primary Energy Rate (TPER)			74.9500 (287)

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF FABRIC ENERGY EFFICIENCY

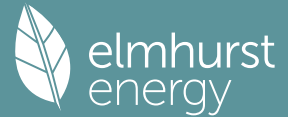
1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	54.2300 (1b)	x 2.7500 (2b)	= 149.1325 (1b) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	54.2300		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 149.1325 (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	2 * 10 = 20.0000 (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) =
	20.0000 / (5) = 0.1341 (8)

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Pressure test
Pressure Test Method
Measured/design AP50
Infiltration rate
Number of sides sheltered

Yes
Blower Door
3.0000 (17)
0.2841 (18)
0 (19)

Shelter factor (20) = 1 - [0.075 x (19)] = 1.0000 (20)
Infiltration rate adjusted to include shelter factor (21) = (18) x (20) = 0.2841 (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	0.3622	0.3551	0.3480	0.3125	0.3054	0.2699	0.2699	0.2628	0.2841	0.3054	0.3196	0.3338	(22b)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.0000	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												0.0000	(23c)
Effective ac	0.5656	0.5631	0.5606	0.5488	0.5466	0.5364	0.5364	0.5345	0.5404	0.5466	0.5511	0.5557	(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	
WINDOWS (Uw = 1.20)			16.7200	1.1450	19.1450			(27)
CORRIDOR DOOR			1.8900	1.2000	2.2680			(26)
EXTERNAL	41.3900	16.7200	24.6700	0.1200	2.9604	70.0000	1726.9000	(29a)
HALLWAY	26.4600	1.8900	24.5700	0.1100	2.7027	70.0000	1719.9000	(29a)
FLAT ROOF	7.2800		7.2800	0.1100	0.8008	9.0000	65.5200	(30)
Total net area of external elements Aum(A, m2)			75.1300					(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) = 27.8769			(33)
SOLID			24.8100	0.0000	0.0000	180.0000	4465.8000	(32)
FLOORS			54.2300			40.0000	2169.2000	(32d)
CEILING			46.9500			40.0000	1878.0000	(32b)

Heat capacity Cm = Sum(A x k)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K (28)...(30) + (32) + (32a)...(32e) = 12025.3200 (34)
List of Thermal Bridges 221.7466 (35)

K1 Element	Length	Psi-value	Total	
E2 Other lintels (including other steel lintels)	5.0000	0.1600	0.8000	
E3 Sill	7.5000	0.1600	1.2000	
E4 Jamb	7.5000	0.1600	1.2000	
E5 Ground floor (normal)	9.0000	0.1600	1.4400	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)				4.6400 (36)
Point Thermal bridges				0.0000 (36a) =
Total fabric heat loss				(33) + (36) + (36a) = 32.5169 (37)

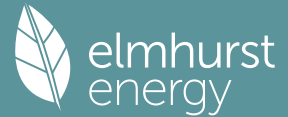
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	27.8357	27.7103	27.5874	27.0102	26.9022	26.3994	26.3994	26.3063	26.5931	26.9022	27.1207	27.3491	(38)
Heat transfer coeff	60.3526	60.2273	60.1044	59.5271	59.4191	58.9164	58.9164	58.8233	59.1100	59.4191	59.6376	59.8660	(39)
Average = Sum(39)m / 12 =												59.5266	
HLP	1.1129	1.1106	1.1083	1.0977	1.0957	1.0864	1.0864	1.0847	1.0900	1.0957	1.0997	1.1039	(40)
HLP (average)												1.0977	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy													1.8148 (42)
Hot water usage for mixer showers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42a)
Hot water usage for baths	23.6233	23.2725	22.7784	21.8674	21.1853	20.4290	20.0205	20.5110	21.0452	21.8545	22.7842	23.5434	(42b)
Hot water usage for other uses	33.2150	32.0072	30.7994	29.5915	28.3837	27.1759	27.1759	28.3837	29.5915	30.7994	32.0072	33.2150	(42c)
Average daily hot water use (litres/day)												52.0980	(43)
Daily hot water use	56.8383	55.2796	53.5778	51.4590	49.5691	47.6049	47.1964	48.8948	50.6368	52.6539	54.7914	56.7584	(44)
Energy conte	90.0180	78.7175	82.3470	70.4448	66.7295	58.5358	57.0799	60.5419	62.4402	71.4509	78.0604	88.8700	(45)
Energy content (annual)										Total = Sum(45)m =		865.2358	
Distribution loss (46)m = 0.15 x (45)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	(46)
Water storage loss:													
Total storage 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	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary 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	(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	76.5153	66.9098	69.9950	59.8781	56.7201	49.7554	48.5179	51.4607	53.0742	60.7332	66.3514	75.5395	(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)

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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	76.5153	66.9098	69.9950	59.8781	56.7201	49.7554	48.5179	51.4607	53.0742	60.7332	66.3514	75.5395 (64)
12Total per year (kWh/year)	Total per year (kWh/year) = Sum(64)m =											735.4504 (64)
Electric shower(s)	43.7633	38.9934	42.5793	40.6329	41.3954	39.4872	40.8034	41.3954	40.6329	42.5793	41.7787	43.7633 (64a)
	Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =											497.8045 (64a)
Heat gains from water heating, kWh/month	30.0696	26.4758	28.1436	25.1277	24.5289	22.3106	22.3303	23.2140	23.4268	25.8281	27.0325	29.8257 (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	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382	90.7382 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	79.7932	88.3425	79.7932	82.4530	79.7932	82.4530	79.7932	79.7932	82.4530	79.7932	82.4530	79.7932 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	158.1990	159.8407	155.7038	146.8971	135.7801	125.3317	118.3516	116.7100	120.8468	129.6535	140.7705	151.2189 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738	32.0738 (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)	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906 (71)
Water heating gains (Table 5)	40.4162	39.3985	37.8274	34.8997	32.9689	30.9870	30.0139	31.2016	32.5372	34.7152	37.5452	40.0883 (72)
Total internal gains	328.6299	337.8032	323.5459	314.4712	298.7637	288.9932	278.3802	277.9263	286.0584	294.3835	310.9901	321.3219 (73)

6. Solar gains

[Jan]			Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	Specific data or Table 6c	FF Access factor Table 6d	Gains W						
Southeast			8.3400	36.7938	0.6300	0.7000	0.7700	93.7806 (77)						
Northwest			8.3800	11.2829	0.6300	0.7000	0.7700	28.8960 (81)						
Solar gains			122.6766	218.5617	324.5400	444.8530	537.2765	550.5477	523.6470	452.0720	365.7915	248.4312	148.6862	103.8546 (83)
Total gains			451.3065	556.3649	648.0859	759.3242	836.0402	839.5410	802.0272	729.9983	651.8499	542.8147	459.6763	425.1765 (84)

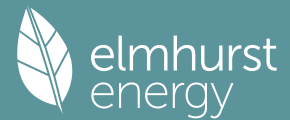
7. Mean internal temperature (heating season)

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	55.3475	55.4627	55.5761	56.1150	56.2170	56.6968	56.6968	56.7865	56.5110	56.2170	56.0111	55.7974
alpha	4.6898	4.6975	4.7051	4.7410	4.7478	4.7798	4.7798	4.7858	4.7674	4.7478	4.7341	4.7198
util living area	0.9871	0.9673	0.9220	0.8033	0.6264	0.4437	0.3222	0.3686	0.5989	0.8749	0.9717	0.9900 (86)
MIT	19.7701	20.0559	20.4003	20.7581	20.9366	20.9899	20.9983	20.9967	20.9616	20.6861	20.1618	19.7188 (87)
Th 2	19.9903	19.9922	19.9940	20.0027	20.0044	20.0119	20.0119	20.0133	20.0090	20.0044	20.0011	19.9976 (88)
util rest of house	0.9836	0.9588	0.9031	0.7640	0.5694	0.3775	0.2504	0.2906	0.5228	0.8378	0.9629	0.9872 (89)
MIT 2	18.8902	19.1706	19.4999	19.8256	19.9662	20.0077	20.0115	20.0124	19.9903	19.7761	19.2846	18.8453 (90)
Living area fraction	fLA = Living area / (4) =											0.4955 (91)
MIT	19.3262	19.6093	19.9460	20.2876	20.4470	20.4944	20.5004	20.5001	20.4715	20.2270	19.7192	19.2781 (92)
Temperature adjustment												0.0000
adjusted MIT	19.3262	19.6093	19.9460	20.2876	20.4470	20.4944	20.5004	20.5001	20.4715	20.2270	19.7192	19.2781 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	0.9806	0.9550	0.9021	0.7759	0.5953	0.4101	0.2860	0.3293	0.5591	0.8469	0.9599	0.9846 (94)
Useful gains	442.5490	531.3227	584.6415	589.1718	497.7231	344.2615	229.3811	240.3768	364.4769	459.7307	441.2448	418.6493 (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	906.8689	885.8991	808.1642	677.8715	519.7390	347.2750	229.7984	241.1841	376.6223	572.0264	752.5796	902.6634 (97)
Space heating kWh	345.4540	238.2754	166.3008	63.8638	16.3799	0.0000	0.0000	0.0000	0.0000	83.5480	224.1610	360.1065 (98a)
Space heating requirement - total per year (kWh/year)												1498.0895
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	345.4540	238.2754	166.3008	63.8638	16.3799	0.0000	0.0000	0.0000	0.0000	83.5480	224.1610	360.1065 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1498.0895

