ENERGY & SUSTAINABILITY STATEMENT

(INCLUDING BREEAM DOMESTIC REFURBISHMENT PRE-ASSESSMENT)

10 Orleans Road

Produced by XCO2 for PMV Planning

March 2024

XCO2
56 Kingsway Place, Sans Walk
London EC1R 0LU

+44 (0)20 7700 1000
mail@xco2.com
xco2.com

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Prepared by	RN	RN				
Checked by	JS	JS				
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EXECUTIVE SUMMARY

The sustainability and energy strategy for the 10 Orleans Road development has been developed in line with the relevant policies of the London Plan and of the London Borough of Richmond upon Thames Local Plan.

The proposals incorporate a range of sustainable design and construction measures, primarily addressing the sustainable management of resources, the protection and enhancement of the environment and the effective adaptation and mitigation of the development to climate change.

This report presents the sustainability strategy and assesses the predicted energy performance and carbon dioxide emissions of the proposed development at 10 Orleans Road, located in the London Borough of Richmond upon Thames.

The proposed development comprises the restoration and conversion of an existing building from commercial space into two residential dwellings.

This document is divided into three parts:

1. Planning policies;
2. Proposed sustainability measures; and,
3. Energy Strategy.

The Planning Policy section provides an overview of the site and planning policies applicable to this development in accordance with the London Borough of Richmond upon Thames Local Plan and the London Plan.

The second section on proposed sustainability measures outlines the sustainability measures that have been adopted in the team's aim to maximise sustainability within the site.

The third section describes the predicted energy performance and carbon dioxide emissions of the proposed development at 10 Orleans Road. The development will be compared to an existing building baseline modelled in line with Part L 2021 standards.

Key sustainability features of the proposals include:

- The re-use of previously developed land and refurbishment of an existing building.
- The enhancement of fabric efficiency is achieved through the construction of a new roof, replacement of windows and door and the refurbishment of the external walls and ground floor.
- Upgrades to a more efficient space heating and domestic hot water system.
- The specification of water efficient fittings to limit water consumption to less than 105 litres per person per day;
- The development is not expected to have any significant adverse effects to air, noise, land, or watercourses.

The energy strategy outlined in this report has been done using the latest Building Regulations Part L 2021 methodology and SAP 10.2 emissions factors as per current GLA Guidance. These carbon emission factors reflect the grid decarbonisation of recent years and ensure that the assessment of new developments better reflect the actual carbon emissions associated with their expected operation.

The energy strategy for the scheme focuses on the efficiency of the fabric and building services, so that the energy demand is reduced to the extent feasible. Energy efficiency is primarily achieved through the construction of a new roof with high-quality insulation, new windows, and door, combined with improved air permeability. Additionally, enhancements include the addition of insulation to walls and floors. Highly efficient lighting, a new more efficient space heating and hot water system, as well as appropriate controls further reduce the regulated energy demand and consumption of the development.

The London Plan and the Local Plan does not set specific CO_2 reduction targets for residential conversions such as that at 10 Orleans Road. However, CO_2 emissions have been reduced as far as is feasible. The 86.79% reduction in regulated CO_2 emissions compared to a Part L 2021 compliant scheme, based on the existing fabric and systems, through roof replacement, cosmetic improvements to the external walls and a more efficient heating and hot water system.

The proposals in their entirety reflect the client and design team's aspirations to deliver a development that pushes the energy efficiency improvements to the allowable level while staying within the boundaries of accepted alterations.

INTRODUCTION

The proposed residential development is located within the London Borough of Richmond upon Thames. This section presents the description of the site and of the development proposal.

SITE & PROPOSAL

The project involves the conversion and alteration of a 1.5-storey commercial building at 10 Orleans Road, Twickenham, located in the London Borough of Richmond Upon Thames. The proposal seeks to transform the current structure into two new homes, effectively repurposing it to align with the residential character of the area while enhancing its contribution to the local community.

The location of the development site is shown in Figure 1 below.

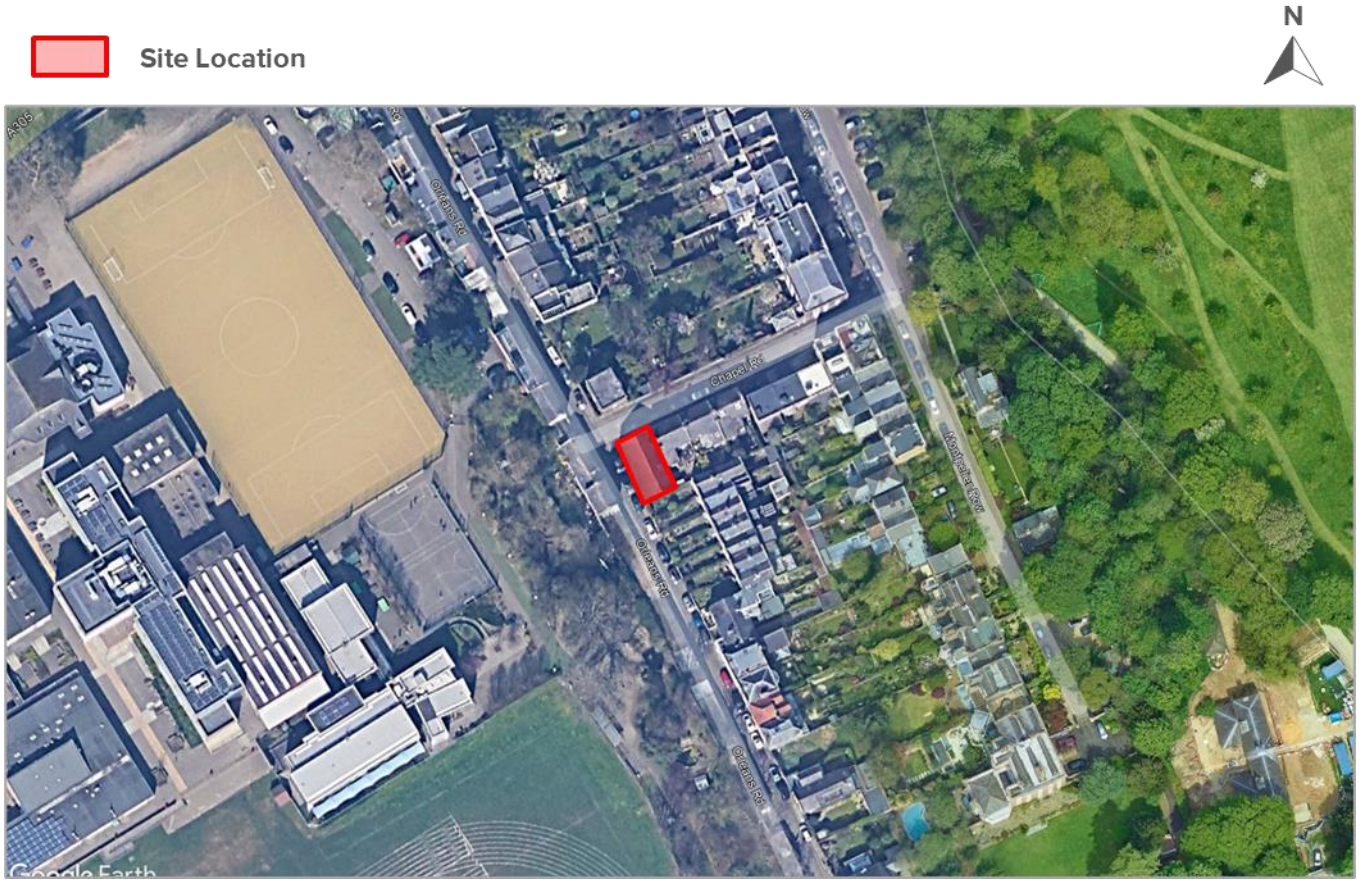


Figure 1: Location of the application site.

PLANNING POLICIES

The proposal responds to the policies within the London Borough of Richmond upon Thames Local Plan.

The most relevant applicable energy policies in the context of the proposed development are presented below.

LONDON BOROUGH OF RICHMOND UPON THAMES LOCAL PLAN

Policy LP 22 – Sustainable Design and Construction

A. Developments will be required to achieve the highest standards of sustainable design and construction to mitigate the likely effects of climate change. Applicants will be required to complete the following:

1. Development of 1 dwelling unit or more, or 100sqm or more of non-residential floor space (including extensions) will be required to complete the Sustainable Construction Checklist SPD. A completed Checklist has to be submitted as part of the planning application.
2. Development that results in a new residential dwelling, including conversions, change of use, and extensions that result in a new dwelling unit, will be required to incorporate water conservation measures to achieve maximum water consumption of 110 litres per person per day for homes (including an allowance of 5 litres or less per person per day for external water consumption).
3. New non-residential buildings over 100sqm will be required to meet BREEAM 'Excellent' standard.
4. Proposals for change of use to residential will be required to meet BREEAM Domestic Refurbishment 'Excellent' standard (where feasible).

B. Developers are required to incorporate measures to improve energy conservation and efficiency as well as contributions to renewable and low carbon energy generation. Proposed developments are required to meet the following minimum reductions in carbon dioxide emissions:

1. All new major residential developments (10 units or more) should achieve zero carbon standards in line with London Plan policy.
2. All other new residential buildings should achieve a 35% reduction.
3. All non-residential buildings over 100sqm should achieve a 35% reduction. From 2019 all major non-residential buildings should achieve zero carbon standards in line with London Plan policy. Targets are expressed as a percentage improvement over the target emission rate (TER) based on Part L of the 2013 Building Regulations.

C. This should be achieved by following the Energy Hierarchy:

1. Be lean: use less energy
2. Be clean: supply energy efficiently
3. Be green: use renewable energy

D. The Council requires developments to contribute towards the Mayor of London target of 25% of heat and power to be generated through localised decentralised energy (DE) systems by 2025. The following will be required:

1. All new development will be required to connect to existing DE networks where feasible. This also applies where a DE network is planned and expected to be operational within 5 years of the development being completed.
2. Development proposals of 50 units or more, or new non-residential development of 1000sqm or more, will need to provide an assessment of the provision of on-site decentralised energy (DE) networks and combined heat and power (CHP).
3. Where feasible, new development of 50 units or more, or new non-residential development of 1000sqm or more, as well as schemes for the Proposal Sites identified in this Plan, will need to provide on-site DE and CHP; this is particularly necessary within the clusters identified for DE opportunities in the borough-wide Heat Mapping Study. Where on-site provision is not feasible, provision should be made for future connection to a local DE network should one become available.

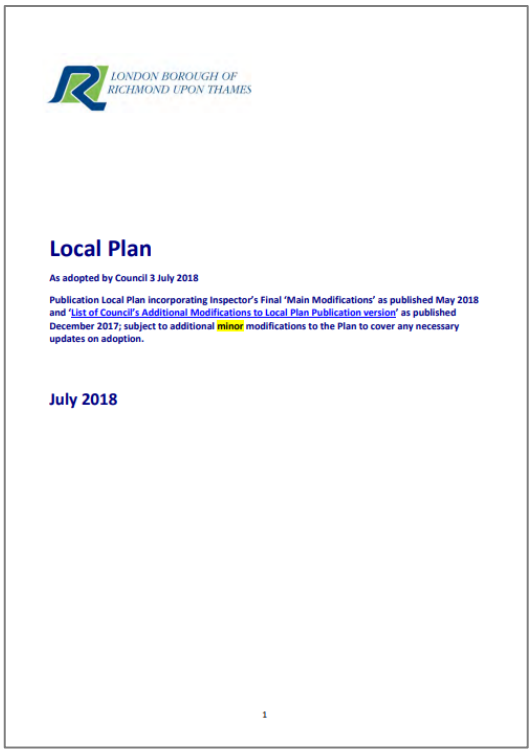
Applicants are required to consider the installation of low, or preferably ultra-low, NOx boilers to reduce the amount of NOx emitted in the borough.

Local opportunities to contribute towards decentralised energy supply from renewable and low-carbon technologies will be encouraged where appropriate.

E. High standards of energy and water efficiency in existing developments will be supported wherever possible through retrofitting. Householder extensions and other development proposals that do not meet the thresholds set out in this policy are encouraged to complete and submit the Sustainable Construction Checklist SPD as far as possible, and opportunities for micro-generation of renewable energy will be supported in line with other policies in this Plan.

Other pertinent policies to sustainability and energy include:

- LP 10 – Local Environmental Impacts, Pollution and Land Contamination
- Policy LP 15 – Biodiversity
- LP 20 – Climate Change Adaptation
- LP 21 – Flood Risk and Sustainable Drainage
- LP 23 – Water Resources and Infrastructure
- LP 24 – Waste Management
- LP 44 – Sustainable Travel Choices
- LP 45 – Parking Standard and Servicing



LONDON BOROUGH OF RICHMOND UPON THAMES

Local Plan

As adopted by Council 3 July 2018

Publication Local Plan incorporating Inspector's Final 'Main Modifications' as published May 2018 and 'List of Council's Additional Modifications to Local Plan Publication version' as published December 2017; subject to additional minor modifications to the Plan to cover any necessary updates on adoption.

July 2018

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PROPOSED SUSTAINABILITY MEASURES

This part of the report presents the key elements of the proposal that underpin environmental sustainability, demonstrates how the development complies with sustainable development policies and incorporates guidance on sustainable design and construction.

LAND AND SITE LAYOUT

Land use and Reuse of Existing Buildings

The land for this proposal is efficiently utilized, as the scheme will be constructed on previously developed land. Currently, the site includes a 1.5-storey building serving as a commercial space. This building will be retained in its entirety. The proposal is to restore and repurpose the building into two residential dwellings.

Micro-climate

A microclimate is the distinctive climate of a small-scale area and the variables within it, such as temperature, rainfall, wind, or humidity may be subtly different to the conditions prevailing over the area as a while. The main characteristics of microclimates within London are temperatures and wind.

The proposed scheme is not of a scale that could potentially have any significant impact on wind conditions around the site or any adverse effects on pedestrian and residents' comfort.

Impacts on Neighbours from Demolition and Construction

The use of the Considerate Constructors Scheme will be encouraged to ensure that contractors carry out their operations in a safe and considerate manner to avoid disturbances to neighbours.

HEALTH AND WELLBEING

Inclusive Design

The development aims to prioritise the future needs of occupants by ensuring the dwelling is designed to comply with Part M of the Building Regulations as far as feasibly possible. The proposal will also ensure that sections 1, 2 and 3 of Checklist A8 as part of the BREEAM Domestic Refurbishment assessment will be completed.

Safety and Security

The design team will implement measures where possible to provide a safe and secure dwelling for the residents.

Open Spaces/Amenity

The property is located within a 7-minute walking distance of Marble Hill Park. This proximity provides residents with access to over sixty acres of riverside parkland, featuring restored gardens and woodlands. The availability of this parkland offers potential benefits in terms of environmental quality and psychological wellbeing due to the established connection between green spaces and mood enhancement.

Daylight/Sunlight

The proposed development plans to replace the existing windows with larger ones, further enhancing the levels of natural light within the building. This alteration will ensure that occupants experience improved visual comfort and gain the full benefits of increased daylight exposure.

Additionally, the incorporation of rooflights in the design will contribute significantly to the daylighting of the interior spaces. These architectural interventions are aimed at optimizing the amount of natural light that permeates the building, thereby maximizing the beneficial effects of daylight on the occupants' wellbeing and comfort,

Physical activity

The presence of amenity providers (shops, pharmacies, public park) within walking distance to the development will encourage residents to walk rather than use personal vehicle.

WATER

Water Efficiency

The development at 10 Orleans Road aims to reduce water consumption to less than 105 litres per person per day, in line with the recommended target set out in the Richmond Local Plan, through the use of water efficient fittings, and these are listed below.

Table 1: Recommended specification for sanitary fittings

Fitting	Fitting specification
WC	4/2.6 litres dual flush
Kitchen sink tap	5 litres per min
Wash basin tap	4 litres per min
Shower	7.5 litres per min
Bath	170 litres
Washing machine	7.5 litres/kg
Dishwasher	0.85 litres/place setting

Water Efficient Landscaping

With the inclusion of landscaping in the current proposal, efforts to reduce potable water consumption from irrigation will be enhanced through a strategic combination of water reuse and the selection of native and drought-resistant plant species. These chosen species are ideally suited to thrive with little to no irrigation, relying solely on natural rainfall. In line with this approach, the courtyard's planting scheme will specifically incorporate these native and drought-resistant varieties, ensuring they flourish with minimal irrigation. Additionally, a rainwater harvesting system will be installed, aiming to provide sufficient irrigation for the landscaping while significantly reducing the reliance on potable water by utilizing rainwater reuse..

MATERIALS AND WASTE

Responsible Sourcing

100% of any timber used during construction will be sourced from accredited Forest Stewardship Council (FSC) or Programme for the Endorsement of forestry Certification (PEFC) source.

Healthy Materials

To minimise potential sources of indoor air pollution, low VOC paints, finishes and other products will be prioritised as far as practically possible. Best practice design detailing with specific focus to edges and building element junctions should also be employed to reduce the risk of thermal bridging and condensation issues, limiting the potential for mould growth.

Embodied Carbon

To further reduce carbon emissions over the lifecycle of the building, low embodied carbon materials for any new elements will be used as far as practically possible, whilst also focusing on design practices to reduce waste production.