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Space heating per m2

(98c) / (4) = 27.6247 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	553.8138	435.9811	447.0567	0.0000	0.0000	0.0000	0.0000 (100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9672	0.9843	0.9752	0.0000	0.0000	0.0000	0.0000 (101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	535.6682	429.1503	435.9534	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	952.5269	910.2554	827.5959	0.0000	0.0000	0.0000	0.0000 (103)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	300.1383	357.9422	291.3820	0.0000	0.0000	0.0000	0.0000 (104)
Cooled fraction									fc = cooled area / (4) =			1.0000 (105)
Intermittency factor (Table 10b)	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500 (106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	75.0346	89.4856	72.8455	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling requirement												237.3656 (107)
Energy for space heating												27.6247 (99)
Energy for space cooling												4.3770 (108)
Total												32.0018 (109)
Fabric Energy Efficiency (DFEE)												32.0 (109)

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY

1. Overall dwelling characteristics

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	54.2300 (1b)	x 2.7500 (2b)	= 149.1325 (1b) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	54.2300		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 149.1325 (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	2 * 10 = 20.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)

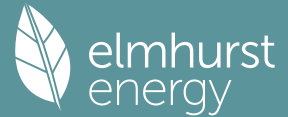
Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	Air changes per hour
Pressure test		20.0000 / (5) = 0.1341 (8)
Pressure Test Method		Yes
Measured/design AP50		Blower Door
Infiltration rate		5.0000 (17)
Number of sides sheltered		0.3841 (18)
		0 (19)

Shelter factor	(20) = 1 - [0.075 x (19)] = 1.0000 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.3841 (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	0.4897	0.4801	0.4705	0.4225	0.4129	0.3649	0.3649	0.3553	0.3841	0.4129	0.4321	0.4513 (22b)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.0000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												0.0000 (23c)
Effective ac	0.6199	0.6153	0.6107	0.5893	0.5853	0.5666	0.5666	0.5631	0.5738	0.5853	0.5934	0.6018 (25)

3. Heat losses and heat loss parameter

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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 Opaque door			1.8900	1.0000	1.8900		(26)						
TER Opening Type (Uw = 1.20)			11.6700	1.1450	13.3626		(27)						
EXTERNAL	41.3900	11.6700	29.7200	0.1800	5.3496		(29a)						
HALLWAY	26.4600	1.8900	24.5700	0.1800	4.4226		(29a)						
FLAT ROOF	7.2800		7.2800	0.1100	0.8008		(30)						
Total net area of external elements Aum(A, m2)			75.1300				(31)						
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		25.8256		(33)						
SOLID			24.8100	0.0000	0.0000		(32)						
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							221.7466 (35)						
List of Thermal Bridges													
K1 Element				Length	Psi-value	Total							
E2 Other lintels (including other steel lintels)				5.0000	0.0500	0.2500							
E3 Sill				7.5000	0.0500	0.3750							
E4 Jamb				7.5000	0.0500	0.3750							
E5 Ground floor (normal)				9.0000	0.1600	1.4400							
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							2.4400 (36)						
Point Thermal bridges						(36a) =	0.0000						
Total fabric heat loss						(33) + (36) + (36a) =	28.2656 (37)						
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)													
(38)m	Jan 30.5087	Feb 30.2795	Mar 30.0549	Apr 28.9998	May 28.8023	Jun 27.8834	Jul 27.8834	Aug 27.7132	Sep 28.2374	Oct 28.8023	Nov 29.2017	Dec 29.6192	(38)
Heat transfer coeff	58.7743	58.5451	58.3205	57.2653	57.0679	56.1490	56.1490	55.9788	56.5029	57.0679	57.4673	57.8848	(39)
Average = Sum(39)m / 12 =												57.2644	
HLP	Jan 1.0838	Feb 1.0796	Mar 1.0754	Apr 1.0560	May 1.0523	Jun 1.0354	Jul 1.0354	Aug 1.0322	Sep 1.0419	Oct 1.0523	Nov 1.0597	Dec 1.0674	(40)
HLP (average)												1.0560	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

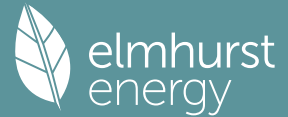
4. Water heating energy requirements (kwh/year)													

Assumed occupancy													1.8148 (42)
Hot water usage for mixer showers													
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000													(42a)
Hot water usage for baths													
23.6233 23.2725 22.7784 21.8674 21.1853 20.4290 20.0205 20.5110 21.0452 21.8545 22.7842 23.5434													(42b)
Hot water usage for other uses													
33.2150 32.0072 30.7994 29.5915 28.3837 27.1759 27.1759 28.3837 29.5915 30.7994 32.0072 33.2150													(42c)
Average daily hot water use (litres/day)													52.0980 (43)
Daily hot water use	Jan 56.8383	Feb 55.2796	Mar 53.5778	Apr 51.4590	May 49.5691	Jun 47.6049	Jul 47.1964	Aug 48.8948	Sep 50.6368	Oct 52.6539	Nov 54.7914	Dec 56.7584	(44)
Energy conte	90.0180	78.7175	82.3470	70.4448	66.7295	58.5358	57.0799	60.5419	62.4402	71.4509	78.0604	88.8700	(45)
Energy content (annual)													
Distribution loss (46)m = 0.15 x (45)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 0.0000													(46)
Water storage loss:													
Total storage loss	0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000												(56)
If cylinder contains dedicated solar storage													
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000													(57)
Primary loss	0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000												(59)
Combi loss	0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000												(61)
Total heat required for water heating calculated for each month													
76.5153 66.9098 69.9950 59.8781 56.7201 49.7554 48.5179 51.4607 53.0742 60.7332 66.3514 75.5395													(62)
WWHRS	0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000												(63a)
PV diverter	0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000												(63b)
Solar input	0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000												(63c)
FGHRS	0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000												(63d)
Output from w/h	76.5153 66.9098 69.9950 59.8781 56.7201 49.7554 48.5179 51.4607 53.0742 60.7332 66.3514 75.5395												(64)
12Total per year (kwh/year)													735.4504 (64)
Electric shower(s)	43.7633 38.9934 42.5793 40.6329 41.3954 39.4872 40.8034 41.3954 40.6329 42.5793 41.7787 43.7633												(64a)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =													497.8045 (64a)
Heat gains from water heating, kWh/month	30.0696 26.4758 28.1436 25.1277 24.5289 22.3106 22.3303 23.2140 23.4268 25.8281 27.0325 29.8257												(65)

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

Metabolic gains (Table 5), Watts													
(66)m	Jan 90.7382	Feb 90.7382	Mar 90.7382	Apr 90.7382	May 90.7382	Jun 90.7382	Jul 90.7382	Aug 90.7382	Sep 90.7382	Oct 90.7382	Nov 90.7382	Dec 90.7382	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
79.8937 88.4538 79.8937 82.5569 79.8937 82.5569 79.8937 79.8937 82.5569 79.8937 82.5569 79.8937													(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
158.1990 159.8407 155.7038 146.8971 135.7801 125.3317 118.3516 116.7100 120.8468 129.6535 140.7705 151.2189													(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
32.0738 32.0738 32.0738 32.0738 32.0738 32.0738 32.0738 32.0738 32.0738 32.0738 32.0738 32.0738													(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 0.0000												(70)

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Losses e.g. evaporation (negative values) (Table 5)	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906	-72.5906 (71)
Water heating gains (Table 5)	40.4162	39.3985	37.8274	34.8997	32.9689	30.9870	30.0139	31.2016	32.5372	34.7152	37.5452	40.0883 (72)
Total internal gains	328.7304	337.9144	323.6464	314.5751	298.8642	289.0971	278.4807	278.0268	286.1623	294.4840	311.0940	321.4224 (73)

6. Solar gains

[Jan]			Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	Specific data or Table 6c	FF	Access factor Table 6d	Gains W			
Southeast			5.8200	36.7938	0.6300	0.7000	0.7700	65.4440 (77)				
Northwest			5.8500	11.2829	0.6300	0.7000	0.7700	20.1720 (81)				
Solar gains	85.6160	152.5361	226.5039	310.4803	374.9922	384.2573	365.4808	315.5210	255.2967	173.3835	103.7685	72.4799 (83)
Total gains	414.3465	490.4506	550.1503	625.0554	673.8564	673.3543	643.9615	593.5478	541.4590	467.8675	414.8625	393.9023 (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)												
tau	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
alpha	56.8338	57.0563	57.2761	58.3314	58.5332	59.4911	59.4911	59.6720	59.1185	58.5332	58.1264	57.7071
util living area	4.7889	4.8038	4.8184	4.8888	4.9022	4.9661	4.9661	4.9781	4.9412	4.9022	4.8751	4.8471
	0.9906	0.9787	0.9520	0.8699	0.7189	0.5224	0.3816	0.4300	0.6737	0.9126	0.9799	0.9925 (86)
MIT	19.7438	19.9816	20.2907	20.6701	20.8975	20.9831	20.9971	20.9949	20.9443	20.6313	20.1328	19.7165 (87)
Th 2	20.0141	20.0176	20.0210	20.0370	20.0400	20.0539	20.0539	20.0565	20.0486	20.0400	20.0339	20.0275 (88)
util rest of house	0.9880	0.9730	0.9392	0.8384	0.6630	0.4498	0.3006	0.3437	0.5970	0.8834	0.9734	0.9904 (89)
MIT 2	18.8830	19.1196	19.4219	19.7854	19.9754	20.0465	20.0532	20.0551	20.0201	19.7623	19.2835	18.8665 (90)
Living area fraction									fLA = Living area / (4) =			0.4955 (91)
MIT	19.3095	19.5467	19.8524	20.2237	20.4323	20.5106	20.5209	20.5207	20.4780	20.1929	19.7043	19.2877 (92)
Temperature adjustment												0.0000
adjusted MIT	19.3095	19.5467	19.8524	20.2237	20.4323	20.5106	20.5209	20.5207	20.4780	20.1929	19.7043	19.2877 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	0.9856	0.9696	0.9366	0.8451	0.6868	0.4853	0.3408	0.3865	0.6329	0.8886	0.9707	0.9883 (94)
Ext temp.	408.3799	475.5285	515.2584	528.2162	462.7718	326.7842	219.4496	229.3925	342.6791	415.7597	402.6896	389.3002 (95)
Heat loss rate W	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)
Space heating kWh	882.1719	857.4918	778.7172	648.4581	498.3343	331.8726	220.1525	230.6734	360.3765	547.4449	724.3364	873.3473 (97)
Space heating requirement - total per year (kWh/year)	352.5012	256.6794	196.0133	86.5742	26.4585	0.0000	0.0000	0.0000	0.0000	97.9738	231.5858	360.1311 (98a)
Solar heating kWh												1607.9172
Solar heating contribution - total per year (kWh/year)	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)
Space heating kWh	352.5012	256.6794	196.0133	86.5742	26.4585	0.0000	0.0000	0.0000	0.0000	97.9738	231.5858	360.1311 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1607.9172
Space heating per m2										(98c) / (4) =		29.6500 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b												
Ext. temp.	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heat loss rate W	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	527.8004	415.5024	425.4388	0.0000	0.0000	0.0000	0.0000 (100)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.9432	0.9722	0.9588	0.0000	0.0000	0.0000	0.0000 (101)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	497.7985	403.9324	407.9095	0.0000	0.0000	0.0000	0.0000 (102)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	758.1702	725.3954	668.0032	0.0000	0.0000	0.0000	0.0000 (103)
Cooled fraction	0.0000	0.0000	0.0000	0.0000	0.0000	187.4676	239.1684	193.5097	0.0000	0.0000	0.0000	0.0000 (104)
Intermittency factor (Table 10b)									fC = cooled area / (4) =			1.0000 (105)
Space cooling kWh	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500 (106)
Space cooling requirement	0.0000	0.0000	0.0000	0.0000	0.0000	46.8669	59.7921	48.3774	0.0000	0.0000	0.0000	0.0000 (107)
Energy for space heating												155.0364 (107)
Energy for space cooling												29.6500 (99)
Total												2.8589 (108)
Fabric Energy Efficiency (TFEE)												32.5088 (109)

Building Regulations England Part L (BREL) Compliance Report

Approved Document L1 2021 Edition, England assessed by Array SAP 10 program, Array

Date: Wed 12 Apr 2023 06:36:01

Project Information			
Assessed By	Mark Simons	Building Type	Flat, End-terrace
OCDEA Registration	EES/004083	Assessment Date	2023-04-12

Dwelling Details			
Assessment Type	As designed	Total Floor Area	47 m ²
Site Reference	39-41 Richmond	Plot Reference	Flat 4 - Heatpump
Address	39-41 Richmond Street, MANCHESTER, M1 3WB		

Client Details	
Name	Mark Simons
Company	EAL Consult
Address	17 Dobree Avenue, London, NW10 2AD

This report covers items included within the SAP calculations. It is not a complete report of regulations compliance.

1a Target emission rate and dwelling emission rate			
Fuel for main heating system	Electricity		
Target carbon dioxide emission rate	17.55 kgCO ₂ /m ²		
Dwelling carbon dioxide emission rate	4.32 kgCO ₂ /m ²		OK
1b Target primary energy rate and dwelling primary energy			
Target primary energy	93.73 kWh _{PE} /m ²		
Dwelling primary energy	45.55 kWh _{PE} /m ²		OK
1c Target fabric energy efficiency and dwelling fabric energy efficiency			
Target fabric energy efficiency	44.0 kWh/m ²		
Dwelling fabric energy efficiency	42.3 kWh/m ²		OK

2a Fabric U-values				
Element	Maximum permitted average U-Value [W/m ² K]	Dwelling average U-Value [W/m ² K]	Element with highest individual U-Value	
External walls	0.26	0.12	Walls (1) (0.12)	OK
Party walls	0.2	N/A	N/A	N/A
Curtain walls	1.6	N/A	N/A	N/A
Floors	0.18	N/A	N/A	N/A
Roofs	0.16	0.11	Roof (1) (0.11)	OK
Windows, doors, and roof windows	1.6	1.2	FRONT (1.2)	OK
Rooflights	2.2	N/A	N/A	N/A

2b Envelope elements (better than typically expected values are flagged with a subsequent (!))			
Name	Net area [m ²]	U-Value [W/m ² K]	
Exposed wall: Walls (1)	52.43	0.12 (!)	
Sheltered wall: Walls (2)	20.06	0.12 (!)	
Exposed roof: Roof (1)	46.95	0.11	

2c Openings (better than typically expected values are flagged with a subsequent (!))				
Name	Area [m ²]	Orientation	Frame factor	U-Value [W/m ² K]
FRONT, WINDOWS	8.38	North West	0.7	1.2
REAR, WINDOWS	6.7	South East	0.7	1.2
ENTRANCE DOOR, CORRIDOR DOOR	1.89	North East	N/A	1.2

2d Thermal bridging (better than typically expected values are flagged with a subsequent (!))				
Building part 1 - Main Dwelling: Thermal bridging calculated from linear thermal transmittances for each junction				
Main element	Junction detail	Source	Psi value [W/mK]	Drawing / reference
External wall	E2: Other lintels (including other steel lintels)	Calculated by person with suitable expertise	0.16	
External wall	E3: Sill	Calculated by person with suitable expertise	0.16	

Main element	Junction detail	Source	Psi value [W/mK]	Drawing / reference
External wall	E4: Jamb	Calculated by person with suitable expertise	0.16	
External wall	E5: Ground floor (normal)	Calculated by person with suitable expertise	0.16	

3 Air permeability (better than typically expected values are flagged with a subsequent (!))

Maximum permitted air permeability at 50Pa	8 m ³ /hm ²	
Dwelling air permeability at 50Pa	3 m ³ /hm ² , Design value (!)	OK
Air permeability test certificate reference		

4 Space heating

Main heating system 1: Heat pump with radiators or underfloor heating - Electricity

Efficiency	345.9%
Emitter type	Underfloor
Flow temperature	45°C
System type	Heat Pump
Manufacturer	Midea
Model	MHC-V6W/D2N8-B
Commissioning	

Secondary heating system: N/A

Fuel	N/A
Efficiency	N/A
Commissioning	

5 Hot water

Cylinder/store - type: Cylinder

Capacity	200 litres
Declared heat loss	2.1 kWh/day
Primary pipework insulated	Yes
Manufacturer	
Model	
Commissioning	

Waste water heat recovery system 1 - type: N/A

Efficiency	
Manufacturer	
Model	

6 Controls

Main heating 1 - type: Time and temperature zone control by arrangement of plumbing and electrical services

Function	
Ecodesign class	
Manufacturer	
Model	

Water heating - type: Cylinder thermostat

Manufacturer	
Model	

7 Lighting

Minimum permitted light source efficacy	75 lm/W	
Lowest light source efficacy	100 lm/W	OK
External lights control	N/A	

8 Mechanical ventilation

System type: N/A

Maximum permitted specific fan power	N/A	
Specific fan power	N/A	N/A
Minimum permitted heat recovery efficiency	N/A	
Heat recovery efficiency	N/A	N/A
Manufacturer/Model		
Commissioning		

9 Local generation

N/A

10 Heat networks	
N/A	
11 Supporting documentary evidence	
N/A	
12 Declarations	
a. Assessor Declaration	
This declaration by the assessor is confirmation that the contents of this BREL Compliance Report are a true and accurate reflection based upon the design information submitted for this dwelling for the purpose of carrying out the "As designed" assessment, and that the supporting documentary evidence (SAP Conventions, Appendix 1 (documentary evidence) schedules the minimum documentary evidence required) has been reviewed in the course of preparing this BREL Compliance Report.	
Signed: Name:	Assessor ID: Date:
b. Client Declaration	
N/A	

Full SAP Calculation Printout



Property Reference	39-41 Richmond				Issued on Date	12/04/2023
Assessment Reference	Flat 4 - Heatpump		Prop Type Ref	39-41 Richmond		
Property	39-41 , Richmond Street, MANCHESTER, M1 3WB					
SAP Rating	86 B	DER	4.32	TER	17.55	
Environmental	97 A	% DER < TER				75.38
CO ₂ Emissions (t/year)	0.19	DFEE	42.29	TFEE	43.99	
Compliance Check	See BREL	% DFEE < TFEE				3.85
% DPER < TPER	51.40	DPER	45.55	TPER	93.73	
Assessor Details	Mr. Mark Simons				Assessor ID	5542-0001
Client	EAI Consult, Mark Simons					

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	46.9500 (1b)	2.7500 (2b)	129.1125 (1b) - (4)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	46.9500		
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 129.1125 (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	2 * 10 = 20.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	Air changes per hour
Pressure test	20.0000 / (5) = 0.1549 (8)
Pressure Test Method	Yes
Measured/design AP50	Blower Door
Infiltration rate	3.0000 (17)
Number of sides sheltered	0.3049 (18)
	0 (19)