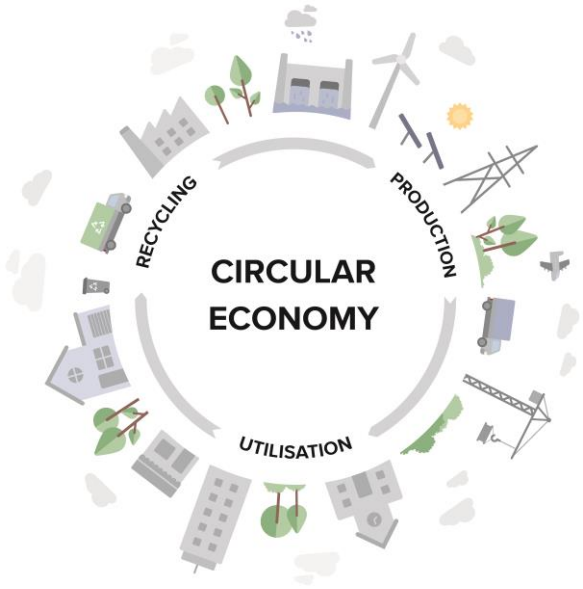
Circular Economy

Circular economy is based on three key principles: design out waste, keep products and materials in use, and regenerate natural systems. Whilst minimal intervention is expected, these principles will be applied during the design and construction by following the actions noted below:

- Design out the need for building components and materials;
- Use of reclaimed materials and remanufactured components over new;
- Product selection considering its entire lifecycle, such as products which can be remanufactured or reused; products with high recycled content; products designed for disassembly; and recyclable or compostable materials.

Operational Waste

The design team will look to incorporate sustainable methods for waste and recycling management during the proposed development's operation to meet requirements from the local authority policies and all applicable legal requirements.



NATURE CONSERVATION & BIODIVERSITY

The ecology of the site could be significantly enhanced through the integration of a small courtyard with an additional 5 sqm of planting space, along with the incorporation of a rainwater harvesting system, such as a water butt, within the courtyard. This initiative offers an innovative alternative to traditional landscaped areas, collectively contributing to the local ecology.

The planting strategy, emphasizing simple low-level flora and a preference for native species, alongside the sustainable practice of rainwater harvesting, aims to attract a diverse array of invertebrates, birds, and other fauna. This approach not only enriches the site's ecological diversity but also promotes water conservation, further enriching the site's ecology by providing a more diversified habitat for local wildlife.

CLIMATE CHANGE ADAPTATION

Overheating

The potential risk of overheating will be mitigated by incorporating both passive and active design measures.

The space heating and hot water for the development will be provided by an ASHP, chosen for its efficiency and environmental benefits. To enhance energy conservation, all heat sources and pipework connected to the ASHP system will be appropriately insulated, reducing heat loss and increasing the overall efficiency of the heating system.

Efficient lighting will replace the existing fixtures to further minimise internal heat gains and reduce energy expenditure.

Internal blinds on all windows and rooflights should be included in the base build to reduce the solar gains into occupied rooms where required.

During peak summer periods the thermal mass of the buildings will absorb and store excess heat. The buildings will release heat in the cooler evenings to allow for cooler internal spaces, dampening the peak diurnal weather conditions.

The dwellings have allowed for passive ventilation as the main method for providing fresh air and dissipating heat.

Surface Water and Flooding

The buildings' fabric and structure will be designed to minimise risk of infiltration and damage via flooding, where possible. The site falls within an area with very low flooding risk to flooding.

AIR, NOISE, AND LIGHT

Air Quality

Air pollution risks from construction and demolition activities on site will be minimal in line with the SPG 'The control of dust and emissions from construction and demolition' under the following categories:

- demolition;
- earthworks;
- construction;
- track out; and,
- non-road mobile machinery (NRMM).

During the operational phase of the development, During the operational phase of the development, the use of fossil fuels and associated combustion emissions for heating will be eliminated, aligning with the all-electric strategy that employs an ASHP. This approach, combined with enhanced insulation levels in the roof and improved air tightness of the building fabric, contributes to significant energy efficiency. The elimination of on-site combustion not only reduces the building's carbon footprint but also classifies the development as air quality neutral. Such measures are integral to achieving the necessary credits for the BREEAM Domestic Refurbishment assessment and align with contemporary environmental sustainability goals. (for further details please refer to the Energy Strategy section of this report).

The specification for the development excludes the use of combustion-based heating systems, thereby negating the emission of NOx and other combustion-related pollutants. This approach underscores the commitment to both environmental sustainability and the improvement of local air quality, in line with the principles of air quality neutral development.

Light Pollution

The lighting design of the proposed development will follow the recommendations of the Institution of Lighting Engineers' Guidance Notes for the Reduction of Obtrusive Light (2005), to minimise light pollution.

Water Pollution

As there is no change in impermeable surfaces, and therefore no increase in surface water runoff, there will be no increase in water pollution to surrounding watercourses. In addition, the contractor will adopt best practice policies to mitigate water pollution from the minor construction activities taking place on this on site.

The development will discharge domestic sewage via a connection to the public foul sewer or combined sewer network where it is reasonable to do so.

TRANSPORT

Alternative means of transportation

As part of the development's transition from commercial space to residential, the plan is to retain the existing number of site parking permits. This approach reflects a like-for-like basis in terms of parking allowance, aligning with the change in use while considering potential requirements from the Council. In order to underpin the reduction of emissions from transport, the development will encourage cycling by providing two secure cycle parking spaces, one in each property.

Public Transport Accessibility

The site has very good accessibility to public transport, with numerous bus routes within a few minutes' walk and St Margaret's Station just over a 15-minute walk away. Additionally, Twickenham Station can be reached within a 20-minute walk. The site has a PTAL rating of 3, indicating a good level of accessibility to public transport options in the area.

Proximity to Amenities

The site is conveniently located a short walk from St Margarets, granting residents easy access to essential amenities such as banks, cash points, coffee shops, grocery stores, post offices, and a variety of food outlets. Additionally, the site is within a 7-minute walk of Marble Hill Park, an expansive area offering over sixty acres of riverside parkland. This includes beautifully restored gardens and woodlands, providing an ideal setting for leisure and community activities.

BREEAM DOMESTIC REFURBISHMENT

In addition to the above measures, which will be incorporated for the development in its entirety, the dwellings will be assessed and certified under the BREEAM Domestic Refurbishment scheme in line with Policy LP 22.

A BREEAM pre-assessment has been undertaken at pre-application stage which has shown that a score of 71.66% and an Excellent rating is feasible.

The results for the pre-assessment are summarised in the table below and include a breakdown of the currently targeted score for each issue and category.

Table 2: BREEAM Pre-Assessment Breakdown

BREEAM Category	Total Credits Available	Score Assessment		
		Sub-total	Weighting	Score (%)
Management	11	10	12.00	10.91
Health & Wellbeing	12	8	17.00	11.33
Energy	29	21	43.00	31.14
Water	5	4	11.00	8.80
Materials	48	29	8.00	4.83
Waste	5	4	3.00	2.40
Pollution	8	3	6.00	2.25
Innovation	10	0	10.00	0.00
BREEAM Very Good		**Total Points Scored: 71.66%**		

ENERGY STRATEGY

This section describes the predicted energy performance and carbon dioxide emissions of the proposed 10 Orleans Road development based on the information provided by the design team.

The overall regulated CO_2 savings *on site* against a Part L 2021 compliant scheme are estimated at 86.79%.

METHODOLOGY

This section of the energy strategy assesses an existing building, therefore it is not possible to compare it with the Part L notional building (TER), as this is only applicable to new builds. Instead, a baseline model was created to reflect the existing building in its expected current state for the purposes of comparing this building with the energy performance of the refurbished building once the proposed improvements have been incorporated.

BASELINE MODEL

GLA BASELINE INPUTS

The baseline model has been designed in line Part L 2021 using the GLA guidance for the residential notional specification of existing buildings. The inputs used can be seen in the table to the right.

Element	Unit	Specification
External Wall	W/m²K	0.55
Roof	W/m²K	0.16
Floor	W/m²K	0.25
Window Glazing	W/m²K	1.6 (0.63 g-value)
Roof Window Glazing	W/m²K	1.6 (0.63 g-value)
Air Permeability	m³/h m² @50 Pa	15
Thermal Bridging	W/m²K	Default
Ventilation	-	Genvex-Combi Blueline MVHR
Heating / Hot Water	Per cent	Gas boiler with 78% summer efficiency
Cooling	SEER	None
Lighting (fixed)	Per cent	100% low energy, 75 lumens/Watt

PROPOSED MODEL

INPUTS

Following discussions with the team, the assessment includes several key enhancements. The proposed model features upgraded insulation, particularly noting the new roof, windows, and doors which significantly improve the building's thermal elements. Additionally, an electric ASHP, specifically the Genvex-'Combi Blueline' model, is proposed for heating efficiency.

Alongside these major updates, the plan includes improved pipework insulation, high-efficiency lighting, and advanced heating controls to further augment the building's energy efficiency and sustainability.

These inputs can be seen in the table below.

Element	Unit	Input
External Wall (repointed and refurbished)	W/m²K	0.25
Roof	W/m²K	0.10
Dormer wall (New built)	W/m²K	0.20
Floor	W/m²K	0.20
Window Glazing	W/m²K	1.2 (0.5 g-value)
Roof Window Glazing	W/m²K	1.2 (0.5 g-value)
Door	W/m²K	1.00
Air permeability	m³/h m² @50 Pa	8.00
Thermal Bridging	W/m²K	20% improvement on default values for refurbishment
MVHR	-	MVHR: Genvex-Combi Blueline
Heating System	Per cent	Combined MVHR with ASHP: Genvex-Combi Blueline
Cooling	-	None
Lighting (fixed)	Per cent	100% low energy lighting, 75 lumens/Watt

ENERGY EFFICIENCY MEASURES

The proposals incorporate a range of passive and active design measures that will reduce the energy demand for space conditioning, hot water, and lighting.

PASSIVE DESIGN MEASURES

ENHANCED U-VALUES

The heat loss of different building fabric elements is dependent upon their U-value, which is a measure of the thermal transmittance through the element. An element with low U-value provides better levels of insulation and reduced heating demand.

The proposed development aims to significantly enhance the building's thermal efficiency, primarily by installation of a new roof. Additionally, the plan involves fitting new windows and rooflights, further contributing to thermal efficiency. Improvements will also extend to the external walls and ground floor through general refurbishments. These measures are designed to reduce the demand for space heating by ensuring better insulation and sealing of the building envelope. Alongside these major changes, all other elements of the building will be improved in line with previous comments to ensure a comprehensive upgrade in energy efficiency.

The tables on the previous page demonstrate the existing and improved performance of the proposed building fabric.

AIR PERMEABILITY IMPROVEMENT

Heat loss may also occur due to air infiltration. Although this cannot be eliminated altogether, good construction detailing, and the use of best practice construction techniques can minimise the amount of air infiltration.

The proposed development will aim to improve upon the default air permeability rate of 15 m^3/m^2 at 50 Pa used in the baseline model. The target is to achieve an air permeability rate of 8.3 m^3/m^2 at 50 Pa. This enhanced performance is expected to be achievable through a comprehensive approach that includes the installation of a new roof, windows, rooflights, and door. In addition, the proposal encompasses significant improvements to the insulation of external walls and the floor. These measures, along with expected

internal cosmetic refurbishments such as sealing of edges and air gaps, will contribute to reducing air leakage and enhancing the overall energy efficiency of the building.

THERMAL BRIDGING

Thermal bridging can cause significant heat loss within buildings, especially older buildings, whereby junctions between insulated building fabric elements provide less thermal resistance than the surrounding envelope. While repeating thermal bridges such as timber studs, rafters and wall ties are accounted for within u-value calculations, linear thermal bridges such as floor junctions, corners, roof junctions and window reveals must be included separately within the SAP calculations.

Heat loss from linear thermal bridges is known as the Psi-value (Ψ). Psi-values can be obtained through the modelling of specific junctions based on the proposed construction details is measured in W/mK. The cumulative impact of the total heat loss expected from all the thermal bridges combined is known as the y-value. The Building Regulations Part L 2021 uses a reference y-value of 0.20 for the notional building. However, as the existing building is expected to have poor thermal bridging performance, the baseline model has been calculated using the default psi-values.

The proposed development aims to improve on the default values by 20%, for all renovation works. For the new-built elements, it is recommended that the respective thermal bridging junctions are assessed and optimised during the detailed design stage.

REDUCING THE NEED FOR ARTIFICIAL LIGHTING

The design of the development strategically incorporates increased dimensions of windows across all building elevations and the installation of new rooflights. These enhancements are aimed at optimising daylight in occupied spaces to a greater extent than standard designs. By maximizing natural light through these architectural features, the dependency on artificial lighting is significantly reduced. This approach not only delivers energy and carbon savings but also creates pleasant and healthy spaces for occupants, benefiting from increased exposure to natural light.

ACTIVE DESIGN MEASURES

HIGH EFFICACY LIGHTING

The development intends to incorporate low energy lighting fittings throughout the residential spaces, replacing the existing fluorescent lighting. All light fittings will be specified as low energy lighting and will primarily accommodate LEDs, with a minimum efficacy of 75 lumens/Watt.

HEAT RECOVERY VENTILATION

Mechanical ventilation heat recovery (MVHR) is proposed for the dwelling. The mechanical ventilation system will include heat recovery in order to achieve ventilation in the most energy-efficient way. Natural ventilation is also proposed for the dwellings.

HEAT GENERATION

The project's heating and ventilation strategy now features the Genvex-Combi Blueline, a combined MVHR and ASHP system. This innovative unit, chosen for its efficiency and sustainability, is notable for its high heat recovery rate of up to 88%. This integration into the development replaces the existing gas boiler and has been included in the updated SAP calculations.

CONTROLS

Advanced lighting and space conditioning controls will be incorporated, specifically heating controls that incorporate time and temperature zone control.

MONITORING

Apart from the above design measures, the development will incorporate monitoring equipment and systems to enable occupiers to monitor and reduce their energy use.

Smart meters will be installed to monitor the heat and electricity consumption of each dwelling; the display board will demonstrate real-time and historical energy use data and will be installed at an accessible location within the dwellings.

DISTRICT ENERGY

The size and location of this development does not lend itself to incorporation into an existing or proposed heat network.

CO_2 EMISSIONS

The regulated CO_2 emissions for the baseline and proposed building are set out in the table below. By means of fabric improvements and building systems upgrades, the carbon emissions are shown to reduce by 86.79%.

Element	CO_2 Emissions (tonnes per year)	Reduction (%)
Baseline	0.99	-
Proposed	0.53	86.79%

CONCLUSIONS

The sustainability strategy for the scheme at 10 Orleans Road has been developed in line with the relevant policies of the London Plan and of the Richmond upon Thames Local Plan and aims at the efficient management of resources, environmental protection and the effective adaptation and mitigation of the development to climate change.

The energy strategy has shown the cumulative CO_2 savings on site are estimated at 86.79% over the existing building baseline assessment which has been modelled in line with Part L 2021.

SUSTAINABILITY

The proposed 10 Orleans Road development will meet the targets set out by Richmond upon Thames Council.

Key sustainability features of the proposals include:

- The re-use of previously developed land and refurbishment of an existing building;
- The improvement in fabric efficiency though additional internal insulation to the roof and refurbishment of the external walls.
- Upgrades to a more efficient, all electric space and water heating system.
- The specification of water efficient fittings to limit water consumption to less than 105 litres per person per day;
- The development is not expected to have any significant adverse effects to air, noise, land, or watercourses.

The BREEAM pre-assessment undertaken in support of the application indicates that a score of 71.66% can be obtained, corresponding to a rating of 'Excellent'.

The sustainability measures incorporated reflect the client and design team's aspirations in integrating sustainability measures and demonstrates that the project is designed to exceed the planning policy sustainability requirements.

ENERGY STRATEGY

The Regulated CO_2 emissions for the development have been reduced against an existing building baseline assessment which has been modelled in line with Part L 2021 through on-site measures alone by 13.21% (0.46 tonnes per annum).

The tables in the following pages detail the CO_2 emissions and savings of the proposed development against the existing scheme.

Overall, the proposed development has been designed to meet energy policies set out by the GLA and the London Borough of Richmond upon Thames, which demonstrates the client and the design team's aspirations to deliver a development that pushes the energy efficiency improvements to the allowable level.

DOMESTIC CUMULATIVE SAVINGS

Table 3: CO_2 emissions after each step of the Energy Hierarchy for the domestic part of the development.