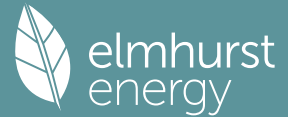
Shelter factor	(20) = 1 - [0.075 x (19)] = 1.0000 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.3049 (21)

	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	0.3888	0.3811	0.3735	0.3354	0.3278	0.2897	0.2897	0.2820	0.3049	0.3278	0.3430	0.3583 (22b)
Effective ac	0.5756	0.5726	0.5698	0.5562	0.5537	0.5420	0.5420	0.5398	0.5465	0.5537	0.5588	0.5642 (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
WINDOWS (U _w = 1.20)			15.0800	1.1450	17.2672		(27)
CORRIDOR DOOR			1.8900	1.2000	2.2680		(26)
EXTERNAL	67.5100	15.0800	52.4300	0.1200	6.2916	70.0000	3670.1000 (29a)
HALLWAY	21.9500	1.8900	20.0600	0.1100	2.2066	70.0000	1404.2000 (29a)
FLAT ROOF	46.9500		46.9500	0.1100	5.1645	9.0000	422.5500 (30)
Total net area of external elements A _{um} (A, m ²)			136.4100				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) = 33.1979		(33)
FLOORS			46.9500			40.0000	1878.0000 (32d)

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Heat capacity $C_m = \text{Sum}(A \times k)$ (28)...(30) + (32) + (32a)...(32e) = 7374.8500 (34)
 Thermal mass parameter (TMP = C_m / TFA) in kJ/m²K 157.0788 (35)

List of Thermal Bridges			Length	Psi-value	Total
K1 Element					
E2 Other lintels (including other steel lintels)			5.0000	0.1600	0.8000
E3 Sill			7.5000	0.1600	1.2000
E4 Jamb			7.5000	0.1600	1.2000
E5 Ground floor (normal)			9.0000	0.1600	1.4400
Thermal bridges (Sum(L x Psi) calculated using Appendix K)					4.6400 (36)
Point Thermal bridges					0.0000 (36a) =
Total fabric heat loss					(33) + (36) + (36a) = 37.8379 (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	24.5231	24.3981	24.2756	23.7000	23.5923	23.0910	23.0910	22.9981	23.2841	23.5923	23.8101	24.0379 (38)
Average = Sum(39)m / 12 =	62.3610	62.2360	62.1134	61.5379	61.4302	60.9289	60.9289	60.8360	61.1220	61.4302	61.6480	61.8758 (39)
HLP	1.3282	1.3256	1.3230	1.3107	1.3084	1.2977	1.2977	1.2958	1.3019	1.3084	1.3131	1.3179 (40)
HLP (average)												1.3107
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

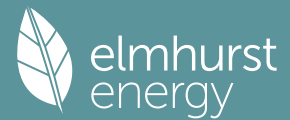
4. Water heating energy requirements (kWh/year)

Assumed occupancy												1.6008 (42)
Hot water usage for mixer showers	51.0601	50.2928	49.1746	47.0352	45.4564	43.6957	42.6949	43.8046	45.0211	46.9115	49.0968	50.8645 (42a)
Hot water usage for baths	23.2429	22.8977	22.4116	21.5153	20.8442	20.1000	19.6981	20.1808	20.7063	21.5026	22.4174	23.1643 (42b)
Hot water usage for other uses	32.6569	31.4694	30.2819	29.0944	27.9068	26.7193	26.7193	27.9068	29.0944	30.2819	31.4694	32.6569 (42c)
Average daily hot water use (litres/day)												98.3136 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy content (annual)	106.9599	104.6599	101.8681	97.6449	94.2074	90.5151	89.1123	91.8922	94.8218	98.6960	102.9836	106.6857 (44)
Distribution loss (46)m = 0.15 x (45)m	169.3984	149.0343	156.5675	133.6710	126.8213	111.2988	107.7736	113.7818	116.9247	133.9296	146.7190	167.0440 (45)
	Total = Sum(45)m =											1632.9639
	25.4098	22.3551	23.4851	20.0506	19.0232	16.6948	16.1660	17.0673	17.5387	20.0894	22.0079	25.0566 (46)
Water storage loss:												
Store volume												200.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												2.1000 (48)
Temperature factor from Table 2b												0.6000 (49)
Enter (49) or (54) in (55)												1.2600 (55)
Total storage loss	39.0600	35.2800	39.0600	37.8000	39.0600	37.8000	39.0600	39.0600	37.8000	39.0600	37.8000	39.0600 (56)
If cylinder contains dedicated solar storage	39.0600	35.2800	39.0600	37.8000	39.0600	37.8000	39.0600	39.0600	37.8000	39.0600	37.8000	39.0600 (57)
Primary loss	31.1612	28.1456	31.1612	30.1560	31.1612	22.5120	23.2624	23.2624	22.5120	31.1612	30.1560	31.1612 (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	239.6196	212.4599	226.7887	201.6270	197.0425	171.6108	170.0960	176.1042	177.2367	204.1508	214.6750	237.2652 (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	239.6196	212.4599	226.7887	201.6270	197.0425	171.6108	170.0960	176.1042	177.2367	204.1508	214.6750	237.2652 (64)
12Total per year (kWh/year)	Total per year (kWh/year) = Sum(64)m =											2428.6763 (64)
Electric shower(s)												2429 (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)
	Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =											0.0000 (64a)
Heat gains from water heating, kWh/month	112.5019	100.2944	108.2356	98.8104	98.3450	85.2565	85.6927	87.6904	87.1271	100.7085	103.1489	111.7191 (65)

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

Metabolic gains (Table 5), Watts												
(66)m	Jan 80.0414	Feb 80.0414	Mar 80.0414	Apr 80.0414	May 80.0414	Jun 80.0414	Jul 80.0414	Aug 80.0414	Sep 80.0414	Oct 80.0414	Nov 80.0414	Dec 80.0414 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5												
	70.2708	77.7998	70.2708	72.6132	70.2708	72.6132	70.2708	70.2708	72.6132	70.2708	72.6132	70.2708 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5												
	139.3197	140.7654	137.1223	129.3665	119.5763	110.3748	104.2276	102.7819	106.4250	114.1808	123.9711	133.1726 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												
	31.0041	31.0041	31.0041	31.0041	31.0041	31.0041	31.0041	31.0041	31.0041	31.0041	31.0041	31.0041 (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)												
	-64.0331	-64.0331	-64.0331	-64.0331	-64.0331	-64.0331	-64.0331	-64.0331	-64.0331	-64.0331	-64.0331	-64.0331 (71)
Water heating gains (Table 5)												
	151.2123	149.2476	145.4780	137.2367	132.1842	118.4117	115.1783	117.8634	121.0098	135.3609	143.2623	150.1601 (72)
Total internal gains												
	407.8152	414.8253	399.8836	386.2288	369.0437	348.4121	336.6892	337.9285	347.0605	366.8250	386.8590	400.6159 (73)

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6. Solar gains

[Jan]			Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	Specific data or Table 6c	FF	Access factor Table 6d	Gains W			
Southeast			6.7000	36.7938	0.6300	0.7000	0.7700	75.3393 (77)				
Northwest			8.3800	11.2829	0.6300	0.7000	0.7700	28.8960 (81)				
Solar gains	104.2353	187.1494	281.5603	391.5991	477.6277	491.3303	466.5550	399.7509	319.2536	213.7139	126.5978	88.0727 (83)
Total gains	512.0506	601.9747	681.4439	777.8279	846.6714	839.7424	803.2442	737.6795	666.3141	580.5389	513.4569	488.6886 (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	32.8502	32.9162	32.9811	33.2896	33.3479	33.6223	33.6223	33.6736	33.5161	33.3479	33.2301	33.1078
alpha	3.1900	3.1944	3.1987	3.2193	3.2232	3.2415	3.2415	3.2449	3.2344	3.2232	3.2153	3.2072
util living area	0.9444	0.9111	0.8554	0.7461	0.5985	0.4428	0.3274	0.3691	0.5711	0.7984	0.9127	0.9509 (86)
Living	19.6103	19.8516	20.1664	20.5220	20.7542	20.8629	20.8931	20.8874	20.8088	20.4960	20.0008	19.5680
Non living	18.2382	18.5366	18.9191	19.3382	19.5864	19.6946	19.7161	19.7149	19.6505	19.3251	18.7349	18.1918
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	20.2891	19.8516	20.1664	20.5220	20.7542	20.8629	20.8931	20.8874	20.8088	20.4960	20.0008	19.7683 (87)
Th 2	19.8188	19.8209	19.8229	19.8325	19.8342	19.8426	19.8426	19.8442	19.8394	19.8342	19.8306	19.8268 (88)
util rest of house	0.9336	0.8949	0.8299	0.7050	0.5406	0.3699	0.2440	0.2806	0.4930	0.7543	0.8939	0.9412 (89)
MIT 2	19.1887	18.5366	18.9191	19.3382	19.5864	19.6946	19.7161	19.7149	19.6505	19.3251	18.7349	18.4865 (90)
Living area fraction	19.6480	19.0856	19.4398	19.8324	20.0739	20.1823	20.2075	20.2044	20.1340	19.8139	19.2634	0.4175 (91)
MIT	19.6480	19.0856	19.4398	19.8324	20.0739	20.1823	20.2075	20.2044	20.1340	19.8139	19.2634	19.0216 (92)
Temperature adjustment												0.0000
adjusted MIT	19.6480	19.0856	19.4398	19.8324	20.0739	20.1823	20.2075	20.2044	20.1340	19.8139	19.2634	19.0216 (93)