	Carbon dioxide emissions for domestic buildings (tonnes CO2 per annum)
	Regulated
Existing	0.99
Proposed	0.53

Table 4: Regulated CO_2 savings from each stage of the Energy Hierarchy for the domestic part of the development

	Regulated domestic carbon dioxide savings	
	Tonnes CO_2 per annum	% over baseline
Existing	-	-
Proposed	0.46	13.21%

APPENDIX A – SAP RESULTS

Full SAP Calculation Printout

Property Reference	Baseline	Issued on Date	14/02/2024
Assessment Reference	0001	Prop Type Ref	
Property			

SAP Rating	54 E	DER		TER	
Environmental	90 B	% DER < TER			N/A
CO_2 Emissions (t/year)	0.99	DFEE		TFEE	
Compliance Check	See BREL	% DFEE < TFEE			
% DPER < TPER		DPER		TPER	

Assessor Details	Mr. Jack Sewell	Assessor ID	AY12-0001
Client			

SAP 10 WORKSHEET FOR Existing dwelling (SAP) (Version 10.2, February 2022)
CALCULATION OF ENERGY RATING

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	51.1700 (1b)	x	2.7000 (2b)	=	138.1590	(1b) - (3b)
First floor	51.1700 (1c)	x	2.9100 (2c)	=	148.9047	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	102.3400					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	287.0637	(5)

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2. Ventilation rate

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		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	0 * 10 =	0.0000	(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) =	0.0000 / (5) =	0.0000	(8)
Number of storeys in the dwelling (ns)		2	(9)
Additional infiltration	[(9) - 1] x 0.1 =	0.1000	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0.3500	(11)
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0.0000	(12)
If no draught lobby, enter 0.05, else enter 0		0.0500	(13)
Percentage of windows and doors draught stripped		100.0000	(14)
Window infiltration	0.25 - [0.2 * (14) / 100] =	0.0500	(15)

Pressure test		No	
Pressure Test Method		Blower Door	
Measured/design AP50		15.0000	(17)
Infiltration rate		0.5500	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4675	(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	0.5961	0.5844	0.5727	0.5142	0.5026	0.4441	0.4441	0.4324	0.4675	0.5026	0.5259	0.5493	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation	0.5000	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)	0.5000	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	62.4000	(23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.7841	0.7724	0.7607	0.7022	0.6906	0.6321	0.6321	0.6204	0.6555	0.6906	0.7139	0.7373	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
window (Uw = 1.60)			16.2200	1.5038	24.3910			(27)
door			3.7500	1.8000	6.7500			(26)
RL1			4.7500	1.5038	7.1429			(27a)
Heatloss Floor 1			51.1700	0.2500	12.7925			(28a)
External Wall	51.7100	3.0100	48.7000	0.5500	26.7850			(29a)

dormer wall	8.4700	4.5000	3.9700	0.5500	2.1835	(29a)
Panel wall	12.6400	12.4600	0.1800	0.5500	0.0990	(29a)
External Roof	58.0300	4.7500	53.2800	0.1600	8.5248	(30)
Total net area of external elements Aum(A, m2)			182.0200			(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		88.6686	(33)
Party Wall			64.3400	0.0000	0.0000	(32)
Party Floor 1			51.1700			(32d)
Party Ceiling 1			51.2000			(32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 250.0000 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E1 Steel lintel with perforated steel base plate	12.2000	0.0500	0.6100
E3 Sill	7.5500	0.0400	0.3020
E4 Jamb	21.1200	0.0400	0.8448
E5 Ground floor (normal)	39.1200	0.0800	3.1296
E7 Party floor between dwellings (in blocks of flats)	44.4800	0.0400	1.7792
E16 Corner (normal)	17.0600	0.0450	0.7677
E18 Party wall between dwellings	10.8400	0.0600	0.6504
P3 Party wall - Intermediate floor between dwellings (in blocks of flats)	14.5400	0.0000	0.0000
E6 Intermediate floor within a dwelling	7.0300	0.0300	0.2109
E13 Gable (insulation at rafter level)	18.1800	0.0500	0.9090
R1 Head of roof window	2.8800	0.2400	0.6912
R2 Sill of roof window	2.8800	0.2400	0.6912
R3 Jamb of roof window	10.4000	0.2400	2.4960
R7 Flat ceiling (inverted)	11.2100	0.3200	3.5872
R4 Ridge (vaulted ceiling)	7.0300	0.1200	0.8436
R8 Roof to wall (rafter)	3.9400	0.3200	1.2608
R9 Roof to wall (flat ceiling)	9.5800	0.2400	2.2992

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 21.0728 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 109.7414 (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	74.2750	73.1679	72.0607	66.5249	65.4177	59.8818	59.8818	58.7747	62.0962	65.4177	67.6320	69.8464	(38)
Heat transfer coeff	184.0165	182.9093	181.8021	176.2663	175.1591	169.6233	169.6233	168.5161	171.8376	175.1591	177.3735	179.5878	(39)

Average = Sum(39)m / 12 = 175.9895

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.7981	1.7873	1.7765	1.7224	1.7115	1.6574	1.6574	1.6466	1.6791	1.7115	1.7332	1.7548	(40)
HLP (average)												1.7197	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.7602 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	79.3109	78.1190	76.3822	73.0591	70.6067	67.8719	66.3174	68.0411	69.9306	72.8669	76.2614	79.0070	(42a)
Hot water usage for baths	30.4399	29.9878	29.3512	28.1774	27.2985	26.3239	25.7975	26.4296	27.1179	28.1608	29.3588	30.3370	(42b)
Hot water usage for other uses	42.8968	41.3369	39.7770	38.2171	36.6572	35.0974	35.0974	36.6572	38.2171	39.7770	41.3369	42.8968	(42c)

Average daily hot water use (litres/day) 140.3416 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	152.6476	149.4437	145.5104	139.4536	134.5625	129.2931	127.2122	131.1279	135.2656	140.8047	146.9570	152.2408	(44)
Energy conte	241.7564	212.8059	223.6441	190.9050	181.1469	158.9810	153.8522	162.3638	166.7960	191.0707	209.3673	238.3723	(45)

Energy content (annual) Total = Sum(45)m = 2331.0615

Distribution loss (46)m = 0.15 x (45)m	36.2635	31.9209	33.5466	28.6358	27.1720	23.8472	23.0778	24.3546	25.0194	28.6606	31.4051	35.7558	(46)

Water storage loss:

Store volume 185.0000 (47)

b) If manufacturer declared loss factor is not known :

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.0330 (51)

Volume factor from Table 2a 0.8656 (52)

Temperature factor from Table 2b 0.5400 (53)

Enter (49) or (54) in (55) 2.8560 (55)

Total storage loss	88.5346	79.9667	88.5346	85.6786	88.5346	85.6786	88.5346	88.5346	85.6786	88.5346	85.6786	88.5346	(56)
If cylinder contains dedicated solar storage	88.5346	79.9667	88.5346	85.6786	88.5346	85.6786	88.5346	88.5346	85.6786	88.5346	85.6786	88.5346	(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	353.5534	313.7837	335.4410	299.0956	292.9439	267.1716	265.6491	274.1607	274.9866	302.8676	317.5579	350.1692	(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	353.5534	313.7837	335.4410	299.0956	292.9439	267.1716	265.6491	274.1607	274.9866	302.8676	317.5579	350.1692	(64)

Total per year (kWh/year) = Sum(64)m = 3647.3804 (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	169.8216	151.5403	163.7992	150.0284	149.6689	139.4137	140.5934	143.4235	142.0122	152.9686	156.1671	168.6963	(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	165.6094	165.6094	165.6094	165.6094	165.6094	165.6094	165.6094	165.6094	165.6094	165.6094	165.6094	165.6094	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	36.4323	32.3588	26.3160	19.9229	14.8926	12.5729	13.5855	17.6590	23.7018	30.0949	35.1252	37.4448	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	388.1435	392.1712	382.0215	360.4139	333.1383	307.5031	290.3772	286.3494	296.4991	318.1067	345.3823	371.0176	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.3211	54.3211	54.3211	54.3211	54.3211	54.3211	54.3211	54.3211	54.3211	54.3211	54.3211	54.3211	(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)	-110.4063	-110.4063	-110.4063	-110.4063	-110.4063	-110.4063	-110.4063	-110.4063	-110.4063	-110.4063	-110.4063	-110.4063	(71)

Water heating gains (Table 5)

	228.2548	225.5063	220.1602	208.3728	201.1679	193.6301	188.9696	192.7735	197.2391	205.6029	216.8987	226.7424 (72)
Total internal gains												
	762.3548	759.5606	738.0219	698.2339	658.7230	623.2304	602.4565	606.3062	626.9643	663.3287	706.9305	744.7290 (73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	4.3100	11.2829	0.6300	0.7000	0.7700	14.8618	(75)
Southwest	11.9100	36.7938	0.6300	0.7000	0.7700	133.9241	(79)
Northeast	4.7500	17.2952	0.6300	0.7000	1.0000	32.6063	(82)

Solar gains	181.3922	326.3841	493.4234	690.9107	847.2023	873.5235	828.6523	706.9623	560.9436	373.2966	220.4209	153.2005	(83)
Total gains	943.7470	1085.9447	1231.4453	1389.1446	1505.9254	1496.7538	1431.1088	1313.2685	1187.9080	1036.6253	927.3514	897.9295	(84)

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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, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	38.6212	38.8550	39.0916	40.3194	40.5742	41.8984	41.8984	42.1737	41.3585	40.5742	40.0677	39.5736	
alpha	3.5747	3.5903	3.6061	3.6880	3.7049	3.7932	3.7932	3.8116	3.7572	3.7049	3.6712	3.6382	
util living area													
	0.9898	0.9823	0.9647	0.9172	0.8172	0.6503	0.4994	0.5551	0.7891	0.9426	0.9826	0.9914	(86)
MIT	18.9961	19.2373	19.6385	20.1854	20.6215	20.8923	20.9697	20.9556	20.7627	20.1975	19.5283	18.9933	(87)
Th 2	20.1010	20.1064	20.1118	20.1388	20.1442	20.1713	20.1713	20.1767	20.1605	20.1442	20.1334	20.1226	(88)
util rest of house													
	0.9878	0.9789	0.9577	0.9004	0.7803	0.5857	0.4138	0.4683	0.7350	0.9277	0.9788	0.9898	(89)
MIT 2	18.2503	18.4936	18.8940	19.4462	19.8554	20.1057	20.1582	20.1561	19.9996	19.4695	18.8039	18.2632	(90)
Living area fraction										fLA = Living area / (4) =		0.4599	(91)
MIT	18.5933	18.8357	19.2364	19.7862	20.2077	20.4675	20.5314	20.5238	20.3506	19.8043	19.1371	18.5990	(92)
Temperature adjustment												0.3000	
adjusted MIT	18.8933	19.1357	19.5364	20.0862	20.5077	20.7675	20.8314	20.8238	20.6506	20.1043	19.4371	18.8990	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9844	0.9743	0.9523	0.8993	0.7969	0.6330	0.4826	0.5373	0.7680	0.9269	0.9749	0.9869	(94)
Useful gains	929.0588	1058.0376	1172.7659	1249.2586	1200.0215	947.4833	690.6506	705.6388	912.3447	960.8423	904.0729	886.1332	(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													
	2685.4068	2603.8379	2370.0482	1971.7489	1542.7578	1046.1494	717.7510	745.4868	1125.6418	1664.7632	2188.2661	2639.7569	(97)
Space heating kWh													
	1306.7229	1038.7778	890.7780	520.1930	254.9958	0.0000	0.0000	0.0000	0.0000	523.7171	924.6191	1304.6960	(98a)
Space heating requirement - total per year (kWh/year)												6764.4997	
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													
	1306.7229	1038.7778	890.7780	520.1930	254.9958	0.0000	0.0000	0.0000	0.0000	523.7171	924.6191	1304.6960	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												6764.4997	
Space heating per m2											(98c) / (4) =	66.0983	(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 %)	170.0000	(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													
	1306.7229	1038.7778	890.7780	520.1930	254.9958	0.0000	0.0000	0.0000	0.0000	523.7171	924.6191	1304.6960	(98)
Space heating efficiency (main heating system 1)													
	170.0000	170.0000	170.0000	170.0000	170.0000	0.0000	0.0000	0.0000	0.0000	170.0000	170.0000	170.0000	(210)
Space heating fuel (main heating system)													
	768.6605	611.0458	523.9871	305.9959	149.9975	0.0000	0.0000	0.0000	0.0000	308.0689	543.8936	767.4682	(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													
	353.5534	313.7837	335.4410	299.0956	292.9439	267.1716	265.6491	274.1607	274.9866	302.8676	317.5579	350.1692	(64)
Efficiency of water heater												170.0000	(216)
(217)m	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	(217)
Fuel for water heating, kWh/month													
	207.9726	184.5787	197.3182	175.9386	172.3199	157.1598	156.2642	161.2710	161.7568	178.1574	186.7987	205.9819	(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	62.4635	56.4186	62.4635	60.4485	62.4635	60.4485	62.4635	62.4635	60.4485	62.4635	60.4485	62.4635	(231)
Lighting	31.8890	25.5825	23.0342	16.8758	13.0354	10.6500	11.8913	15.4568	20.0768	26.3419	29.7531	32.7752	(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	3979.1175	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	170.0000	
Water heating fuel used	2145.5179	(219)
Space cooling fuel	0.0000	(221)
Electricity for pumps and fans:		
(BalancedWithHeatRecovery, DataSheet: in-use factor = 1.4000, SFP = 2.1000)		
mechanical ventilation fans (SFP = 2.1000)	735.4572	(230a)
Total electricity for the above, kWh/year	735.4572	(231)
Electricity for lighting (calculated in Appendix L)	257.3621	(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	7117.4547	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3979.1175	16.4900	656.1565	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2145.5179	16.4900	353.7959	(247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000	(247a)
Pumps, fans and electric keep-hot	735.4572	16.4900	121.2769	(249)
Energy for lighting	257.3621	16.4900	42.4390	(250)
Additional standing charges			0.0000	(251)
Total energy cost			1173.6683	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.3600	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	2.8677	(257)
SAP value		53.5153	
SAP rating (Section 12)		54	(258)
SAP band		E	

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	3979.1175	0.1548	615.9087	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2145.5179	0.1405	301.5395	(264)
Space and water heating			917.4482	(265)
Pumps, fans and electric keep-hot	735.4572	0.1387	102.0170	(267)
Energy for lighting	257.3621	0.1443	37.1453	(268)
Total CO2, kg/year			1056.6105	(272)
CO2 emissions per m2			10.3200	(273)
EI value			90.3905	
EI rating			90	(274)
EI band			B	

SAP 10 WORKSHEET FOR Existing dwelling (SAP) (Version 10.2, February 2022)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	51.1700	(1b) x	2.7000	(2b) =	138.1590	(1b) - (3b)
First floor	51.1700	(1c) x	2.9100	(2c) =	148.9047	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	102.3400					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		287.0637	(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	0 * 10 =	0.0000	(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) =	0.0000 / (5) =	0.0000	(8)
Number of storeys in the dwelling (ns)		2	(9)
Additional infiltration	[(9) - 1] x 0.1 =	0.1000	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0.3500	(11)
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0.0000	(12)
If no draught lobby, enter 0.05, else enter 0		0.0500	(13)
Percentage of windows and doors draught stripped		100.0000	(14)
Window infiltration	0.25 - [0.2 * (14) / 100] =	0.0500	(15)
Pressure test		No	
Pressure Test Method		Blower Door	
Measured/design AP50		15.0000	(17)
Infiltration rate		0.5500	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4675	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	6.0000	5.6000	5.6000	5.0000	5.0000	4.4000	4.4000	4.3000	4.7000	5.4000	5.5000	5.9000	(22)
Wind factor	1.5000	1.4000	1.4000	1.2500	1.2500	1.1000	1.1000	1.0750	1.1750	1.3500	1.3750	1.4750	(22a)
Adj infilt rate	0.7012	0.6545	0.6545	0.5844	0.5844	0.5142	0.5142	0.5026	0.5493	0.6311	0.6428	0.6896	(22b)

Balanced mechanical ventilation with heat recovery		
If mechanical ventilation	0.5000	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)	0.5000	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	62.4000	(23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.8892	0.8425	0.8425	0.7724	0.7724	0.7022	0.7022	0.6906	0.7373	0.8191	0.8308	0.8776	(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	
window (Uw = 1.60)			16.2200	1.5038	24.3910			(27)
door			3.7500	1.8000	6.7500			(26)
RL1			4.7500	1.5038	7.1429			(27a)
Heatloss Floor 1			51.1700	0.2500	12.7925			(28a)
External Wall	51.7100	3.0100	48.7000	0.5500	26.7850			(29a)
dormer wall	8.4700	4.5000	3.9700	0.5500	2.1835			(29a)
Panel wall	12.6400	12.4600	0.1800	0.5500	0.0990			(29a)
External Roof	58.0300	4.7500	53.2800	0.1600	8.5248			(30)
Total net area of external elements Aum(A, m2)			182.0200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		88.6686			(33)
Party Wall			64.3400	0.0000	0.0000			(32)
Party Floor 1			51.1700					(32d)
Party Ceiling 1			51.2000					(32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
List of Thermal Bridges		

K1 Element	Length	Psi-value	Total
E1 Steel lintel with perforated steel base plate	12.2000	0.0500	0.6100
E3 Sill	7.5500	0.0400	0.3020
E4 Jamb	21.1200	0.0400	0.8448
E5 Ground floor (normal)	39.1200	0.0800	3.1296
E7 Party floor between dwellings (in blocks of flats)	44.4800	0.0400	1.7792
E16 Corner (normal)	17.0600	0.0450	0.7677
E18 Party wall between dwellings	10.8400	0.0600	0.6504
P3 Party wall - Intermediate floor between dwellings (in blocks of flats)	14.5400	0.0000	0.0000
E6 Intermediate floor within a dwelling	7.0300	0.0300	0.2109
E13 Gable (insulation at rafter level)	18.1800	0.0500	0.9090
R1 Head of roof window	2.8800	0.2400	0.6912
R2 Sill of roof window	2.8800	0.2400	0.6912
R3 Jamb of roof window	10.4000	0.2400	2.4960
R7 Flat ceiling (inverted)	11.2100	0.3200	3.5872
R4 Ridge (vaulted ceiling)	7.0300	0.1200	0.8436
R8 Roof to wall (rafter)	3.9400	0.3200	1.2608
R9 Roof to wall (flat ceiling)	9.5800	0.2400	2.2992