8. Space heating requirement

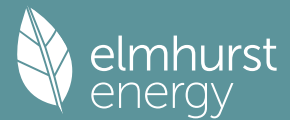
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9318	0.8829	0.8205	0.7050	0.5531	0.3919	0.2706	0.3087	0.5138	0.7535	0.8830	0.9332 (94)
Useful gains	477.1370	531.4719	559.1233	548.3663	468.2775	329.0743	217.3964	227.7248	342.3389	437.4087	453.3841	456.0630 (95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000 (96)
Heat loss rate W	957.1198	882.8519	803.7356	672.7558	514.4124	340.1231	219.7984	231.4450	368.8119	566.0118	749.8483	917.0984 (97)
Space heating kWh	357.1072	236.1274	181.9916	89.5605	34.3244	0.0000	0.0000	0.0000	0.0000	95.6808	213.4542	343.0103 (98a)
Space heating requirement - total per year (kWh/year)												1551.2564
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	357.1072	236.1274	181.9916	89.5605	34.3244	0.0000	0.0000	0.0000	0.0000	95.6808	213.4542	343.0103 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1551.2564
Space heating per m2										(98c) / (4) =		33.0406 (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 %)												345.8576 (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	357.1072	236.1274	181.9916	89.5605	34.3244	0.0000	0.0000	0.0000	0.0000	95.6808	213.4542	343.0103 (98)
Space heating efficiency (main heating system 1)	345.8576	345.8576	345.8576	345.8576	345.8576	0.0000	0.0000	0.0000	0.0000	345.8576	345.8576	345.8576 (210)
Space heating fuel (main heating system)	103.2527	68.2730	52.6204	25.8952	9.9244	0.0000	0.0000	0.0000	0.0000	27.6648	61.7174	99.1768 (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

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Water heating requirement	239.6196	212.4599	226.7887	201.6270	197.0425	171.6108	170.0960	176.1042	177.2367	204.1508	214.6750	237.2652 (64)
Efficiency of water heater (217)m	292.6092	292.6092	292.6092	292.6092	292.6092	292.6092	292.6092	292.6092	292.6092	292.6092	292.6092	292.6092 (216)
Fuel for water heating, kWh/month	81.8906	72.6087	77.5056	68.9066	67.3398	58.6485	58.1308	60.1841	60.5711	69.7691	73.3658	81.0860 (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	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (231)
Lighting	13.5862	10.8994	9.8137	7.1899	5.5537	4.5374	5.0663	6.5853	8.5537	11.2229	12.6762	13.9638 (232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (233a)
Electricity generated by wind turbines (Appendix M) (negative quantity) (234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity) (235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) (235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235c)
Electricity generated by PVs (Appendix M) (negative quantity) (233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (233b)
Electricity generated by wind turbines (Appendix M) (negative quantity) (234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity) (235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) (235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235d)
Annual totals kWh/year												
Space heating fuel - main system 1												448.5246 (211)
Space heating fuel - main system 2												0.0000 (213)
Space heating fuel - secondary												0.0000 (215)
Efficiency of water heater												292.6092
Water heating fuel used												830.0067 (219)
Space cooling fuel												0.0000 (221)
Electricity for pumps and fans:												
Total electricity for the above, kWh/year												0.0000 (231)
Electricity for lighting (calculated in Appendix L)												109.6485 (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												1388.1798 (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	448.5246	0.1562	70.0654 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	830.0067	0.1409	116.9709 (264)
Space and water heating			187.0363 (265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (267)
Energy for lighting	109.6485	0.1443	15.8257 (268)
Total CO2, kg/year			202.8619 (272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			4.3200 (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	448.5246	1.5783	707.8988 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	830.0067	1.5211	1262.5277 (278)
Space and water heating			1970.4265 (279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (281)
Energy for lighting	109.6485	1.5338	168.1825 (282)
Total Primary energy kWh/year			2138.6090 (286)
Dwelling Primary energy Rate (DPER)			45.5500 (287)

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1. Overall dwelling characteristics

Ground floor		Area (m ²)	Storey height (m)	Volume (m ³)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	46.9500	46.9500 (1b)	x 2.7500 (2b)	= 129.1125 (1b) - (4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 129.1125 (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	2 * 10 =	20.0000 (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) =	20.0000 / (5) =	0.1549 (8)
Pressure test	Yes	
Pressure Test Method	Blower Door	
Measured/design AP50	5.0000	(17)
Infiltration rate	0.4049	(18)
Number of sides sheltered	0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4049 (21)

Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	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	0.5163	0.5061	0.4960	0.4454	0.4353	0.3847	0.3847	0.3745	0.4049	0.4353	0.4555	0.4758 (22b)
Effective ac	0.6333	0.6281	0.6230	0.5992	0.5947	0.5740	0.5740	0.5701	0.5820	0.5947	0.6037	0.6132 (25)

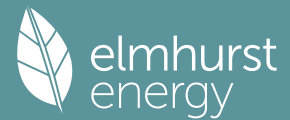
3. Heat losses and heat loss parameter

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 Opaque door			1.8900	1.0000	1.8900		(26)					
TER Opening Type (Uw = 1.20)			9.8500	1.1450	11.2786		(27)					
EXTERNAL	67.5100	9.8500	57.6600	0.1800	10.3788		(29a)					
HALLWAY	21.9500	1.8900	20.0600	0.1800	3.6108		(29a)					
FLAT ROOF	46.9500		46.9500	0.1100	5.1645		(30)					
Total net area of external elements Aum(A, m2)			136.4100				(31)					
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	32.3227		(33)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							157.0788 (35)					
List of Thermal Bridges												
K1 Element				Length	Psi-value	Total						
E2 Other lintels (including other steel lintels)				5.0000	0.0500	0.2500						
E3 Sill				7.5000	0.0500	0.3750						
E4 Jamb				7.5000	0.0500	0.3750						
E5 Ground floor (normal)				9.0000	0.1600	1.4400						
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							2.4400 (36)					
Point Thermal bridges						(36a) =	0.0000					
Total fabric heat loss						(33) + (36) + (36a) =	34.7627 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 26.9813	Feb 26.7608	Mar 26.5447	Apr 25.5297	May 25.3398	Jun 24.4557	Jul 24.4557	Aug 24.2920	Sep 24.7962	Oct 25.3398	Nov 25.7240	Dec 26.1256 (38)
Heat transfer coeff	61.7440	61.5236	61.3075	60.2924	60.1025	59.2184	59.2184	59.0547	59.5589	60.1025	60.4867	60.8883 (39)
Average = Sum(39)m / 12 =												60.2915
HLP	Jan 1.3151	Feb 1.3104	Mar 1.3058	Apr 1.2842	May 1.2801	Jun 1.2613	Jul 1.2613	Aug 1.2578	Sep 1.2686	Oct 1.2801	Nov 1.2883	Dec 1.2969 (40)
HLP (average)												1.2842
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

4. Water heating energy requirements (kWh/year)

Assumed occupancy												1.6008 (42)
Hot water usage for mixer showers												
	51.0601	50.2928	49.1746	47.0352	45.4564	43.6957	42.6949	43.8046	45.0211	46.9115	49.0968	50.8645 (42a)
Hot water usage for baths												
	22.0807	21.7528	21.2910	20.4396	19.8020	19.0950	18.7132	19.1717	19.6710	20.4275	21.2965	22.0061 (42b)

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Hot water usage for other uses	31.0241	29.8959	28.7678	27.6396	26.5115	25.3833	25.3833	26.5115	27.6396	28.7678	29.8959	31.0241 (42c)
Average daily hot water use (litres/day)												95.7517 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	104.1649	101.9415	99.2334	95.1144	91.7699	88.1741	86.7914	89.4879	92.3317	96.1068	100.2893	103.8946 (44)
Energy content (annual)	164.9718	145.1634	152.5181	130.2069	123.5399	108.4203	104.9667	110.8047	113.8543	130.4160	142.8805	162.6739 (45)
Distribution loss (46)m = 0.15 x (45)m	24.7458	21.7745	22.8777	19.5310	18.5310	16.2630	15.7450	16.6207	17.0781	19.5624	21.4321	24.4011 (46)
Water storage loss:												
Store volume												200.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.6525 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.8924 (55)
Total storage loss	27.6637	24.9865	27.6637	26.7713	27.6637	26.7713	27.6637	27.6637	26.7713	27.6637	26.7713	27.6637 (56)
If cylinder contains dedicated solar storage												
Primary loss	27.6637	24.9865	27.6637	26.7713	27.6637	26.7713	27.6637	27.6637	26.7713	27.6637	26.7713	27.6637 (57)
Combi 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)
Total heat required for water heating calculated for each month	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (61)
WWHRS	215.8978	191.1611	203.4441	179.4902	174.4660	157.7036	155.8928	161.7307	163.1375	181.3421	192.1638	213.6000 (62)
PV diverter	-23.3425	-20.6443	-21.6176	-17.9002	-16.6823	-14.2752	-13.3807	-14.2291	-14.7697	-17.4118	-19.7255	-22.9103 (63a)
Solar input	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000 (63b)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63c)
Output from w/h	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63d)
Total per year (kWh/year)	192.5553	170.5168	181.8266	161.5900	157.7836	143.4284	142.5121	147.5017	148.3679	163.9303	172.4383	190.6897 (64)
Electric shower(s)												
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)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 (64a)
Heat gains from water heating, kWh/month	95.5940	85.0650	91.4531	82.7204	81.8179	75.4764	75.6423	77.5834	77.2832	84.1042	86.9344	94.8299 (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	80.0414	80.0414	80.0414	80.0414	80.0414	80.0414	80.0414	80.0414	80.0414	80.0414	80.0414	80.0414 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	70.4683	78.0185	70.4683	72.8173	70.4683	72.8173	70.4683	70.4683	72.8173	70.4683	72.8173	70.4683 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	139.3197	140.7654	137.1223	129.3665	119.5763	110.3748	104.2276	102.7819	106.4250	114.1808	123.9711	133.1726 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	31.0041	31.0041	31.0041	31.0041	31.0041	31.0041	31.0041	31.0041	31.0041	31.0041	31.0041	31.0041 (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)	-64.0331	-64.0331	-64.0331	-64.0331	-64.0331	-64.0331	-64.0331	-64.0331	-64.0331	-64.0331	-64.0331	-64.0331 (71)
Water heating gains (Table 5)	128.4865	126.5848	122.9208	114.8895	109.9703	104.8283	101.6698	104.2788	107.3377	113.0432	120.7422	127.4596 (72)
Total internal gains	388.2870	395.3812	380.5239	367.0857	350.0273	335.0328	323.3781	324.5415	333.5925	347.7048	367.5430	381.1129 (73)

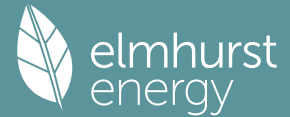
6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	Specific data or Table 6c	FF	Access factor Table 6d	Gains W		
Southeast				4.3800	36.7938	0.6300		0.7000	0.7700	49.2517 (77)		
Northwest				5.4700	11.2829	0.6300		0.7000	0.7700	18.8617 (81)		
Solar gains	68.1134	122.2874	183.9602	255.8289	312.0093	320.9519	304.7714	261.1462	208.5787	139.6406	82.7251	57.5526 (83)
Total gains	456.4004	517.6686	564.4842	622.9146	662.0366	655.9847	628.1496	585.6876	542.1712	487.3454	450.2681	438.6655 (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, n _{l,m} (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	33.1784	33.2973	33.4147	33.9772	34.0846	34.5935	34.5935	34.6894	34.3957	34.0846	33.8681	33.6447
alpha	3.2119	3.2198	3.2276	3.2651	3.2723	3.3062	3.3062	3.3126	3.2930	3.2723	3.2579	3.2430
util living area	0.9580	0.9368	0.9012	0.8220	0.6975	0.5338	0.4013	0.4436	0.6521	0.8509	0.9347	0.9623 (86)
MIT	19.1582	19.4303	19.8181	20.3204	20.6960	20.9095	20.9733	20.9627	20.8199	20.3419	19.6891	19.1284 (87)
Th 2	19.8290	19.8327	19.8363	19.8532	19.8564	19.8713	19.8713	19.8740	19.8655	19.8564	19.8500	19.8433 (88)
util rest of house	0.9495	0.9244	0.8816	0.7874	0.6410	0.4535	0.3040	0.3432	0.5733	0.8139	0.9198	0.9547 (89)
MIT 2	17.7380	18.0791	18.5602	19.1719	19.5922	19.8122	19.8601	19.8572	19.7344	19.2154	18.4197	17.7098 (90)

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Living area fraction									fLA = Living area / (4) =			0.4175 (91)
MIT	18.3309	18.6432	19.0853	19.6513	20.0530	20.2703	20.3248	20.3187	20.1876	19.6857	18.9496	18.3020 (92)
Temperature adjustment												
adjusted MIT	18.3309	18.6432	19.0853	19.6513	20.0530	20.2703	20.3248	20.3187	20.1876	19.6857	18.9496	18.3020 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9352	0.9086	0.8665	0.7806	0.6514	0.4830	0.3439	0.3839	0.5971	0.8075	0.9051	0.9412	(94)
Useful gains	426.8458	470.3425	489.1244	486.2161	431.2595	316.8170	216.0305	224.8378	323.7443	393.5258	407.5518	412.8716	(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	866.3215	845.5299	771.5749	648.2234	502.0353	335.7851	220.5788	231.4170	362.5701	546.0723	716.7445	858.6475	(97)
Space heating kWh	326.9699	252.1259	210.1432	116.6452	52.6572	0.0000	0.0000	0.0000	0.0000	113.4946	222.6187	331.6573	(98a)
Space heating requirement - total per year (kWh/year)												1626.3121	
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	326.9699	252.1259	210.1432	116.6452	52.6572	0.0000	0.0000	0.0000	0.0000	113.4946	222.6187	331.6573	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1626.3121	
Space heating per m2										(98c) / (4) =		34.6392	(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	326.9699	252.1259	210.1432	116.6452	52.6572	0.0000	0.0000	0.0000	0.0000	113.4946	222.6187	331.6573	(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)	354.2469	273.1592	227.6741	126.3762	57.0500	0.0000	0.0000	0.0000	0.0000	122.9627	241.1904	359.3254	(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	192.5553	170.5168	181.8266	161.5900	157.7836	143.4284	142.5121	147.5017	148.3679	163.9303	172.4383	190.6897	(64)
Efficiency of water heater (217)m	85.2370	84.9353	84.3852	83.3411	81.8764	79.8000	79.8000	79.8000	79.8000	83.2519	84.6336	79.8000	(216)
Fuel for water heating, kWh/month	225.9058	200.7609	215.4721	193.8898	192.7095	179.7349	178.5866	184.8392	185.9247	196.9088	203.7467	223.5821	(219)
Space cooling fuel requirement (221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting	14.6419	11.7463	10.5762	7.7486	5.9852	4.8900	5.4599	7.0970	9.2184	12.0950	13.6612	15.0489	(232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-12.7429	-18.9689	-28.7804	-34.2319	-38.5894	-36.6626	-36.2408	-33.3883	-28.6372	-22.5236	-14.3695	-10.9048	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity) (234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity) (235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) (235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity) (233b)m	-4.4431	-9.5655	-19.4184	-29.7613	-39.9268	-40.3041	-39.8052	-33.4190	-24.1415	-13.8471	-5.9876	-3.4957	(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												1761.9849	(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												2382.0610	(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)													118.1687 (232)

Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation													-580.1553 (233)
Wind generation													0.0000 (234)

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Hydro-electric generation (Appendix N)	0.0000 (235a)
Electricity generated - Micro CHP (Appendix N)	0.0000 (235)
Appendix Q - special features	
Energy saved or generated	-0.0000 (236)
Energy used	0.0000 (237)
Total delivered energy for all uses	3768.0593 (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	1761.9849	0.2100	370.0168 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	2382.0610	0.2100	500.2328 (264)
Space and water heating			870.2496 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	118.1687	0.1443	17.0554 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-316.0400	0.1334	-42.1704
PV Unit electricity exported	-264.1153	0.1253	-33.0999
Total			-75.2703 (269)
Total CO2, kg/year			823.9640 (272)
EPC Target Carbon Dioxide Emission Rate (TER)			17.5500 (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	1761.9849	1.1300	1991.0429 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	2382.0610	1.1300	2691.7289 (278)
Space and water heating			4682.7719 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	118.1687	1.5338	181.2512 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-316.0400	1.4931	-471.8738
PV Unit electricity exported	-264.1153	0.4600	-121.4924
Total			-593.3662 (283)
Total Primary energy kWh/year			4400.7576 (286)
Target Primary Energy Rate (TPER)			93.7300 (287)

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022) CALCULATION OF FABRIC ENERGY EFFICIENCY

1. Overall dwelling characteristics

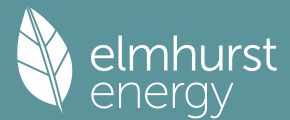
	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	46.9500 (1b)	x 2.7500 (2b)	= 129.1125 (1b) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	46.9500		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 129.1125 (5)

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	2 * 10 = 20.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)

Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	Air changes per hour
Pressure test	20.0000 / (5) =	0.1549 (8)
Pressure Test Method		Yes
Measured/design AP50		Blower Door
		3.0000 (17)

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Infiltration rate												0.3049 (18)
Number of sides sheltered												0 (19)
Shelter factor												(20) = 1 - [0.075 x (19)] = 1.0000 (20)
Infiltration rate adjusted to include shelter factor												(21) = (18) x (20) = 0.3049 (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	0.3888	0.3811	0.3735	0.3354	0.3278	0.2897	0.2897	0.2820	0.3049	0.3278	0.3430	0.3583 (22b)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.0000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												0.0000 (23c)
Effective ac	0.5756	0.5726	0.5698	0.5562	0.5537	0.5420	0.5420	0.5398	0.5465	0.5537	0.5588	0.5642 (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
WINDOWS (Uw = 1.20)			15.0800	1.1450	17.2672		(27)
CORRIDOR DOOR			1.8900	1.2000	2.2680		(26)
EXTERNAL	67.5100	15.0800	52.4300	0.1200	6.2916	70.0000	(29a)
HALLWAY	21.9500	1.8900	20.0600	0.1100	2.2066	70.0000	(29a)
FLAT ROOF	46.9500		46.9500	0.1100	5.1645	9.0000	(30)
Total net area of external elements Aum(A, m2)			136.4100				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	33.1979		(33)
FLOORS			46.9500			40.0000	1878.0000 (32d)
Heat capacity Cm = Sum(A x k)				(28)...(30) + (32) + (32a)...(32e) =		7374.8500	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K						157.0788	(35)
List of Thermal Bridges							
K1 Element				Length	Psi-value	Total	
E2 Other lintels (including other steel lintels)				5.0000	0.1600	0.8000	
E3 Sill				7.5000	0.1600	1.2000	
E4 Jamb				7.5000	0.1600	1.2000	
E5 Ground floor (normal)				9.0000	0.1600	1.4400	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							4.6400 (36)
Point Thermal bridges						(36a) =	0.0000
Total fabric heat loss				(33) + (36) + (36a) =			37.8379 (37)