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		21.0728	(36)
Point Thermal bridges	(36a) =	0.0000	
Total fabric heat loss	(33) + (36) + (36a) =	109.7414	(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	84.2396	79.8109	79.8109	73.1679	73.1679	66.5249	66.5249	65.4177	69.8464	77.5965	78.7037	83.1324	(38)
Heat transfer coeff	193.9810	189.5523	189.5523	182.9093	182.9093	176.2663	176.2663	175.1591	179.5878	187.3380	188.4452	192.8738	(39)
Average = Sum(39)m / 12 =												184.5701	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.8955	1.8522	1.8522	1.7873	1.7873	1.7224	1.7224	1.7115	1.7548	1.8305	1.8414	1.8846	(40)
HLP (average)												1.8035	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7602	(42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	79.3109	78.1190	76.3822	73.0591	70.6067	67.8719	66.3174	68.0411	69.9306	72.8669	76.2614	79.0070	(42a)
Hot water usage for baths	30.4399	29.9878	29.3512	28.1774	27.2985	26.3239	25.7975	26.4296	27.1179	28.1608	29.3588	30.3370	(42b)

Hot water usage for other uses													
	42.8968	41.3369	39.7770	38.2171	36.6572	35.0974	35.0974	36.6572	38.2171	39.7770	41.3369	42.8968	(42c)
Average daily hot water use (litres/day)												140.3416	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	152.6476	149.4437	145.5104	139.4536	134.5625	129.2931	127.2122	131.1279	135.2656	140.8047	146.9570	152.2408	(44)
Energy conte	241.7564	212.8059	223.6441	190.9050	181.1469	158.9810	153.8522	162.3638	166.7960	191.0707	209.3673	238.3723	(45)
Energy content (annual)										Total = Sum(45)m =		2331.0615	
Distribution loss (46)m = 0.15 x (45)m													
	36.2635	31.9209	33.5466	28.6358	27.1720	23.8472	23.0778	24.3546	25.0194	28.6606	31.4051	35.7558	(46)
Water storage loss:													
Store volume												185.0000	(47)
b) If manufacturer declared loss factor is not known :													
Hot water storage loss factor from Table 2 (kWh/litre/day)												0.0330	(51)
Volume factor from Table 2a												0.8656	(52)
Temperature factor from Table 2b												0.5400	(53)
Enter (49) or (54) in (55)												2.8560	(55)
Total storage loss													
	88.5346	79.9667	88.5346	85.6786	88.5346	85.6786	88.5346	88.5346	85.6786	88.5346	85.6786	88.5346	(56)
If cylinder contains dedicated solar storage													
	88.5346	79.9667	88.5346	85.6786	88.5346	85.6786	88.5346	88.5346	85.6786	88.5346	85.6786	88.5346	(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													
	353.5534	313.7837	335.4410	299.0956	292.9439	267.1716	265.6491	274.1607	274.9866	302.8676	317.5579	350.1692	(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													
	353.5534	313.7837	335.4410	299.0956	292.9439	267.1716	265.6491	274.1607	274.9866	302.8676	317.5579	350.1692	(64)
										Total per year (kWh/year) = Sum(64)m =		3647.3804	(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													
	169.8216	151.5403	163.7992	150.0284	149.6689	139.4137	140.5934	143.4235	142.0122	152.9686	156.1671	168.6963	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	165.6094	165.6094	165.6094	165.6094	165.6094	165.6094	165.6094	165.6094	165.6094	165.6094	165.6094	165.6094	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	36.4323	32.3588	26.3160	19.9229	14.8926	12.5729	13.5855	17.6590	23.7018	30.0949	35.1252	37.4448	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	388.1435	392.1712	382.0215	360.4139	333.1383	307.5031	290.3772	286.3494	296.4991	318.1067	345.3823	371.0176	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.3211	54.3211	54.3211	54.3211	54.3211	54.3211	54.3211	54.3211	54.3211	54.3211	54.3211	54.3211	(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)													
	-110.4063	-110.4063	-110.4063	-110.4063	-110.4063	-110.4063	-110.4063	-110.4063	-110.4063	-110.4063	-110.4063	-110.4063	(71)
Water heating gains (Table 5)													
	228.2548	225.5063	220.1602	208.3728	201.1679	193.6301	188.9696	192.7735	197.2391	205.6029	216.8987	226.7424	(72)
Total internal gains													
	762.3548	759.5606	738.0219	698.2339	658.7230	623.2304	602.4565	606.3062	626.9643	663.3287	706.9305	744.7290	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	4.3100	15.4538	0.6300	0.7000	0.7700	20.3556	(75)
Southwest	11.9100	47.2368	0.6300	0.7000	0.7700	171.9349	(79)
Northeast	4.7500	23.9035	0.6300	0.7000	1.0000	45.0647	(82)

Solar gains	237.3552	362.4988	551.0902	787.1575	919.5088	1013.4280	889.4116	808.8597	645.2295	422.0770	278.2424	192.7493	(83)
Total gains	999.7100	1122.0594	1289.1121	1485.3914	1578.2318	1636.6584	1491.8682	1415.1659	1272.1938	1085.4057	985.1729	937.4784	(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, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	36.6373	37.4933	37.4933	38.8550	38.8550	40.3194	40.3194	40.5742	39.5736	37.9365	37.7136	36.8476	
alpha	3.4425	3.4996	3.4996	3.5903	3.5903	3.6880	3.6880	3.7049	3.6382	3.5291	3.5142	3.4565	
util living area													
	0.9829	0.9743	0.9528	0.8986	0.8025	0.6306	0.5345	0.5463	0.7429	0.9174	0.9688	0.9850	(86)
MIT	19.2407	19.4452	19.7642	20.2442	20.6265	20.8922	20.9539	20.9523	20.8073	20.3218	19.7842	19.2516	(87)
Th 2	20.0523	20.0739	20.0739	20.1064	20.1064	20.1388	20.1388	20.1442	20.1226	20.0847	20.0793	20.0577	(88)
util rest of house													
	0.9793	0.9690	0.9430	0.8780	0.7621	0.5653	0.4501	0.4594	0.6782	0.8939	0.9610	0.9817	(89)
MIT 2	18.4591	18.6766	18.9894	19.4753	19.8265	20.0737	20.1173	20.1222	20.0009	19.5425	19.0177	18.4743	(90)
Living area fraction										fLA = Living area / (4) =		0.4599	(91)
MIT	18.8186	19.0301	19.3457	19.8290	20.1944	20.4502	20.5020	20.5040	20.3718	19.9009	19.3703	18.8318	(92)
Temperature adjustment												0.3000	
adjusted MIT	19.1186	19.3301	19.6457	20.1290	20.4944	20.7502	20.8020	20.8040	20.6718	20.2009	19.6703	19.1318	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9747	0.9637	0.9376	0.8786	0.7806	0.6126	0.5159	0.5272	0.7203	0.8973	0.9567	0.9775	(94)
Useful gains	974.4336	1081.3377	1208.6501	1305.0899	1231.9697	1002.5372	769.6739	746.1116	916.3803	973.9093	942.5206	916.4125	(95)
Ext temp.	6.1000	6.4000	7.5000	9.3000	11.9000	14.5000	16.2000	16.3000	14.6000	11.8000	9.0000	6.4000	(96)

Heat loss rate W

2525.3591	2450.9262	2302.2545	1980.7191	1572.0008	1101.6954	811.1858	788.9117	1090.4198	1573.8142	2010.7578	2455.6330	(97)

Space heating kWh

1153.8886	920.3635	813.6416	486.4530	252.9831	0.0000	0.0000	0.0000	0.0000	446.3292	769.1308	1145.1800	(98a)

Space heating requirement - total per year (kWh/year) 5987.9697

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

1153.8886	920.3635	813.6416	486.4530	252.9831	0.0000	0.0000	0.0000	0.0000	446.3292	769.1308	1145.1800	(98c)

Space heating requirement after solar contribution - total per year (kWh/year) 5987.9697

Space heating per m2 (98c) / (4) = 58.5106 (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 %) 170.0000 (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													
	1153.8886	920.3635	813.6416	486.4530	252.9831	0.0000	0.0000	0.0000	0.0000	446.3292	769.1308	1145.1800	(98)
Space heating efficiency (main heating system 1)													
	170.0000	170.0000	170.0000	170.0000	170.0000	0.0000	0.0000	0.0000	0.0000	170.0000	170.0000	170.0000	(210)
Space heating fuel (main heating system)													
	678.7580	541.3903	478.6127	286.1488	148.8136	0.0000	0.0000	0.0000	0.0000	262.5466	452.4299	673.6353	(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													
	353.5534	313.7837	335.4410	299.0956	292.9439	267.1716	265.6491	274.1607	274.9866	302.8676	317.5579	350.1692	(64)
Efficiency of water heater												170.0000	(216)
(217)m	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	(217)
Fuel for water heating, kWh/month													
	207.9726	184.5787	197.3182	175.9386	172.3199	157.1598	156.2642	161.2710	161.7568	178.1574	186.7987	205.9819	(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	62.4635	56.4186	62.4635	60.4485	62.4635	60.4485	62.4635	62.4635	60.4485	62.4635	60.4485	62.4635	(231)
Lighting	31.8890	25.5825	23.0342	16.8758	13.0354	10.6500	11.8913	15.4568	20.0768	26.3419	29.7531	32.7752	(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 3522.3351 (211)

Space heating fuel - main system 2 0.0000 (213)

Space heating fuel - secondary 0.0000 (215)

Efficiency of water heater 170.0000

Water heating fuel used 2145.5179 (219)

Space cooling fuel 0.0000 (221)

Electricity for pumps and fans:

(BalancedWithHeatRecovery, DataSheet: in-use factor = 1.4000, SFP = 2.1000)

mechanical ventilation fans (SFP = 2.1000) 735.4572 (230a)

Total electricity for the above, kWh/year 735.4572 (231)

Electricity for lighting (calculated in Appendix L) 257.3621 (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 6660.6724 (238)

10a. Fuel costs - using BEDF prices (536)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3522.3351	25.1600	886.2195	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2145.5179	25.1600	539.8123	(247)
Energy for instantaneous electric shower(s)	0.0000	25.1600	0.0000	(247a)
Pumps, fans and electric keep-hot	735.4572	25.1600	185.0410	(249)
Energy for lighting	257.3621	25.1600	64.7523	(250)
Additional standing charges			0.0000	(251)
Total energy cost			1675.8252	(255)

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

	Energy	Emission factor	Emissions

	kWh/year	kg CO2/kWh	kg CO2/year	
Space heating - main system 1	3522.3351	0.1547	544.8762	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2145.5179	0.1405	301.5395	(264)
Space and water heating			846.4157	(265)
Pumps, fans and electric keep-hot	735.4572	0.1387	102.0170	(267)
Energy for lighting	257.3621	0.1443	37.1453	(268)
Total CO2, kg/year			985.5780	(272)

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	3522.3351	1.5727	5539.6301	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2145.5179	1.5197	3260.4642	(278)
Space and water heating			8800.0943	(279)
Pumps, fans and electric keep-hot	735.4572	1.5128	1112.5997	(281)
Energy for lighting	257.3621	1.5338	394.7506	(282)
Total Primary energy kWh/year			10307.4446	(286)

SAP 10 EPC IMPROVEMENTS

0001

Current energy efficiency rating: E 54
Current environmental impact rating: B 90

N	Solar water heating	Recommended
U	Solar photovoltaic panels	Recommended
V2	Wind turbine	Not applicable

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 2.2	-£ 106	-53 kg (5.4%)
U Solar photovoltaic panels	+ 6.5	-£ 275	-147 kg (15.8%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£106	0.52 kg/m²	D 56	B 91
Solar photovoltaic panels	£275	1.44 kg/m²	D 62	A 92
Total Savings	£381	1.96 kg/m²		

Potential energy efficiency rating: D 62
Potential environmental impact rating: A 92

Fuel prices for cost data on this page from database revision number 536 TEST (31 Jan 2024)
Recommendation texts revision number 6.1 (11 Jun 2019)

Typical heating and lighting costs of this home (per year, South West England):

	Current	Potential	Saving
Electricity	£1676	£1570	£106
Space heating	£1071	£1093	-£21
Water heating	£540	£412	£128
Lighting	£65	£65	£0
Generated (PV)	-£0	-£275	£275
Total cost of fuels	£1676	£1295	£381
Total cost of uses	£1676	£1295	£382
Delivered energy	65 kWh/m²	50 kWh/m²	15 kWh/m²
Carbon dioxide emissions	1.0 tonnes	0.8 tonnes	0.2 tonnes
CO2 emissions per m²	10 kg/m²	8 kg/m²	2 kg/m²
Primary energy	101 kWh/m²	79 kWh/m²	22 kWh/m²

SAP 10 WORKSHEET FOR Existing dwelling (SAP) (Version 10.2, February 2022)
CALCULATION OF ENERGY RATING FOR IMPROVED DWELLING

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	51.1700 (1b)	x	2.7000 (2b)	=	138.1590	(1b) - (3b)
First floor	51.1700 (1c)	x	2.9100 (2c)	=	148.9047	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	102.3400					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	287.0637	(5)

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2. Ventilation rate

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		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	0 * 10 =	0.0000	(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) =	0.0000 / (5) =	0.0000	(8)
Number of storeys in the dwelling (ns)		2	(9)
Additional infiltration	[(9) - 1] x 0.1 =	0.1000	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0.3500	(11)
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0.0000	(12)
If no draught lobby, enter 0.05, else enter 0		0.0500	(13)
Percentage of windows and doors draught stripped		100.0000	(14)
Window infiltration	0.25 - [0.2 * (14) / 100] =	0.0500	(15)
Pressure test		No	
Pressure Test Method		Blower Door	
Measured/design AP50		15.0000	(17)
Infiltration rate		0.5500	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4675	(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	0.5961	0.5844	0.5727	0.5142	0.5026	0.4441	0.4441	0.4324	0.4675	0.5026	0.5259	0.5493	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation	0.5000	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)	0.5000	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	62.4000	(23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.7841	0.7724	0.7607	0.7022	0.6906	0.6321	0.6321	0.6204	0.6555	0.6906	0.7139	0.7373	(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	
window (Uw = 1.60)			16.2200	1.5038	24.3910			(27)
door			3.7500	1.8000	6.7500			(26)
RL1			4.7500	1.5038	7.1429			(27a)
Heatloss Floor 1			51.1700	0.2500	12.7925			(28a)
External Wall	51.7100	3.0100	48.7000	0.5500	26.7850			(29a)
dormer wall	8.4700	4.5000	3.9700	0.5500	2.1835			(29a)
Panel wall	12.6400	12.4600	0.1800	0.5500	0.0990			(29a)
External Roof	58.0300	4.7500	53.2800	0.1600	8.5248			(30)
Total net area of external elements Aum(A, m2)			182.0200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		88.6686			(33)
Party Wall			64.3400	0.0000	0.0000			(32)
Party Floor 1			51.1700					(32d)
Party Ceiling 1			51.2000					(32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E1 Steel lintel with perforated steel base plate	12.2000	0.0500	0.6100
E3 Sill	7.5500	0.0400	0.3020
E4 Jamb	21.1200	0.0400	0.8448
E5 Ground floor (normal)	39.1200	0.0800	3.1296
E7 Party floor between dwellings (in blocks of flats)	44.4800	0.0400	1.7792
E16 Corner (normal)	17.0600	0.0450	0.7677
E18 Party wall between dwellings	10.8400	0.0600	0.6504
P3 Party wall - Intermediate floor between dwellings (in blocks of flats)	14.5400	0.0000	0.0000
E6 Intermediate floor within a dwelling	7.0300	0.0300	0.2109
E13 Gable (insulation at rafter level)	18.1800	0.0500	0.9090
R1 Head of roof window	2.8800	0.2400	0.6912
R2 Sill of roof window	2.8800	0.2400	0.6912
R3 Jamb of roof window	10.4000	0.2400	2.4960
R7 Flat ceiling (inverted)	11.2100	0.3200	3.5872
R4 Ridge (vaulted ceiling)	7.0300	0.1200	0.8436
R8 Roof to wall (rafter)	3.9400	0.3200	1.2608
R9 Roof to wall (flat ceiling)	9.5800	0.2400	2.2992

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		21.0728	(36)
Point Thermal bridges	(36a) =	0.0000	
Total fabric heat loss	(33) + (36) + (36a) =	109.7414	(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	74.2750	73.1679	72.0607	66.5249	65.4177	59.8818	59.8818	58.7747	62.0962	65.4177	67.6320	69.8464	(38)
Heat transfer coeff	184.0165	182.9093	181.8021	176.2663	175.1591	169.6233	169.6233	168.5161	171.8376	175.1591	177.3735	179.5878	(39)
Average = Sum(39)m / 12 =												175.9895	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.7981	1.7873	1.7765	1.7224	1.7115	1.6574	1.6574	1.6466	1.6791	1.7115	1.7332	1.7548	(40)
HLP (average)												1.7197	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7602	(42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	79.3109	78.1190	76.3822	73.0591	70.6067	67.8719	66.3174	68.0411	69.9306	72.8669	76.2614	79.0070	(42a)
Hot water usage for baths	30.4399	29.9878	29.3512	28.1774	27.2985	26.3239	25.7975	26.4296	27.1179	28.1608	29.3588	30.3370	(42b)
Hot water usage for other uses	42.8968	41.3369	39.7770	38.2171	36.6572	35.0974	35.0974	36.6572	38.2171	39.7770	41.3369	42.8968	(42c)
Average daily hot water use (litres/day)												140.3416	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	152.6476	149.4437	145.5104	139.4536	134.5625	129.2931	127.2122	131.1279	135.2656	140.8047	146.9570	152.2408	(44)
Energy conte	241.7564	212.8059	223.6441	190.9050	181.1469	158.9810	153.8522	162.3638	166.7960	191.0707	209.3673	238.3723	(45)
Energy content (annual)										Total = Sum(45)m =		2331.0615	
Distribution loss (46)m = 0.15 x (45)m													
	36.2635	31.9209	33.5466	28.6358	27.1720	23.8472	23.0778	24.3546	25.0194	28.6606	31.4051	35.7558	(46)
Water storage loss:													
Store volume												185.0000	(47)
b) If manufacturer declared loss factor is not known :													
Hot water storage loss factor from Table 2 (kWh/litre/day)												0.0330	(51)
Volume factor from Table 2a												0.8656	(52)
Temperature factor from Table 2b												0.5400	(53)
Enter (49) or (54) in (55)												2.8560	(55)
Total storage loss													
	88.5346	79.9667	88.5346	85.6786	88.5346	85.6786	88.5346	88.5346	85.6786	88.5346	85.6786	88.5346	(56)
If cylinder contains dedicated solar storage													
	88.5346	79.9667	88.5346	85.6786	88.5346	85.6786	88.5346	88.5346	85.6786	88.5346	85.6786	88.5346	(57)
Primary loss	23.2624	21.0112	21.8667	15.7584	10.4681	9.9053	10.2355	11.1660	17.1091	21.8667	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													
	353.5534	313.7837	334.0453	292.3420	280.1496	254.5649	252.6222	262.0643	269.5837	301.4719	317.5579	350.1692	(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)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.8000	(H2)
Collector linear heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0000	(H4)
Collector loop efficiency												0.9000	(H5)
Incidence angle modifier												1.0000	(H6)
Overshading factor												0.8000	(H8)
Overall heat loss coefficient of system												6.5000	(H10)
Heat loss coefficient of collector loop												3.9667	(H11)
Dedicated solar storage volume												75.0000	(H12)
Effective solar volume												75.0000	(H14)
Reference volume												225.0000	(H15)
Storage tank correction coefficient												1.3161	(H16)
Heat delivered to hot water												662.7724	(H24)
Heat delivered to space heating												0.0000	(H29)
Solar input												662.7724	
Solar input	-0.0000	-16.1603	-60.1140	-84.4353	-112.9732	-104.9765	-104.7558	-89.9627	-60.4330	-28.9615	-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													
	353.5534	297.6235	273.9313	207.9067	167.1764	149.5884	147.8664	172.1016	209.1507	272.5104	317.5579	350.1692	(64)
										Total per year (kWh/year) = Sum(64)m =		2919.1357	(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													
	169.8216	151.5403	162.6826	144.6255	139.4335	129.3283	130.1719	133.7464	137.6898	151.8520	156.1671	168.6963	(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	165.6094	165.6094	165.6094	165.6094	165.6094	165.6094	165.6094	165.6094	165.6094	165.6094	165.6094	165.6094	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	36.4323	32.3588	26.3160	19.9229	14.8926	12.5729	13.5855	17.6590	23.7018	30.0949	35.1252	37.4448	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	388.1435	392.1712	382.0215	360.4139	333.1383	307.5031	290.3772	286.3494	296.4991	318.1067	345.3823	371.0176	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.3211	54.3211	54.3211	54.3211	54.3211	54.3211	54.3211	54.3211	54.3211	54.3211	54.3211	54.3211	(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)													
	-110.4063	-110.4063	-110.4063	-110.4063	-110.4063	-110.4063	-110.4063	-110.4063	-110.4063	-110.4063	-110.4063	-110.4063	(71)
Water heating gains (Table 5)													
	228.2548	225.5063	218.6594	200.8688	187.4106	179.6226	174.9622	179.7666	191.2359	204.1021	216.8987	226.7424	(72)
Total internal gains													
	762.3548	759.5606	736.5211	690.7299	644.9657	609.2229	588.4491	593.2993	620.9611	661.8279	706.9305	744.7290	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	4.3100	11.2829	0.6300	0.7000	0.7700	14.8618	(75)
Southwest	11.9100	36.7938	0.6300	0.7000	0.7700	133.9241	(79)
Northeast	4.7500	17.2952	0.6300	0.7000	1.0000	32.6063	(82)

Solar gains	181.3922	326.3841	493.4234	690.9107	847.2023	873.5235	828.6523	706.9623	560.9436	373.2966	220.4209	153.2005	(83)
Total gains	943.7470	1085.9447	1229.9445	1381.6406	1492.1680	1482.7464	1417.1013	1300.2616	1181.9048	1035.1245	927.3514	897.9295	(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, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	38.6212	38.8550	39.0916	40.3194	40.5742	41.8984	41.8984	42.1737	41.3585	40.5742	40.0677	39.5736	
alpha	3.5747	3.5903	3.6061	3.6880	3.7049	3.7932	3.7932	3.8116	3.7572	3.7049	3.6712	3.6382	
util living area													
	0.9898	0.9823	0.9648	0.9183	0.8206	0.6547	0.5037	0.5596	0.7911	0.9428	0.9826	0.9914	(86)
MIT	18.9961	19.2373	19.6372	20.1804	20.6155	20.8898	20.9688	20.9543	20.7605	20.1963	19.5283	18.9933	(87)
Th 2	20.1010	20.1064	20.1118	20.1388	20.1442	20.1713	20.1713	20.1767	20.1605	20.1442	20.1334	20.1226	(88)
util rest of house													
	0.9878	0.9789	0.9579	0.9018	0.7840	0.5900	0.4176	0.4725	0.7372	0.9280	0.9788	0.9898	(89)
MIT 2	18.2503	18.4936	18.8928	19.4415	19.8504	20.1040	20.1578	20.1555	19.9979	19.4684	18.8039	18.2632	(90)
Living area fraction										fLA = Living area / (4) =		0.4599	(91)
MIT	18.5933	18.8357	19.2352	19.7813	20.2023	20.4654	20.5308	20.5229	20.3486	19.8032	19.1371	18.5990	(92)

Temperature adjustment												0.3000	
adjusted MIT	18.8933	19.1357	19.5352	20.0813	20.5023	20.7654	20.8308	20.8229	20.6486	20.1032	19.4371	18.8990	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9844	0.9743	0.9525	0.9005	0.8001	0.6373	0.4867	0.5417	0.7700	0.9272	0.9749	0.9869	(94)
Useful gains	929.0588	1058.0376	1171.5189	1244.1866	1193.9539	944.8929	689.7589	704.3792	910.0572	959.7157	904.0729	886.1332	(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	2685.4068	2603.8379	2369.8300	1970.8932	1541.8019	1045.8007	717.6446	745.3332	1125.3021	1664.5733	2188.2661	2639.7569	(97)
Space heating kWh	1306.7229	1038.7778	891.5435	523.2288	258.7990	0.0000	0.0000	0.0000	0.0000	524.4141	924.6191	1304.6960	(98a)
Space heating requirement - total per year (kWh/year)												6772.8011	
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	1306.7229	1038.7778	891.5435	523.2288	258.7990	0.0000	0.0000	0.0000	0.0000	524.4141	924.6191	1304.6960	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												6772.8011	
Space heating per m2											(98c) / (4) =	66.1794	(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 %)												170.0000	(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	1306.7229	1038.7778	891.5435	523.2288	258.7990	0.0000	0.0000	0.0000	0.0000	524.4141	924.6191	1304.6960	(98)
Space heating efficiency (main heating system 1)	170.0000	170.0000	170.0000	170.0000	170.0000	0.0000	0.0000	0.0000	0.0000	170.0000	170.0000	170.0000	(210)
Space heating fuel (main heating system)	768.6605	611.0458	524.4374	307.7816	152.2347	0.0000	0.0000	0.0000	0.0000	308.4789	543.8936	767.4682	(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	353.5534	297.6235	273.9313	207.9067	167.1764	149.5884	147.8664	172.1016	209.1507	272.5104	317.5579	350.1692	(64)
Efficiency of water heater												170.0000	(216)
(217)m	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	(217)
Fuel for water heating, kWh/month	207.9726	175.0726	161.1360	122.2981	98.3390	87.9932	86.9802	101.2362	123.0298	160.3002	186.7987	205.9819	(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	69.2580	62.5556	69.2580	67.0239	69.2580	67.0239	69.2580	69.2580	67.0239	69.2580	67.0239	69.2580	(231)
Lighting	31.8890	25.5825	23.0342	16.8758	13.0354	10.6500	11.8913	15.4568	20.0768	26.3419	29.7531	32.7752	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-41.4882	-63.8970	-98.8529	-116.1074	-124.5555	-107.0262	-105.9277	-98.7106	-85.4671	-74.3418	-47.1164	-35.2582	(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	3984.0006	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	170.0000	
Water heating fuel used	1717.1386	(219)
Space cooling fuel	0.0000	(221)
Electricity for pumps and fans:		
(BalancedWithHeatRecovery, DataSheet: in-use factor = 1.4000, SFP = 2.1000)		
mechanical ventilation fans (SFP = 2.1000)	735.4572	(230a)
pump for solar water heating	80.0000	(230g)
Total electricity for the above, kWh/year	815.4572	(231)
Electricity for lighting (calculated in Appendix L)	257.3621	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-998.7489	(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	5775.2097	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3984.0006	16.4900	656.9617	(240)
Total CO2 associated with community systems			0.0000	(473)

Water heating (other fuel)	1717.1386	16.4900	283.1562	(247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000	(247a)
Pumps, fans and electric keep-hot	735.4572	16.4900	121.2769	(249)
Pump for solar water heating	80.0000	16.4900	13.1920	(249)
Energy for lighting	257.3621	16.4900	42.4390	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-998.7489	16.4900	-164.6937	
PV Unit electricity exported	0.0000	5.5900	0.0000	
Total			-164.6937	(252)
Total energy cost			952.3321	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.3600	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	2.3269	(257)
SAP value		62.2816	
SAP rating (Section 12)		62	(258)
SAP band		D	

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	3984.0006	0.1548	616.5840	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1717.1386	0.1439	247.1789	(264)
Space and water heating			863.7629	(265)
Pumps, fans and electric keep-hot	815.4572	0.1387	113.1140	(267)
Energy for lighting	257.3621	0.1443	37.1453	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-998.7489	0.1344	-134.2111	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-134.2111	(269)
Total CO2, kg/year			879.8111	(272)
CO2 emissions per m2			8.6000	(273)
EI value			91.9985	
EI rating			92	(274)
EI band			A	

SAP 10 WORKSHEET FOR Existing dwelling (SAP) (Version 10.2, February 2022)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING

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1. Overall dwelling characteristics

		Area (m2)		Storey height (m)		Volume (m3)	
Ground floor		51.1700 (1b)	x	2.7000 (2b)	=	138.1590	(1b) - (3b)
First floor		51.1700 (1c)	x	2.9100 (2c)	=	148.9047	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	102.3400						(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	287.0637	(5)

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2. Ventilation rate

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		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	0 * 10 =	0.0000	(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) =	0.0000 / (5) =	0.0000	(8)
Number of storeys in the dwelling (ns)		2	(9)
Additional infiltration	[(9) - 1] x 0.1 =	0.1000	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0.3500	(11)
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0.0000	(12)
If no draught lobby, enter 0.05, else enter 0		0.0500	(13)
Percentage of windows and doors draught stripped		100.0000	(14)
Window infiltration	0.25 - [0.2 * (14) / 100] =	0.0500	(15)
Pressure test		No	
Pressure Test Method		Blower Door	
Measured/design AP50		15.0000	(17)
Infiltration rate		0.5500	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.4675	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	6.0000	5.6000	5.6000	5.0000	5.0000	4.4000	4.4000	4.3000	4.7000	5.4000	5.5000	5.9000	(22)
Wind factor	1.5000	1.4000	1.4000	1.2500	1.2500	1.1000	1.1000	1.0750	1.1750	1.3500	1.3750	1.4750	(22a)
Adj infilt rate													
	0.7012	0.6545	0.6545	0.5844	0.5844	0.5142	0.5142	0.5026	0.5493	0.6311	0.6428	0.6896	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation 0.5000 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) 0.5000 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 62.4000 (23c)

Effective ac	0.8892	0.8425	0.8425	0.7724	0.7724	0.7022	0.7022	0.6906	0.7373	0.8191	0.8308	0.8776	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
window (Uw = 1.60)			16.2200	1.5038	24.3910			(27)
door			3.7500	1.8000	6.7500			(26)
RL1			4.7500	1.5038	7.1429			(27a)
Heatloss Floor 1			51.1700	0.2500	12.7925			(28a)
External Wall	51.7100	3.0100	48.7000	0.5500	26.7850			(29a)
dormer wall	8.4700	4.5000	3.9700	0.5500	2.1835			(29a)
Panel wall	12.6400	12.4600	0.1800	0.5500	0.0990			(29a)
External Roof	58.0300	4.7500	53.2800	0.1600	8.5248			(30)
Total net area of external elements Aum(A, m2)			182.0200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		88.6686			(33)
Party Wall			64.3400	0.0000	0.0000			(32)
Party Floor 1			51.1700					(32d)
Party Ceiling 1			51.2000					(32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 250.0000 (35)

List of Thermal Bridges

	K1 Element	Length	Psi-value	Total
E1	Steel lintel with perforated steel base plate	12.2000	0.0500	0.6100
E3	Sill	7.5500	0.0400	0.3020
E4	Jamb	21.1200	0.0400	0.8448
E5	Ground floor (normal)	39.1200	0.0800	3.1296
E7	Party floor between dwellings (in blocks of flats)	44.4800	0.0400	1.7792
E16	Corner (normal)	17.0600	0.0450	0.7677
E18	Party wall between dwellings	10.8400	0.0600	0.6504
P3	Party wall - Intermediate floor between dwellings (in blocks of flats)	14.5400	0.0000	0.0000
E6	Intermediate floor within a dwelling	7.0300	0.0300	0.2109
E13	Gable (insulation at rafter level)	18.1800	0.0500	0.9090
R1	Head of roof window	2.8800	0.2400	0.6912
R2	Sill of roof window	2.8800	0.2400	0.6912
R3	Jamb of roof window	10.4000	0.2400	2.4960
R7	Flat ceiling (inverted)	11.2100	0.3200	3.5872
R4	Ridge (vaulted ceiling)	7.0300	0.1200	0.8436
R8	Roof to wall (rafter)	3.9400	0.3200	1.2608
R9	Roof to wall (flat ceiling)	9.5800	0.2400	2.2992

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 21.0728 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 109.7414 (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	84.2396	79.8109	79.8109	73.1679	73.1679	66.5249	66.5249	65.4177	69.8464	77.5965	78.7037	83.1324	(38)
Heat transfer coeff	193.9810	189.5523	189.5523	182.9093	182.9093	176.2663	176.2663	175.1591	179.5878	187.3380	188.4452	192.8738	(39)

Average = Sum(39)m / 12 = 184.5701

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.8955	1.8522	1.8522	1.7873	1.7873	1.7224	1.7224	1.7115	1.7548	1.8305	1.8414	1.8846	(40)
HLP (average)												1.8035	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.7602 (42)

Hot water usage for mixer showers

79.3109	78.1190	76.3822	73.0591	70.6067	67.8719	66.3174	68.0411	69.9306	72.8669	76.2614	79.0070	(42a)

Hot water usage for baths

30.4399	29.9878	29.3512	28.1774	27.2985	26.3239	25.7975	26.4296	27.1179	28.1608	29.3588	30.3370	(42b)

Hot water usage for other uses

42.8968	41.3369	39.7770	38.2171	36.6572	35.0974	35.0974	36.6572	38.2171	39.7770	41.3369	42.8968	(42c)

Average daily hot water use (litres/day) 140.3416 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	152.6476	149.4437	145.5104	139.4536	134.5625	129.2931	127.2122	131.1279	135.2656	140.8047	146.9570	152.2408	(44)
Energy conte	241.7564	212.8059	223.6441	190.9050	181.1469	158.9810	153.8522	162.3638	166.7960	191.0707	209.3673	238.3723	(45)
Energy content (annual)										Total = Sum(45)m =		2331.0615	
Distribution loss (46)m = 0.15 x (45)m	36.2635	31.9209	33.5466	28.6358	27.1720	23.8472	23.0778	24.3546	25.0194	28.6606	31.4051	35.7558	(46)

Water storage loss:

Store volume 185.0000 (47)

b) If manufacturer declared loss factor is not known :

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.0330 (51)

Volume factor from Table 2a 0.8656 (52)

Temperature factor from Table 2b 0.5400 (53)

Enter (49) or (54) in (55) 2.8560 (55)

Total storage loss

88.5346	79.9667	88.5346	85.6786	88.5346	85.6786	88.5346	88.5346	85.6786	88.5346	85.6786	88.5346	(56)

If cylinder contains dedicated solar storage

88.5346	79.9667	88.5346	85.6786	88.5346	85.6786	88.5346	88.5346	85.6786	88.5346	85.6786	88.5346	(57)
Primary loss 23.2624	21.0112	21.8667	15.7584	10.4681	9.9053	10.2355	11.1660	17.1091	21.8667	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

353.5534	313.7837	334.0453	292.3420	280.1496	254.5649	252.6222	262.0643	269.5837	301.4719	317.5579	350.1692	(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)

Aperture area of solar collector 3.0000 (H1)

Zero-loss collector efficiency 0.8000 (H2)

Collector linear heat loss coefficient 1.8000 (H3)