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

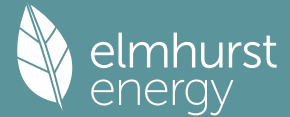
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	24.5231	24.3981	24.2756	23.7000	23.5923	23.0910	23.0910	22.9981	23.2841	23.5923	23.8101	24.0379 (38)
Heat transfer coeff	62.3610	62.2360	62.1134	61.5379	61.4302	60.9289	60.9289	60.8360	61.1220	61.4302	61.6480	61.8758 (39)
Average = Sum(39)m / 12 =												61.5373

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.3282	1.3256	1.3230	1.3107	1.3084	1.2977	1.2977	1.2958	1.3019	1.3084	1.3131	1.3179 (40)
HLP (average)												1.3107
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

4. Water heating energy requirements (kWh/year)

Assumed occupancy												1.6008 (42)
Hot water usage for mixer showers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (42a)
Hot water usage for baths	22.0807	21.7528	21.2910	20.4396	19.8020	19.0950	18.7132	19.1717	19.6710	20.4275	21.2965	22.0061 (42b)
Hot water usage for other uses	31.0241	29.8959	28.7678	27.6396	26.5115	25.3833	25.3833	26.5115	27.6396	28.7678	29.8959	31.0241 (42c)
Average daily hot water use (litres/day)												48.6760 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	53.1048	51.6487	50.0588	48.0792	46.3135	44.4784	44.0965	45.6832	47.3107	49.1953	51.1924	53.0302 (44)
Energy conte	84.1051	73.5471	76.9385	65.8180	62.3468	54.6913	53.3309	56.5654	58.3388	66.7575	72.9330	83.0324 (45)
Energy content (annual)												Total = Sum(45)m = 808.4049
Distribution loss (46)m = 0.15 x (45)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 (46)
Water storage loss:												
Total storage 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 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Primary 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 (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	71.4893	62.5151	65.3977	55.9453	52.9948	46.4876	45.3313	48.0806	49.5880	56.7439	61.9930	70.5776 (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	71.4893	62.5151	65.3977	55.9453	52.9948	46.4876	45.3313	48.0806	49.5880	56.7439	61.9930	70.5776 (64)
Total per year (kWh/year) = Sum(64)m =												687.1442 (64)

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12Total per year (kWh/year)												687 (64)
Electric shower(s)	40.8906	36.4339	39.7844	37.9658	38.6782	36.8952	38.1251	38.6782	37.9658	39.7844	39.0363	40.8906 (64a)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =												465.1285 (64a)
Heat gains from water heating, kWh/month	28.0950	24.7372	26.2955	23.4778	22.9183	20.8457	20.8641	21.6897	21.8884	24.1321	25.2573	27.8671 (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	80.0414	80.0414	80.0414	80.0414	80.0414	80.0414	80.0414	80.0414	80.0414	80.0414	80.0414	80.0414	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	70.2708	77.7998	70.2708	72.6132	70.2708	72.6132	70.2708	70.2708	72.6132	70.2708	72.6132	70.2708	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	139.3197	140.7654	137.1223	129.3665	119.5763	110.3748	104.2276	102.7819	106.4250	114.1808	123.9711	133.1726	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	31.0041	31.0041	31.0041	31.0041	31.0041	31.0041	31.0041	31.0041	31.0041	31.0041	31.0041	31.0041	(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)	-64.0331	-64.0331	-64.0331	-64.0331	-64.0331	-64.0331	-64.0331	-64.0331	-64.0331	-64.0331	-64.0331	-64.0331	(71)
Water heating gains (Table 5)	37.7621	36.8114	35.3435	32.6080	30.8041	28.9524	28.0431	29.1528	30.4006	32.4356	35.0796	37.4557	(72)
Total internal gains	294.3651	302.3891	289.7490	281.6002	267.6636	258.9528	249.5540	249.2180	256.4512	263.8996	278.6763	287.9115	(73)

6. Solar gains

[Jan]			Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	Specific data or Table 6c	FF	Access factor Table 6d	Gains W			

Southeast			6.7000	36.7938	0.6300	0.7000	0.7700		75.3393 (77)			
Northwest			8.3800	11.2829	0.6300	0.7000	0.7700		28.8960 (81)			

Solar gains	104.2353	187.1494	281.5603	391.5991	477.6277	491.3303	466.5550	399.7509	319.2536	213.7139	126.5978	88.0727 (83)
Total gains	398.6004	489.5385	571.3093	673.1993	745.2913	750.2830	716.1090	648.9689	575.7048	477.6136	405.2742	375.9842 (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	32.8502	32.9162	32.9811	33.2896	33.3479	33.6223	33.6223	33.6736	33.5161	33.3479	33.2301	33.1078
alpha	3.1900	3.1944	3.1987	3.2193	3.2232	3.2415	3.2415	3.2449	3.2344	3.2232	3.2153	3.2072
util living area	0.9706	0.9454	0.8999	0.7999	0.6540	0.4878	0.3645	0.4147	0.6348	0.8603	0.9504	0.9752 (86)
MIT	18.9768	19.3322	19.8037	20.3601	20.7393	20.9254	20.9780	20.9667	20.8249	20.2918	19.5364	18.9148 (87)
Th 2	19.8188	19.8209	19.8229	19.8325	19.8342	19.8426	19.8426	19.8442	19.8394	19.8342	19.8306	19.8268 (88)
util rest of house	0.9644	0.9344	0.8800	0.7627	0.5957	0.4100	0.2728	0.3172	0.5547	0.8242	0.9384	0.9699 (89)
MIT 2	18.0156	18.3633	18.8177	19.3380	19.6613	19.8057	19.8357	19.8328	19.7415	19.2950	18.5756	17.9604 (90)
Living area fraction	18.4168	18.7678	19.2293	19.7647	20.1113	20.2732	20.3126	20.3062	fLA = Living area / (4) = 20.1937	19.7111	18.9767	0.4175 (91)
MIT	18.4168	18.7678	19.2293	19.7647	20.1113	20.2732	20.3126	20.3062	20.1937	19.7111	18.9767	18.3588 (92)
Temperature adjustment												0.0000
adjusted MIT	18.4168	18.7678	19.2293	19.7647	20.1113	20.2732	20.3126	20.3062	20.1937	19.7111	18.9767	18.3588 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	0.9547	0.9220	0.8682	0.7604	0.6103	0.4398	0.3107	0.3571	0.5806	0.8198	0.9273	0.9610	(94)
Ext temp.	380.5299	451.3741	496.0115	511.8780	454.8810	329.9565	222.4837	231.7702	334.2670	391.5531	375.8229	361.3296	(95)
Heat loss rate W	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)
Space heating kWh	880.3395	863.0760	790.6625	668.5896	516.7092	345.6603	226.2044	237.6347	372.4615	559.6961	732.1737	876.0888	(97)
Space heating requirement - total per year (kWh/year)	371.8583	276.6637	219.2204	112.8323	46.0002	0.0000	0.0000	0.0000	0.0000	125.0983	256.5726	382.9809	(98a)
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)	371.8583	276.6637	219.2204	112.8323	46.0002	0.0000	0.0000	0.0000	0.0000	125.0983	256.5726	382.9809	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)	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)
Space heating per m2	371.8583	276.6637	219.2204	112.8323	46.0002	0.0000	0.0000	0.0000	0.0000	125.0983	256.5726	382.9809	(98c)
(98c) / (4) =												38.1518	(99)

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8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	572.7312	450.8735	462.3537	0.0000	0.0000	0.0000	0.0000 (100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8890	0.9284	0.9047	0.0000	0.0000	0.0000	0.0000 (101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	509.1754	418.5846	418.2736	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	852.3438	813.7968	736.6580	0.0000	0.0000	0.0000	0.0000 (103)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	247.0812	294.0378	236.8780	0.0000	0.0000	0.0000	0.0000 (104)
Cooled fraction									fC = cooled area / (4) =			1.0000 (105)
Intermittency factor (Table 10b)	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500 (106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	61.7703	73.5095	59.2195	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling requirement												194.4993 (107)
Energy for space heating												38.1518 (99)
Energy for space cooling												4.1427 (108)
Total												42.2945 (109)
Fabric Energy Efficiency (DFEE)												42.3 (109)

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

1. Overall dwelling characteristics

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	46.9500 (1b)	x 2.7500 (2b)	= 129.1125 (1b) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	46.9500		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	129.1125 (5)