Collector 2nd order heat loss coefficient												0.0000	(H4)
Collector loop efficiency												0.9000	(H5)
Incidence angle modifier												1.0000	(H6)
Overshading factor												0.8000	(H8)
Overall heat loss coefficient of system												6.5000	(H10)
Heat loss coefficient of collector loop												3.9667	(H11)
Dedicated solar storage volume												75.0000	(H12)
Effective solar volume												75.0000	(H14)
Reference volume												225.0000	(H15)
Storage tank correction coefficient												1.3161	(H16)
Heat delivered to hot water												796.3381	(H24)
Heat delivered to space heating												0.0000	(H29)
Solar input												796.3381	
Solar input	-6.8433	-24.7492	-72.9860	-100.1784	-123.3253	-123.3462	-112.2114	-105.6751	-75.4509	-40.8994	-10.6729	-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													
	346.7101	289.0345	261.0592	192.1637	156.8243	131.2187	140.4107	156.3892	194.1329	260.5725	306.8850	350.1692	(64)
									Total per year (kWh/year) = Sum(64)m =			2785.5700	(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													
	169.8216	151.5403	162.6826	144.6255	139.4335	129.3283	130.1719	133.7464	137.6898	151.8520	156.1671	168.6963	(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	165.6094	165.6094	165.6094	165.6094	165.6094	165.6094	165.6094	165.6094	165.6094	165.6094	165.6094	165.6094	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	36.4323	32.3588	26.3160	19.9229	14.8926	12.5729	13.5855	17.6590	23.7018	30.0949	35.1252	37.4448	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	388.1435	392.1712	382.0215	360.4139	333.1383	307.5031	290.3772	286.3494	296.4991	318.1067	345.3823	371.0176	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.3211	54.3211	54.3211	54.3211	54.3211	54.3211	54.3211	54.3211	54.3211	54.3211	54.3211	54.3211	(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)													
	-110.4063	-110.4063	-110.4063	-110.4063	-110.4063	-110.4063	-110.4063	-110.4063	-110.4063	-110.4063	-110.4063	-110.4063	(71)
Water heating gains (Table 5)													
	228.2548	225.5063	218.6594	200.8688	187.4106	179.6226	174.9622	179.7666	191.2359	204.1021	216.8987	226.7424	(72)
Total internal gains													
	762.3548	759.5606	736.5211	690.7299	644.9657	609.2229	588.4491	593.2993	620.9611	661.8279	706.9305	744.7290	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	4.3100	15.4538	0.6300	0.7000	0.7700	20.3556	(75)
Southwest	11.9100	47.2368	0.6300	0.7000	0.7700	171.9349	(79)
Northeast	4.7500	23.9035	0.6300	0.7000	1.0000	45.0647	(82)

Solar gains	237.3552	362.4988	551.0902	787.1575	919.5088	1013.4280	889.4116	808.8597	645.2295	422.0770	278.2424	192.7493	(83)
Total gains	999.7100	1122.0594	1287.6113	1477.8874	1564.4745	1622.6509	1477.8607	1402.1590	1266.1906	1083.9049	985.1729	937.4784	(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, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	36.6373	37.4933	37.4933	38.8550	38.8550	40.3194	40.3194	40.5742	39.5736	37.9365	37.7136	36.8476	
alpha	3.4425	3.4996	3.4996	3.5903	3.5903	3.6880	3.6880	3.7049	3.6382	3.5291	3.5142	3.4565	
util living area													
	0.9829	0.9743	0.9529	0.8998	0.8057	0.6346	0.5387	0.5504	0.7449	0.9177	0.9688	0.9850	(86)
MIT	19.2407	19.4452	19.7631	20.2395	20.6209	20.8900	20.9527	20.9511	20.8055	20.3208	19.7842	19.2516	(87)
Th 2	20.0523	20.0739	20.0739	20.1064	20.1064	20.1388	20.1388	20.1442	20.1226	20.0847	20.0793	20.0577	(88)
util rest of house													
	0.9793	0.9690	0.9431	0.8794	0.7657	0.5693	0.4540	0.4632	0.6803	0.8942	0.9610	0.9817	(89)
MIT 2	18.4591	18.6766	18.9883	19.4711	19.8219	20.0722	20.1166	20.1215	19.9996	19.5416	19.0177	18.4743	(90)
Living area fraction									fLA = Living area / (4) =			0.4599	(91)
MIT	18.8186	19.0301	19.3446	19.8245	20.1894	20.4483	20.5012	20.5031	20.3703	19.9000	19.3703	18.8318	(92)
Temperature adjustment												0.3000	
adjusted MIT	19.1186	19.3301	19.6446	20.1245	20.4894	20.7483	20.8012	20.8031	20.6703	20.2000	19.6703	19.1318	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9747	0.9637	0.9378	0.8799	0.7838	0.6164	0.5200	0.5312	0.7223	0.8976	0.9567	0.9775	(94)
Useful gains	974.4336	1081.3377	1207.4655	1300.3792	1226.2256	1000.1690	768.4477	744.8840	914.5235	972.8935	942.5206	916.4125	(95)
Ext temp.	6.1000	6.4000	7.5000	9.3000	11.9000	14.5000	16.2000	16.3000	14.6000	11.8000	9.0000	6.4000	(96)
Heat loss rate W													
	2525.3591	2450.9262	2302.0409	1979.9082	1571.0731	1101.3688	811.0306	788.7570	1090.1441	1573.6364	2010.7578	2455.6330	(97)
Space heating kWh													
	1153.8886	920.3635	814.3641	489.2609	256.5665	0.0000	0.0000	0.0000	0.0000	446.9527	769.1308	1145.1800	(98a)
Space heating requirement - total per year (kWh/year)												5995.7071	
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													
	1153.8886	920.3635	814.3641	489.2609	256.5665	0.0000	0.0000	0.0000	0.0000	446.9527	769.1308	1145.1800	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												5995.7071	
Space heating per m2											(98c) / (4) =	58.5862	(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 %)												170.0000	(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													
	1153.8886	920.3635	814.3641	489.2609	256.5665	0.0000	0.0000	0.0000	0.0000	446.9527	769.1308	1145.1800	(98)
Space heating efficiency (main heating system 1)													
	170.0000	170.0000	170.0000	170.0000	170.0000	0.0000	0.0000	0.0000	0.0000	170.0000	170.0000	170.0000	(210)
Space heating fuel (main heating system)													
	678.7580	541.3903	479.0377	287.8005	150.9215	0.0000	0.0000	0.0000	0.0000	262.9134	452.4299	673.6353	(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													
	346.7101	289.0345	261.0592	192.1637	156.8243	131.2187	140.4107	156.3892	194.1329	260.5725	306.8850	350.1692	(64)
Efficiency of water heater												170.0000	(216)
(217)m	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	(217)
Fuel for water heating, kWh/month													
	203.9471	170.0203	153.5643	113.0375	92.2496	77.1875	82.5946	91.9937	114.1958	153.2779	180.5206	205.9819	(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	69.2580	62.5556	69.2580	67.0239	69.2580	67.0239	69.2580	69.2580	67.0239	69.2580	67.0239	69.2580	(231)
Lighting	31.8890	25.5825	23.0342	16.8758	13.0354	10.6500	11.8913	15.4568	20.0768	26.3419	29.7531	32.7752	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-52.9051	-69.6692	-107.0125	-125.8609	-130.1143	-114.7863	-109.3424	-105.9015	-93.1684	-81.3249	-57.5242	-43.5676	(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	3526.8865	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	170.0000	
Water heating fuel used	1638.5706	(219)
Space cooling fuel	0.0000	(221)
Electricity for pumps and fans:		
(BalancedWithHeatRecovery, DataSheet: in-use factor = 1.4000, SFP = 2.1000)		
mechanical ventilation fans (SFP = 2.1000)	735.4572	(230a)
pump for solar water heating	80.0000	(230g)
Total electricity for the above, kWh/year	815.4572	(231)
Electricity for lighting (calculated in Appendix L)	257.3621	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-1091.1774	(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	5147.0990	(238)

10a. Fuel costs - using BEDF prices (536)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3526.8865	25.1600	887.3646	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1638.5706	25.1600	412.2644	(247)
Energy for instantaneous electric shower(s)	0.0000	25.1600	0.0000	(247a)
Pumps, fans and electric keep-hot	735.4572	25.1600	185.0410	(249)
Pump for solar water heating	80.0000	25.1600	20.1280	(249)
Energy for lighting	257.3621	25.1600	64.7523	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1091.1774	25.1600	-274.5402	
PV Unit electricity exported	0.0000	5.8100	0.0000	
Total			-274.5402	(252)
Total energy cost			1295.0101	(255)

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	3526.8865	0.1547	545.5056	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1638.5706	0.1444	236.6284	(264)
Space and water heating			782.1339	(265)
Pumps, fans and electric keep-hot	815.4572	0.1387	113.1140	(267)
Energy for lighting	257.3621	0.1443	37.1453	(268)

Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1091.1774	0.1350	-147.3035	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-147.3035	(269)
Total CO2, kg/year			785.0898	(272)

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	3526.8865	1.5726	5546.5096	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1638.5706	1.5341	2513.7950	(278)
Space and water heating			8060.3047	(279)
Pumps, fans and electric keep-hot	815.4572	1.5128	1233.6237	(281)
Energy for lighting	257.3621	1.5338	394.7506	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1091.1774	1.4989	-1635.6174	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-1635.6174	(283)
Total Primary energy kWh/year			8053.0615	(286)

Full SAP Calculation Printout

Property Reference	Proposed	Issued on Date	14/02/2024
Assessment Reference	00002	Prop Type Ref	
Property			

SAP Rating	75 C	DER		TER	
Environmental	95 A	% DER < TER			N/A
CO_2 Emissions (t/year)	0.53	DFEE		TFEE	
Compliance Check	See BREL	% DFEE < TFEE			
% DPER < TPER		DPER		TPER	

Assessor Details	Mr. Jack Sewell	Assessor ID	AY12-0001
Client			

SAP 10 WORKSHEET FOR Conversion (As Designed) (Version 10.2, February 2022)
CALCULATION OF ENERGY RATING

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	51.1700 (1b)	x	2.7000 (2b)	=	138.1590	(1b) - (3b)
First floor	51.1700 (1c)	x	2.9100 (2c)	=	148.9047	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	102.3400					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	287.0637	(5)

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2. Ventilation rate

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		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	0 * 10 =	0.0000	(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) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		8.0000	(17)
Infiltration rate		0.4000	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3400	(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	0.4335	0.4250	0.4165	0.3740	0.3655	0.3230	0.3230	0.3145	0.3400	0.3655	0.3825	0.3995	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation	0.5000	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)	0.5000	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	79.2000	(23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.5375	0.5290	0.5205	0.4780	0.4695	0.4270	0.4270	0.4185	0.4440	0.4695	0.4865	0.5035	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
window (Uw = 1.20)			16.2200	1.1450	18.5725			(27)
door			3.7500	1.0000	3.7500			(26)
RL1			4.7500	1.1450	5.4389			(27a)
Heatloss Floor 1			51.1700	0.2000	10.2340			(28a)
External Wall	51.7100	3.0100	48.7000	0.2500	12.1750			(29a)
dormer wall	8.4700	4.5000	3.9700	0.1500	0.5955			(29a)
Panel wall	12.6400	12.4600	0.1800	0.2500	0.0450			(29a)
External Roof	58.0300	4.7500	53.2800	0.1000	5.3280			(30)
Total net area of external elements Aum(A, m2)			182.0200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		56.1390			(33)
Party Wall			64.3400	0.0000	0.0000			(32)
Party Floor 1			51.1700					(32d)
Party Ceiling 1			51.2000					(32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 250.0000 (35)

List of Thermal Bridges

	K1 Element	Length	Psi-value	Total
E1	Steel lintel with perforated steel base plate	12.2000	0.0400	0.4880
E3	Sill	7.5500	0.0320	0.2416
E4	Jamb	21.1200	0.0320	0.6758
E5	Ground floor (normal)	39.1200	0.0800	3.1296
E7	Party floor between dwellings (in blocks of flats)	44.4800	0.0400	1.7792
E16	Corner (normal)	17.0600	0.0450	0.7677
E18	Party wall between dwellings	10.8400	0.0600	0.6504
P3	Party wall - Intermediate floor between dwellings (in blocks of flats)	14.5400	0.0000	0.0000
E6	Intermediate floor within a dwelling	7.0300	0.0300	0.2109
E13	Gable (insulation at rafter level)	18.1800	0.0500	0.9090
R1	Head of roof window	2.8800	0.1920	0.5530
R2	Sill of roof window	2.8800	0.1920	0.5530
R3	Jamb of roof window	10.4000	0.1920	1.9968
R7	Flat ceiling (inverted)	11.2100	0.2560	2.8698
R4	Ridge (vaulted ceiling)	7.0300	0.0960	0.6749
R8	Roof to wall (rafter)	3.9400	0.2560	1.0086
R9	Roof to wall (flat ceiling)	9.5800	0.1920	1.8394

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 18.3476 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 74.4866 (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	50.9179	50.1127	49.3075	45.2814	44.4762	40.4501	40.4501	39.6449	42.0606	44.4762	46.0866	47.6971	(38)
Heat transfer coeff	125.4045	124.5993	123.7940	119.7680	118.9628	114.9367	114.9367	114.1315	116.5471	118.9628	120.5732	122.1836	(39)

Average = Sum(39)m / 12 = 119.5667

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2254	1.2175	1.2096	1.1703	1.1624	1.1231	1.1231	1.1152	1.1388	1.1624	1.1782	1.1939	(40)
HLP (average)												1.1683	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.7602 (42)

Hot water usage for mixer showers

79.3109	78.1190	76.3822	73.0591	70.6067	67.8719	66.3174	68.0411	69.9306	72.8669	76.2614	79.0070	(42a)

Hot water usage for baths

30.4399	29.9878	29.3512	28.1774	27.2985	26.3239	25.7975	26.4296	27.1179	28.1608	29.3588	30.3370	(42b)

Hot water usage for other uses

42.8968	41.3369	39.7770	38.2171	36.6572	35.0974	35.0974	36.6572	38.2171	39.7770	41.3369	42.8968	(42c)

Average daily hot water use (litres/day) 140.3416 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	152.6476	149.4437	145.5104	139.4536	134.5625	129.2931	127.2122	131.1279	135.2656	140.8047	146.9570	152.2408	(44)
Energy conte	241.7564	212.8059	223.6441	190.9050	181.1469	158.9810	153.8522	162.3638	166.7960	191.0707	209.3673	238.3723	(45)

Energy content (annual) Total = Sum(45)m = 2331.0615

Distribution loss (46)m = 0.15 x (45)m

36.2635	31.9209	33.5466	28.6358	27.1720	23.8472	23.0778	24.3546	25.0194	28.6606	31.4051	35.7558	(46)

Water storage loss:

Store volume 269.0000 (47)

a) If manufacturer declared loss factor is known (kWh/day): 1.7700 (48)

Temperature factor from Table 2b 0.6000 (49)

Enter (49) or (54) in (55) 1.0620 (55)

Total storage loss

32.9220	29.7360	32.9220	31.8600	32.9220	31.8600	32.9220	32.9220	31.8600	32.9220	31.8600	32.9220	(56)

If cylinder contains dedicated solar storage

32.9220	29.7360	32.9220	31.8600	32.9220	31.8600	32.9220	32.9220	31.8600	32.9220	31.8600	32.9220	(57)
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)
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)

Primary loss / Combi loss

Total heat required for water heating calculated for each month

297.9408	263.5531	279.8285	245.2770	237.3313	213.3530	210.0366	218.5482	221.1680	247.2551	263.7393	294.5567	(62)
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)
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)
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)
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)

WWHRS / PV diverter / Solar input / FGHRS

Output from w/h

297.9408	263.5531	279.8285	245.2770	237.3313	213.3530	210.0366	218.5482	221.1680	247.2551	263.7393	294.5567	(64)

Total per year (kWh/year) = Sum(64)m = 2992.5875 (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

98.9939	87.5669	92.9716	81.4855	78.8413	70.8708	69.7658	72.5959	73.4693	82.1409	87.6242	97.8687	(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	165.6094	165.6094	165.6094	165.6094	165.6094	165.6094	165.6094	165.6094	165.6094	165.6094	165.6094	165.6094	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	36.4323	32.3588	26.3160	19.9229	14.8926	12.5729	13.5855	17.6590	23.7018	30.0949	35.1252	37.4448	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	388.1435	392.1712	382.0215	360.4139	333.1383	307.5031	290.3772	286.3494	296.4991	318.1067	345.3823	371.0176	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.3211	54.3211	54.3211	54.3211	54.3211	54.3211	54.3211	54.3211	54.3211	54.3211	54.3211	54.3211	(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)	-110.4063	-110.4063	-110.4063	-110.4063	-110.4063	-110.4063	-110.4063	-110.4063	-110.4063	-110.4063	-110.4063	-110.4063	(71)
Water heating gains (Table 5)	133.0564	130.3079	124.9618	113.1743	105.9695	98.4316	93.7712	97.5751	102.0407	110.4045	121.7003	131.5440	(72)
Total internal gains	670.1564	667.3622	645.8235	606.0354	566.5246	528.0319	507.2581	511.1078	531.7659	571.1303	614.7321	652.5306	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	4.3100	11.2829	0.5000	0.7000	0.7700	11.7951	(75)
Southwest	11.9100	36.7938	0.5000	0.7000	0.7700	106.2889	(79)
Northeast	4.7500	17.2952	0.5000	0.7000	1.0000	25.8780	(82)