2. Ventilation rate

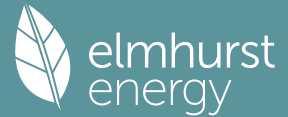
	m ³ per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	2 * 10 = 20.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	Air changes per hour 20.0000 / (5) = 0.1549 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	5.0000 (17)
Infiltration rate	0.4049 (18)
Number of sides sheltered	0 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] = 1.0000 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.4049 (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	0.5163	0.5061	0.4960	0.4454	0.4353	0.3847	0.3847	0.3745	0.4049	0.4353	0.4555	0.4758 (22b)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.0000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												0.0000 (23c)
Effective ac	0.6333	0.6281	0.6230	0.5992	0.5947	0.5740	0.5740	0.5701	0.5820	0.5947	0.6037	0.6132 (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
TER Opaque door			1.8900	1.0000	1.8900		(26)
TER Opening Type (Uw = 1.20)			9.8500	1.1450	11.2786		(27)

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EXTERNAL	67.5100	9.8500	57.6600	0.1800	10.3788	(29a)
HALLWAY	21.9500	1.8900	20.0600	0.1800	3.6108	(29a)
FLAT ROOF	46.9500		46.9500	0.1100	5.1645	(30)
Total net area of external elements Aum(A, m2)			136.4100			(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =	32.3227		(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 157.0788 (35)

List of Thermal Bridges						
K1 Element	Length	Psi-value	Total			
E2 Other lintels (including other steel lintels)	5.0000	0.0500	0.2500			
E3 Sill	7.5000	0.0500	0.3750			
E4 Jamb	7.5000	0.0500	0.3750			
E5 Ground floor (normal)	9.0000	0.1600	1.4400			
Thermal bridges (Sum(L x Psi) calculated using Appendix K)				2.4400	(36)	
Point Thermal bridges				0.0000	(36a) =	
Total fabric heat loss				(33) + (36) + (36a) =	34.7627	(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	26.9813	26.7608	26.5447	25.5297	25.3398	24.4557	24.4557	24.2920	24.7962	25.3398	25.7240	26.1256 (38)
Average = Sum(39)m / 12 =	61.7440	61.5236	61.3075	60.2924	60.1025	59.2184	59.2184	59.0547	59.5589	60.1025	60.4867	60.8883 (39)
												60.2915
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.3151	1.3104	1.3058	1.2842	1.2801	1.2613	1.2613	1.2578	1.2686	1.2801	1.2883	1.2969 (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													1.6008	(42)
Hot water usage for mixer showers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42a)
Hot water usage for baths	22.0807	21.7528	21.2910	20.4396	19.8020	19.0950	18.7132	19.1717	19.6710	20.4275	21.2965	22.0061	22.0061	(42b)
Hot water usage for other uses	31.0241	29.8959	28.7678	27.6396	26.5115	25.3833	25.3833	26.5115	27.6396	28.7678	29.8959	31.0241	31.0241	(42c)
Average daily hot water use (litres/day)													48.6760	(43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Energy conte	53.1048	51.6487	50.0588	48.0792	46.3135	44.4784	44.0965	45.6832	47.3107	49.1953	51.1924	53.0302	53.0302	(44)
Energy content (annual)	84.1051	73.5471	76.9385	65.8180	62.3468	54.6913	53.3309	56.5654	58.3388	66.7575	72.9330	83.0324	83.0324	(45)
Distribution loss (46)m = 0.15 x (45)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	0.0000	(46)
Water storage loss:														
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	71.4893	62.5151	65.3977	55.9453	52.9948	46.4876	45.3313	48.0806	49.5880	56.7439	61.9930	70.5776	70.5776	(62)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
PV diverter	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	71.4893	62.5151	65.3977	55.9453	52.9948	46.4876	45.3313	48.0806	49.5880	56.7439	61.9930	70.5776	70.5776	(64)
12Total per year (kWh/year)													687.1442	(64)
Electric shower(s)	40.8906	36.4339	39.7844	37.9658	38.6782	36.8952	38.1251	38.6782	37.9658	39.7844	39.0363	40.8906	40.8906	(64a)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =													465.1285	(64a)
Heat gains from water heating, kWh/month	28.0950	24.7372	26.2955	23.4778	22.9183	20.8457	20.8641	21.6897	21.8884	24.1321	25.2573	27.8671	27.8671	(65)

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

Metabolic gains (Table 5), Watts														
(66)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	80.0414	80.0414	80.0414	80.0414	80.0414	80.0414	80.0414	80.0414	80.0414	80.0414	80.0414	80.0414	80.0414	(66)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	70.4683	78.0185	70.4683	72.8173	70.4683	72.8173	70.4683	70.4683	72.8173	70.4683	72.8173	70.4683	70.4683	(67)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	139.3197	140.7654	137.1223	129.3665	119.5763	110.3748	104.2276	102.7819	106.4250	114.1808	123.9711	133.1726	133.1726	(68)
Pumps, fans	31.0041	31.0041	31.0041	31.0041	31.0041	31.0041	31.0041	31.0041	31.0041	31.0041	31.0041	31.0041	31.0041	(69)
Losses e.g. evaporation (negative values) (Table 5)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Water heating gains (Table 5)	-64.0331	-64.0331	-64.0331	-64.0331	-64.0331	-64.0331	-64.0331	-64.0331	-64.0331	-64.0331	-64.0331	-64.0331	-64.0331	(71)
Total internal gains	37.7621	36.8114	35.3435	32.6080	30.8041	28.9524	28.0431	29.1528	30.4006	32.4356	35.0796	37.4557	37.4557	(72)
	294.5626	302.6078	289.9465	281.8043	267.8611	259.1569	249.7515	249.4155	256.6553	264.0972	278.8804	288.1091	288.1091	(73)

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6. Solar gains

[Jan]			Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W				
Southeast			4.3800	36.7938	0.6300	0.7000	0.7700	49.2517 (77)				
Northwest			5.4700	11.2829	0.6300	0.7000	0.7700	18.8617 (81)				
Solar gains	68.1134	122.2874	183.9602	255.8289	312.0093	320.9519	304.7714	261.1462	208.5787	139.6406	82.7251	57.5526 (83)
Total gains	362.6760	424.8952	473.9068	537.6331	579.8705	580.1088	554.5229	510.5617	465.2340	403.7377	361.6055	345.6617 (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	33.1784	33.2973	33.4147	33.9772	34.0846	34.5935	34.5935	34.6894	34.3957	34.0846	33.8681	33.6447
alpha	3.2119	3.2198	3.2276	3.2651	3.2723	3.3062	3.3062	3.3126	3.2930	3.2723	3.2579	3.2430
util living area	0.9771	0.9615	0.9341	0.8666	0.7517	0.5873	0.4486	0.4991	0.7174	0.8998	0.9625	0.9802 (86)
MIT	18.9013	19.1930	19.6128	20.1762	20.6150	20.8797	20.9628	20.9471	20.7579	20.1811	19.4618	18.8688 (87)
Th 2	19.8290	19.8327	19.8363	19.8532	19.8564	19.8713	19.8713	19.8740	19.8655	19.8564	19.8500	19.8433 (88)
util rest of house	0.9722	0.9533	0.9197	0.8374	0.6981	0.5037	0.3422	0.3899	0.6405	0.8712	0.9531	0.9759 (89)
MIT 2	17.9489	18.2379	18.6496	19.1964	19.5892	19.8085	19.8589	19.8548	19.7231	19.2164	18.5183	17.9269 (90)
Living area fraction	fLA = Living area / (4) =											0.4175 (91)
MIT	18.3465	18.6366	19.0517	19.6054	20.0174	20.2557	20.3197	20.3108	20.1551	19.6191	18.9122	18.3201 (92)
Temperature adjustment	0.0000											
adjusted MIT	18.3465	18.6366	19.0517	19.6054	20.0174	20.2557	20.3197	20.3108	20.1551	19.6191	18.9122	18.3201 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9637	0.9425	0.9078	0.8301	0.7063	0.5335	0.3857	0.4338	0.6619	0.8641	0.9432	0.9682 (94)
Useful gains	349.5137	400.4712	430.1961	446.3017	409.5496	309.5111	213.8843	221.5065	307.9175	348.8662	341.0504	334.6667 (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	867.2878	845.1268	769.5137	645.4547	499.8970	334.9207	220.2774	230.9505	360.6329	542.0711	714.4803	859.7498 (97)
Space heating kWh	385.2239	298.8085	252.4524	143.3902	67.2185	0.0000	0.0000	0.0000	0.0000	143.7444	268.8695	390.6618 (98a)
Space heating requirement - total per year (kWh/year)												1950.3693
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	385.2239	298.8085	252.4524	143.3902	67.2185	0.0000	0.0000	0.0000	0.0000	143.7444	268.8695	390.6618 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1950.3693
Space heating per m2										(98c) / (4) =		41.5414 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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
Heat loss rate W												
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	556.6530	438.2162	448.8157	0.0000	0.0000	0.0000	0.0000 (100)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.8250	0.8819	0.8527	0.0000	0.0000	0.0000	0.0000 (101)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	459.2551	386.4684	382.7093	0.0000	0.0000	0.0000	0.0000 (102)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	653.2175	624.7177	574.6767	0.0000	0.0000	0.0000	0.0000 (103)
Cooled fraction												
Intermittency factor (Table 10b)									fC = cooled area / (4) =			1.0000 (105)
Space cooling kWh	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500 (106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	34.9132	44.3144	35.7059	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling requirement												114.9335 (107)
Energy for space heating												41.5414 (99)
Energy for space cooling												2.4480 (108)
Total												43.9894 (109)
Fabric Energy Efficiency (TFEE)												44.0 (109)