Solar gains	143.9620	259.0350	391.6059	548.3418	672.3828	693.2726	657.6605	561.0812	445.1934	296.2671	174.9372	121.5877	(83)
Total gains	814.1184	926.3972	1037.4294	1154.3772	1238.9074	1221.3045	1164.9186	1072.1890	976.9592	867.3974	789.6693	774.1183	(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	56.6722	57.0384	57.4094	59.3393	59.7409	61.8336	61.8336	62.2698	60.9791	59.7409	58.9430	58.1661	
alpha	4.7781	4.8026	4.8273	4.9560	4.9827	5.1222	5.1222	5.1513	5.0653	4.9827	4.9295	4.8777	
util living area	0.9933	0.9867	0.9688	0.9112	0.7825	0.5836	0.4307	0.4833	0.7447	0.9421	0.9869	0.9946	(86)
MIT	19.6716	19.8701	20.1815	20.5853	20.8569	20.9760	20.9958	20.9928	20.9196	20.5611	20.0656	19.6671	(87)
Th 2	19.8998	19.9060	19.9123	19.9438	19.9502	19.9820	19.9820	19.9884	19.9693	19.9502	19.9375	19.9249	(88)
util rest of house	0.9911	0.9824	0.9586	0.8833	0.7236	0.4987	0.3329	0.3803	0.6612	0.9176	0.9819	0.9929	(89)
MIT 2	18.7121	18.9130	19.2223	19.6276	19.8614	19.9720	19.9810	19.9865	19.9293	19.6195	19.1325	18.7270	(90)
Living area fraction									fLA = Living area / (4) =			0.4599	(91)
MIT	19.1534	19.3532	19.6634	20.0681	20.3192	20.4338	20.4478	20.4493	20.3848	20.0526	19.5617	19.1594	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.1534	19.3532	19.6634	20.0681	20.3192	20.4338	20.4478	20.4493	20.3848	20.0526	19.5617	19.1594	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9891	0.9796	0.9557	0.8870	0.7456	0.5372	0.3780	0.4278	0.6969	0.9205	0.9796	0.9912	(94)
Useful gains	805.2614	907.5209	991.5030	1023.9318	923.7430	656.1315	440.3211	458.6936	680.8576	798.3975	773.5964	767.3200	(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	1862.6846	1800.8600	1629.5555	1337.5794	1025.3687	670.5147	442.2482	462.1579	732.4704	1124.5050	1502.5432	1827.7921	(97)
Space heating kWh	786.7228	600.3239	474.7110	225.8263	75.6095	0.0000	0.0000	0.0000	0.0000	242.6240	524.8417	788.9912	(98a)
Space heating requirement - total per year (kWh/year)												3719.6504	
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	786.7228	600.3239	474.7110	225.8263	75.6095	0.0000	0.0000	0.0000	0.0000	242.6240	524.8417	788.9912	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												3719.6504	
Space heating per m2											(98c) / (4) =	36.3460	(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 %)	219.3000	(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	786.7228	600.3239	474.7110	225.8263	75.6095	0.0000	0.0000	0.0000	0.0000	242.6240	524.8417	788.9912	(98)
Space heating efficiency (main heating system 1)	219.3000	219.3000	219.3000	219.3000	219.3000	0.0000	0.0000	0.0000	0.0000	219.3000	219.3000	219.3000	(210)
Space heating fuel (main heating system)	358.7427	273.7455	216.4665	102.9760	34.4777	0.0000	0.0000	0.0000	0.0000	110.6356	239.3259	359.7771	(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	297.9408	263.5531	279.8285	245.2770	237.3313	213.3530	210.0366	218.5482	221.1680	247.2551	263.7393	294.5567	(64)
Efficiency of water heater												190.4000	(216)
(217)m	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	(217)
Fuel for water heating, kWh/month	156.4815	138.4207	146.9687	128.8220	124.6488	112.0551	110.3133	114.7837	116.1597	129.8609	138.5185	154.7041	(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	26.3983	23.8436	26.3983	25.5467	26.3983	25.5467	26.3983	26.3983	25.5467	26.3983	25.5467	26.3983	(231)
Lighting	31.8890	25.5825	23.0342	16.8758	13.0354	10.6500	11.8913	15.4568	20.0768	26.3419	29.7531	32.7752	(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												1696.1470	(211)

Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	190.4000	
Water heating fuel used	1571.7371	(219)
Space cooling fuel	0.0000	(221)
Electricity for pumps and fans:		
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.8875)		
mechanical ventilation fans (SFP = 0.8875)	310.8182	(230a)
Total electricity for the above, kWh/year	310.8182	(231)
Electricity for lighting (calculated in Appendix L)	257.3621	(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	3836.0645	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1696.1470	16.4900	279.6946	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1571.7371	16.4900	259.1795	(247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000	(247a)
Pumps, fans and electric keep-hot	310.8182	16.4900	51.2539	(249)
Energy for lighting	257.3621	16.4900	42.4390	(250)
Additional standing charges			0.0000	(251)
Total energy cost			632.5670	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.3600	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	1.5456	(257)
SAP value		74.9463	
SAP rating (Section 12)		75	(258)
SAP band		C	

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	1696.1470	0.1559	264.4987	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1571.7371	0.1409	221.5280	(264)
Space and water heating			486.0267	(265)
Pumps, fans and electric keep-hot	310.8182	0.1387	43.1143	(267)
Energy for lighting	257.3621	0.1443	37.1453	(268)
Total CO2, kg/year			566.2863	(272)
CO2 emissions per m2			5.5300	(273)
EI value			94.8498	
EI rating			95	(274)
EI band			A	

SAP 10 WORKSHEET FOR Conversion (As Designed) (Version 10.2, February 2022)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	51.1700	(1b)	x 2.7000	(2b) =	138.1590	(1b) - (3b)
First floor	51.1700	(1c)	x 2.9100	(2c) =	148.9047	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	102.3400					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		287.0637	(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	0 * 10 =	0.0000	(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) =	0.0000 / (5) =	0.0000 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		8.0000 (17)
Infiltration rate		0.4000 (18)
Number of sides sheltered		2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3400 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	6.0000	5.6000	5.6000	5.0000	5.0000	4.4000	4.4000	4.3000	4.7000	5.4000	5.5000	5.9000	(22)
Wind factor	1.5000	1.4000	1.4000	1.2500	1.2500	1.1000	1.1000	1.0750	1.1750	1.3500	1.3750	1.4750	(22a)
Adj infilt rate	0.5100	0.4760	0.4760	0.4250	0.4250	0.3740	0.3740	0.3655	0.3995	0.4590	0.4675	0.5015	(22b)

Balanced mechanical ventilation with heat recovery	
If mechanical ventilation	0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)	0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	79.2000 (23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.6140	0.5800	0.5800	0.5290	0.5290	0.4780	0.4780	0.4695	0.5035	0.5630	0.5715	0.6055	(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	
window (Uw = 1.20)			16.2200	1.1450	18.5725			(27)
door			3.7500	1.0000	3.7500			(26)
RL1			4.7500	1.1450	5.4389			(27a)
Heatloss Floor 1			51.1700	0.2000	10.2340			(28a)
External Wall	51.7100	3.0100	48.7000	0.2500	12.1750			(29a)
dormer wall	8.4700	4.5000	3.9700	0.1500	0.5955			(29a)
Panel wall	12.6400	12.4600	0.1800	0.2500	0.0450			(29a)
External Roof	58.0300	4.7500	53.2800	0.1000	5.3280			(30)
Total net area of external elements Aum(A, m2)			182.0200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		56.1390			(33)
Party Wall			64.3400	0.0000	0.0000			(32)
Party Floor 1			51.1700					(32d)
Party Ceiling 1			51.2000					(32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E1 Steel lintel with perforated steel base plate	12.2000	0.0400	0.4880
E3 Sill	7.5500	0.0320	0.2416
E4 Jamb	21.1200	0.0320	0.6758
E5 Ground floor (normal)	39.1200	0.0800	3.1296
E7 Party floor between dwellings (in blocks of flats)	44.4800	0.0400	1.7792
E16 Corner (normal)	17.0600	0.0450	0.7677
E18 Party wall between dwellings	10.8400	0.0600	0.6504
P3 Party wall - Intermediate floor between dwellings (in blocks of flats)	14.5400	0.0000	0.0000
E6 Intermediate floor within a dwelling	7.0300	0.0300	0.2109
E13 Gable (insulation at rafter level)	18.1800	0.0500	0.9090
R1 Head of roof window	2.8800	0.1920	0.5530
R2 Sill of roof window	2.8800	0.1920	0.5530
R3 Jamb of roof window	10.4000	0.1920	1.9968
R7 Flat ceiling (inverted)	11.2100	0.2560	2.8698
R4 Ridge (vaulted ceiling)	7.0300	0.0960	0.6749
R8 Roof to wall (rafter)	3.9400	0.2560	1.0086
R9 Roof to wall (flat ceiling)	9.5800	0.1920	1.8394

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		18.3476 (36)
Point Thermal bridges	(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =	74.4866 (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	58.1648	54.9440	54.9440	50.1127	50.1127	45.2814	45.2814	44.4762	47.6971	53.3336	54.1388	57.3596	(38)
Heat transfer coeff	132.6514	129.4305	129.4305	124.5993	124.5993	119.7680	119.7680	118.9628	122.1836	127.8201	128.6253	131.8462	(39)
Average = Sum(39)m / 12 =												125.8071	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2962	1.2647	1.2647	1.2175	1.2175	1.1703	1.1703	1.1624	1.1939	1.2490	1.2568	1.2883	(40)
HLP (average)												1.2293	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.7602 (42)

Hot water usage for mixer showers

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
79.3109	78.1190	76.3822	73.0591	70.6067	67.8719	66.3174	68.0411	69.9306	72.8669	76.2614	79.0070	(42a)

Hot water usage for baths

30.4399	29.9878	29.3512	28.1774	27.2985	26.3239	25.7975	26.4296	27.1179	28.1608	29.3588	30.3370	(42b)

Hot water usage for other uses

42.8968	41.3369	39.7770	38.2171	36.6572	35.0974	35.0974	36.6572	38.2171	39.7770	41.3369	42.8968	(42c)

Average daily hot water use (litres/day)	140.3416 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	152.6476	149.4437	145.5104	139.4536	134.5625	129.2931	127.2122	131.1279	135.2656	140.8047	146.9570	152.2408	(44)
Energy conte	241.7564	212.8059	223.6441	190.9050	181.1469	158.9810	153.8522	162.3638	166.7960	191.0707	209.3673	238.3723	(45)
Energy content (annual)										Total = Sum(45)m =		2331.0615	
Distribution loss (46)m = 0.15 x (45)m	36.2635	31.9209	33.5466	28.6358	27.1720	23.8472	23.0778	24.3546	25.0194	28.6606	31.4051	35.7558	(46)

Water storage loss:	
Store volume	269.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):	1.7700 (48)
Temperature factor from Table 2b	0.6000 (49)
Enter (49) or (54) in (55)	1.0620 (55)

Total storage loss

32.9220	29.7360	32.9220	31.8600	32.9220	31.8600	32.9220	32.9220	31.8600	32.9220	31.8600	32.9220	(56)

If cylinder contains dedicated solar storage

32.9220	29.7360	32.9220	31.8600	32.9220	31.8600	32.9220	32.9220	31.8600	32.9220	31.8600	32.9220	(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													
	297.9408	263.5531	279.8285	245.2770	237.3313	213.3530	210.0366	218.5482	221.1680	247.2551	263.7393	294.5567	(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													
	297.9408	263.5531	279.8285	245.2770	237.3313	213.3530	210.0366	218.5482	221.1680	247.2551	263.7393	294.5567	(64)
										Total per year (kWh/year) = Sum(64)m =		2992.5875	(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													
	98.9939	87.5669	92.9716	81.4855	78.8413	70.8708	69.7658	72.5959	73.4693	82.1409	87.6242	97.8687	(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	165.6094	165.6094	165.6094	165.6094	165.6094	165.6094	165.6094	165.6094	165.6094	165.6094	165.6094	165.6094	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	36.4323	32.3588	26.3160	19.9229	14.8926	12.5729	13.5855	17.6590	23.7018	30.0949	35.1252	37.4448	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	388.1435	392.1712	382.0215	360.4139	333.1383	307.5031	290.3772	286.3494	296.4991	318.1067	345.3823	371.0176	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.3211	54.3211	54.3211	54.3211	54.3211	54.3211	54.3211	54.3211	54.3211	54.3211	54.3211	54.3211	(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)													
	-110.4063	-110.4063	-110.4063	-110.4063	-110.4063	-110.4063	-110.4063	-110.4063	-110.4063	-110.4063	-110.4063	-110.4063	(71)
Water heating gains (Table 5)													
	133.0564	130.3079	124.9618	113.1743	105.9695	98.4316	93.7712	97.5751	102.0407	110.4045	121.7003	131.5440	(72)
Total internal gains													
	670.1564	667.3622	645.8235	606.0354	566.5246	528.0319	507.2581	511.1078	531.7659	571.1303	614.7321	652.5306	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	4.3100	15.4538	0.5000	0.7000	0.7700	16.1553	(75)
Southwest	11.9100	47.2368	0.5000	0.7000	0.7700	136.4563	(79)
Northeast	4.7500	23.9035	0.5000	0.7000	1.0000	35.7656	(82)

Solar gains	188.3772	287.6975	437.3732	624.7282	729.7689	804.3079	705.8822	641.9521	512.0869	334.9817	220.8273	152.9757	(83)
Total gains	858.5335	955.0596	1083.1966	1230.7636	1296.2935	1332.3399	1213.1403	1153.0599	1043.8528	906.1120	835.5594	805.5063	(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	53.5761	54.9093	54.9093	57.0384	57.0384	59.3393	59.3393	59.7409	58.1661	55.6011	55.2531	53.9033	
alpha	4.5717	4.6606	4.6606	4.8026	4.8026	4.9560	4.9560	4.9827	4.8777	4.7067	4.6835	4.5936	
util living area													
	0.9874	0.9790	0.9561	0.8896	0.7680	0.5666	0.4677	0.4780	0.6929	0.9131	0.9733	0.9893	(86)
MIT	19.8483	20.0205	20.2699	20.6245	20.8569	20.9754	20.9921	20.9917	20.9390	20.6413	20.2497	19.8474	(87)
Th 2	19.8438	19.8686	19.8686	19.9060	19.9060	19.9438	19.9438	19.9502	19.9249	19.8810	19.8748	19.8500	(88)
util rest of house													
	0.9828	0.9717	0.9412	0.8557	0.7050	0.4820	0.3679	0.3748	0.5983	0.8741	0.9619	0.9853	(89)
MIT 2	18.8446	19.0321	19.2721	19.6284	19.8195	19.9336	19.9417	19.9480	19.8978	19.6332	19.2634	18.8490	(90)
Living area fraction										fLA = Living area / (4) =		0.4599	(91)
MIT	19.3062	19.4867	19.7310	20.0865	20.2966	20.4128	20.4248	20.4280	20.3767	20.0969	19.7170	19.3082	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.3062	19.4867	19.7310	20.0865	20.2966	20.4128	20.4248	20.4280	20.3767	20.0969	19.7170	19.3082	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9801	0.9686	0.9390	0.8620	0.7289	0.5204	0.4139	0.4224	0.6401	0.8828	0.9599	0.9828	(94)
Useful gains	841.4143	925.0525	1017.1364	1060.8593	944.8991	693.3493	502.1081	487.0495	668.1531	799.9571	802.0627	791.6382	(95)
Ext temp.	6.1000	6.4000	7.5000	9.3000	11.9000	14.5000	16.2000	16.3000	14.6000	11.8000	9.0000	6.4000	(96)
Heat loss rate W													
	1751.8252	1693.8201	1583.0642	1343.9919	1046.2155	708.1642	505.9990	491.0831	705.8184	1060.5066	1378.4822	1701.9008	(97)
Space heating kWh													
	677.3457	516.6118	421.0503	203.8554	75.3794	0.0000	0.0000	0.0000	0.0000	193.8488	415.0221	677.2354	(98a)
Space heating requirement - total per year (kWh/year)												3180.3489	
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													
	677.3457	516.6118	421.0503	203.8554	75.3794	0.0000	0.0000	0.0000	0.0000	193.8488	415.0221	677.2354	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												3180.3489	
Space heating per m2											(98c) / (4) =	31.0763	(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 %)	219.3000	(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	677.3457	516.6118	421.0503	203.8554	75.3794	0.0000	0.0000	0.0000	0.0000	193.8488	415.0221	677.2354	(98)
Space heating efficiency (main heating system 1)	219.3000	219.3000	219.3000	219.3000	219.3000	0.0000	0.0000	0.0000	0.0000	219.3000	219.3000	219.3000	(210)
Space heating fuel (main heating system)	308.8671	235.5731	191.9974	92.9573	34.3727	0.0000	0.0000	0.0000	0.0000	88.3943	189.2486	308.8169	(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	297.9408	263.5531	279.8285	245.2770	237.3313	213.3530	210.0366	218.5482	221.1680	247.2551	263.7393	294.5567	(64)
Efficiency of water heater												190.4000	(216)
(217)m	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	(217)
Fuel for water heating, kWh/month	156.4815	138.4207	146.9687	128.8220	124.6488	112.0551	110.3133	114.7837	116.1597	129.8609	138.5185	154.7041	(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	26.3983	23.8436	26.3983	25.5467	26.3983	25.5467	26.3983	26.3983	25.5467	26.3983	25.5467	26.3983	(231)
Lighting	31.8890	25.5825	23.0342	16.8758	13.0354	10.6500	11.8913	15.4568	20.0768	26.3419	29.7531	32.7752	(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	1450.2275	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	190.4000	
Water heating fuel used	1571.7371	(219)
Space cooling fuel	0.0000	(221)
Electricity for pumps and fans:		
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.8875)		
mechanical ventilation fans (SFP = 0.8875)	310.8182	(230a)
Total electricity for the above, kWh/year	310.8182	(231)
Electricity for lighting (calculated in Appendix L)	257.3621	(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	3590.1450	(238)

10a. Fuel costs - using BEDF prices (536)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1450.2275	25.1600	364.8772	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1571.7371	25.1600	395.4491	(247)
Energy for instantaneous electric shower(s)	0.0000	25.1600	0.0000	(247a)
Pumps, fans and electric keep-hot	310.8182	25.1600	78.2019	(249)
Energy for lighting	257.3621	25.1600	64.7523	(250)
Additional standing charges			0.0000	(251)
Total energy cost			903.2805	(255)

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	1450.2275	0.1560	226.1781	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1571.7371	0.1409	221.5280	(264)
Space and water heating			447.7061	(265)
Pumps, fans and electric keep-hot	310.8182	0.1387	43.1143	(267)
Energy for lighting	257.3621	0.1443	37.1453	(268)
Total CO2, kg/year			527.9657	(272)

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	1450.2275	1.5774	2287.5986	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1571.7371	1.5212	2390.8710	(278)
Space and water heating			4678.4696	(279)
Pumps, fans and electric keep-hot	310.8182	1.5128	470.2058	(281)
Energy for lighting	257.3621	1.5338	394.7506	(282)

Total Primary energy kWh/year 5543.4260 (286)

SAP 10 EPC IMPROVEMENTS

00002

Current energy efficiency rating: C 75
Current environmental impact rating: A 95

N Solar water heating		Recommended
U Solar photovoltaic panels		Recommended
V2 Wind turbine		Not applicable

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.7	-£ 81	-41 kg (7.7%)
U Solar photovoltaic panels	+ 6.0	-£ 251	-135 kg (27.7%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£81	0.40 kg/m²	C 77	A 95
Solar photovoltaic panels	£251	1.32 kg/m²	B 83	A 96
Total Savings	£333	1.72 kg/m²		

Potential energy efficiency rating: B 83
Potential environmental impact rating: A 96

Fuel prices for cost data on this page from database revision number 536 TEST (31 Jan 2024)
Recommendation texts revision number 6.1 (11 Jun 2019)

Typical heating and lighting costs of this home (per year, South West England):

	Current	Potential	Saving
Electricity	£903	£822	£81
Space heating	£443	£463	-£20
Water heating	£395	£294	£102
Lighting	£65	£65	£0
Generated (PV)	-£0	-£251	£251
Total cost of fuels	£903	£571	£332
Total cost of uses	£903	£571	£333
Delivered energy	35 kWh/m²	22 kWh/m²	13 kWh/m²
Carbon dioxide emissions	0.5 tonnes	0.4 tonnes	0.2 tonnes
CO2 emissions per m²	5 kg/m²	3 kg/m²	2 kg/m²
Primary energy	54 kWh/m²	35 kWh/m²	19 kWh/m²

SAP 10 WORKSHEET FOR Conversion (As Designed) (Version 10.2, February 2022)
CALCULATION OF ENERGY RATING FOR IMPROVED DWELLING

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	51.1700	(1b)	x 2.7000	(2b) =	138.1590	(1b) - (3b)
First floor	51.1700	(1c)	x 2.9100	(2c) =	148.9047	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	102.3400					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		287.0637	(5)

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2. Ventilation rate

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	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	0 * 10 =	0.0000	(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) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		8.0000	(17)
Infiltration rate		0.4000	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3400	(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												
	0.4335	0.4250	0.4165	0.3740	0.3655	0.3230	0.3230	0.3145	0.3400	0.3655	0.3825	0.3995 (22b)
Balanced mechanical ventilation with heat recovery												
If mechanical ventilation												0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												79.2000 (23c)
Effective ac	0.5375	0.5290	0.5205	0.4780	0.4695	0.4270	0.4270	0.4185	0.4440	0.4695	0.4865	0.5035 (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	
window (Uw = 1.20)			16.2200	1.1450	18.5725			(27)
door			3.7500	1.0000	3.7500			(26)
RL1			4.7500	1.1450	5.4389			(27a)
Heatloss Floor 1			51.1700	0.2000	10.2340			(28a)
External Wall	51.7100	3.0100	48.7000	0.2500	12.1750			(29a)
dormer wall	8.4700	4.5000	3.9700	0.1500	0.5955			(29a)
Panel wall	12.6400	12.4600	0.1800	0.2500	0.0450			(29a)
External Roof	58.0300	4.7500	53.2800	0.1000	5.3280			(30)
Total net area of external elements Aum(A, m2)			182.0200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	56.1390			(33)
Party Wall			64.3400	0.0000	0.0000			(32)
Party Floor 1			51.1700					(32d)
Party Ceiling 1			51.2000					(32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E1 Steel lintel with perforated steel base plate	12.2000	0.0400	0.4880
E3 Sill	7.5500	0.0320	0.2416
E4 Jamb	21.1200	0.0320	0.6758
E5 Ground floor (normal)	39.1200	0.0800	3.1296
E7 Party floor between dwellings (in blocks of flats)	44.4800	0.0400	1.7792
E16 Corner (normal)	17.0600	0.0450	0.7677
E18 Party wall between dwellings	10.8400	0.0600	0.6504
P3 Party wall - Intermediate floor between dwellings (in blocks of flats)	14.5400	0.0000	0.0000
E6 Intermediate floor within a dwelling	7.0300	0.0300	0.2109
E13 Gable (insulation at rafter level)	18.1800	0.0500	0.9090
R1 Head of roof window	2.8800	0.1920	0.5530
R2 Sill of roof window	2.8800	0.1920	0.5530
R3 Jamb of roof window	10.4000	0.1920	1.9968
R7 Flat ceiling (inverted)	11.2100	0.2560	2.8698
R4 Ridge (vaulted ceiling)	7.0300	0.0960	0.6749
R8 Roof to wall (rafter)	3.9400	0.2560	1.0086
R9 Roof to wall (flat ceiling)	9.5800	0.1920	1.8394

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		18.3476 (36)
Point Thermal bridges	(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =	74.4866 (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	50.9179	50.1127	49.3075	45.2814	44.4762	40.4501	40.4501	39.6449	42.0606	44.4762	46.0866	47.6971	(38)
Heat transfer coeff	125.4045	124.5993	123.7940	119.7680	118.9628	114.9367	114.9367	114.1315	116.5471	118.9628	120.5732	122.1836	(39)
Average = Sum(39)m / 12 =												119.5667	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2254	1.2175	1.2096	1.1703	1.1624	1.1231	1.1231	1.1152	1.1388	1.1624	1.1782	1.1939	(40)
HLP (average)												1.1683	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.7602 (42)
Hot water usage for mixer showers												
	79.3109	78.1190	76.3822	73.0591	70.6067	67.8719	66.3174	68.0411	69.9306	72.8669	76.2614	79.0070 (42a)
Hot water usage for baths												
	30.4399	29.9878	29.3512	28.1774	27.2985	26.3239	25.7975	26.4296	27.1179	28.1608	29.3588	30.3370 (42b)
Hot water usage for other uses												
	42.8968	41.3369	39.7770	38.2171	36.6572	35.0974	35.0974	36.6572	38.2171	39.7770	41.3369	42.8968 (42c)
Average daily hot water use (litres/day)												140.3416 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	152.6476	149.4437	145.5104	139.4536	134.5625	129.2931	127.2122	131.1279	135.2656	140.8047	146.9570	152.2408	(44)
Energy conte	241.7564	212.8059	223.6441	190.9050	181.1469	158.9810	153.8522	162.3638	166.7960	191.0707	209.3673	238.3723	(45)
Energy content (annual)										Total = Sum(45)m =		2331.0615	
Distribution loss (46)m = 0.15 x (45)m													
	36.2635	31.9209	33.5466	28.6358	27.1720	23.8472	23.0778	24.3546	25.0194	28.6606	31.4051	35.7558	(46)
Water storage loss:													
Store volume												269.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.7700	(48)
Temperature factor from Table 2b												0.6000	(49)
Enter (49) or (54) in (55)												1.0620	(55)
Total storage loss													
	32.9220	29.7360	32.9220	31.8600	32.9220	31.8600	32.9220	32.9220	31.8600	32.9220	31.8600	32.9220	(56)
If cylinder contains dedicated solar storage													
	32.9220	29.7360	32.9220	31.8600	32.9220	31.8600	32.9220	32.9220	31.8600	32.9220	31.8600	32.9220	(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													
	297.9408	263.5531	279.8285	245.2770	237.3313	213.3530	210.0366	218.5482	221.1680	247.2551	263.7393	294.5567	(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)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.8000	(H2)
Collector linear heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0000	(H4)
Collector loop efficiency												0.9000	(H5)
Incidence angle modifier												1.0000	(H6)
Overshading factor												0.8000	(H8)
Overall heat loss coefficient of system												6.5000	(H10)

Heat loss coefficient of collector loop												3.9667	(H11)
Dedicated solar storage volume												75.0000	(H12)
Effective solar volume												75.0000	(H14)
Reference volume												225.0000	(H15)
Storage tank correction coefficient												1.3161	(H16)
Heat delivered to hot water												641.7895	(H24)
Heat delivered to space heating												0.0000	(H29)
Solar input												641.7895	
Solar input	-0.0000	-16.1890	-59.0375	-82.0878	-108.9507	-100.7938	-100.2682	-86.8169	-58.8697	-28.7761	-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													
	297.9408	247.3641	220.7909	163.1893	128.3807	112.5592	109.7684	131.7313	162.2983	218.4790	263.7393	294.5567	(64)
										Total per year (kWh/year) = Sum(64)m =		2350.7980	(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													
	98.9939	87.5669	92.9716	81.4855	78.8413	70.8708	69.7658	72.5959	73.4693	82.1409	87.6242	97.8687	(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	165.6094	165.6094	165.6094	165.6094	165.6094	165.6094	165.6094	165.6094	165.6094	165.6094	165.6094	165.6094	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	36.4323	32.3588	26.3160	19.9229	14.8926	12.5729	13.5855	17.6590	23.7018	30.0949	35.1252	37.4448	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	388.1435	392.1712	382.0215	360.4139	333.1383	307.5031	290.3772	286.3494	296.4991	318.1067	345.3823	371.0176	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.3211	54.3211	54.3211	54.3211	54.3211	54.3211	54.3211	54.3211	54.3211	54.3211	54.3211	54.3211	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-110.4063	-110.4063	-110.4063	-110.4063	-110.4063	-110.4063	-110.4063	-110.4063	-110.4063	-110.4063	-110.4063	-110.4063	(71)
Water heating gains (Table 5)													
	133.0564	130.3079	124.9618	113.1743	105.9695	98.4316	93.7712	97.5751	102.0407	110.4045	121.7003	131.5440	(72)
Total internal gains													
	670.1564	667.3622	645.8235	606.0354	566.5246	528.0319	507.2581	511.1078	531.7659	571.1303	614.7321	652.5306	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	4.3100	11.2829	0.5000	0.7000	0.7700	11.7951	(75)
Southwest	11.9100	36.7938	0.5000	0.7000	0.7700	106.2889	(79)
Northeast	4.7500	17.2952	0.5000	0.7000	1.0000	25.8780	(82)

Solar gains	143.9620	259.0350	391.6059	548.3418	672.3828	693.2726	657.6605	561.0812	445.1934	296.2671	174.9372	121.5877	(83)
Total gains	814.1184	926.3972	1037.4294	1154.3772	1238.9074	1221.3045	1164.9186	1072.1890	976.9592	867.3974	789.6693	774.1183	(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, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	56.6722	57.0384	57.4094	59.3393	59.7409	61.8336	61.8336	62.2698	60.9791	59.7409	58.9430	58.1661	
alpha	4.7781	4.8026	4.8273	4.9560	4.9827	5.1222	5.1222	5.1513	5.0653	4.9827	4.9295	4.8777	
util living area													
	0.9933	0.9867	0.9688	0.9112	0.7825	0.5836	0.4307	0.4833	0.7447	0.9421	0.9869	0.9946	(86)
MIT	19.6716	19.8701	20.1815	20.5853	20.8569	20.9760	20.9958	20.9928	20.9196	20.5611	20.0656	19.6671	(87)
Th 2	19.8998	19.9060	19.9123	19.9438	19.9502	19.9820	19.9820	19.9884	19.9693	19.9502	19.9375	19.9249	(88)
util rest of house													
	0.9911	0.9824	0.9586	0.8833	0.7236	0.4987	0.3329	0.3803	0.6612	0.9176	0.9819	0.9929	(89)
MIT 2	18.7121	18.9130	19.2223	19.6276	19.8614	19.9720	19.9810	19.9865	19.9293	19.6195	19.1325	18.7270	(90)
Living area fraction										fLA = Living area / (4) =		0.4599	(91)
MIT	19.1534	19.3532	19.6634	20.0681	20.3192	20.4338	20.4478	20.4493	20.3848	20.0526	19.5617	19.1594	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.1534	19.3532	19.6634	20.0681	20.3192	20.4338	20.4478	20.4493	20.3848	20.0526	19.5617	19.1594	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9891	0.9796	0.9557	0.8870	0.7456	0.5372	0.3780	0.4278	0.6969	0.9205	0.9796	0.9912	(94)
Useful gains	805.2614	907.5209	991.5030	1023.9318	923.7430	656.1315	440.3211	458.6936	680.8576	798.3975	773.5964	767.3200	(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													
	1862.6846	1800.8600	1629.5555	1337.5794	1025.3687	670.5147	442.2482	462.1579	732.4704	1124.5050	1502.5432	1827.7921	(97)
Space heating kWh													
	786.7228	600.3239	474.7110	225.8263	75.6095	0.0000	0.0000	0.0000	0.0000	242.6240	524.8417	788.9912	(98a)
Space heating requirement - total per year (kWh/year)												3719.6504	
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													
	786.7228	600.3239	474.7110	225.8263	75.6095	0.0000	0.0000	0.0000	0.0000	242.6240	524.8417	788.9912	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												3719.6504	
Space heating per m2											(98c) / (4) =	36.3460	(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 %)												219.3000	(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													
	786.7228	600.3239	474.7110	225.8263	75.6095	0.0000	0.0000	0.0000	0.0000	242.6240	524.8417	788.9912	(98)
Space heating efficiency (main heating system 1)													
	219.3000	219.3000	219.3000	219.3000	219.3000	0.0000	0.0000	0.0000	0.0000	219.3000	219.3000	219.3000	(210)
Space heating fuel (main heating system)													
	358.7427	273.7455	216.4665	102.9760	34.4777	0.0000	0.0000	0.0000	0.0000	110.6356	239.3259	359.7771	(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													
	297.9408	247.3641	220.7909	163.1893	128.3807	112.5592	109.7684	131.7313	162.2983	218.4790	263.7393	294.5567	(64)
Efficiency of water heater												190.4000	(216)
(217)m	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	(217)
Fuel for water heating, kWh/month													
	156.4815	129.9181	115.9616	85.7087	67.4268	59.1173	57.6515	69.1866	85.2407	114.7474	138.5185	154.7041	(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	33.1928	29.9806	33.1928	32.1220	33.1928	32.1220	33.1928	33.1928	32.1220	33.1928	32.1220	33.1928	(231)
Lighting	31.8890	25.5825	23.0342	16.8758	13.0354	10.6500	11.8913	15.4568	20.0768	26.3419	29.7531	32.7752	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-39.5399	-59.6568	-90.0297	-102.7829	-109.1272	-99.7176	-98.4729	-92.2938	-80.6307	-68.2034	-44.4564	-33.7224	(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												1696.1470	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												190.4000	
Water heating fuel used												1234.6628	(219)
Space cooling fuel												0.0000	(221)
Electricity for pumps and fans:													
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.8875)													
mechanical ventilation fans (SFP = 0.8875)												310.8182	(230a)
pump for solar water heating												80.0000	(230g)
Total electricity for the above, kWh/year												390.8182	(231)
Electricity for lighting (calculated in Appendix L)												257.3621	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-918.6337	(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												2660.3565	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1696.1470	16.4900	279.6946	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1234.6628	16.4900	203.5959	(247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000	(247a)
Pumps, fans and electric keep-hot	310.8182	16.4900	51.2539	(249)
Pump for solar water heating	80.0000	16.4900	13.1920	(249)
Energy for lighting	257.3621	16.4900	42.4390	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-918.6337	16.4900	-151.4827	
PV Unit electricity exported	0.0000	5.5900	0.0000	
Total			-151.4827	(252)
Total energy cost			438.6928	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.3600	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	1.0719	(257)
SAP value		82.6250	
SAP rating (Section 12)		83	(258)
SAP band		B	

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	1696.1470	0.1559	264.4987	(261)

Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1234.6628	0.1446	178.5726	(264)
Space and water heating			443.0712	(265)
Pumps, fans and electric keep-hot	390.8182	0.1387	54.2113	(267)
Energy for lighting	257.3621	0.1443	37.1453	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-918.6337	0.1344	-123.4232	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-123.4232	(269)
Total CO2, kg/year			411.0047	(272)
CO2 emissions per m2			4.0200	(273)
EI value			96.2621	
EI rating			96	(274)
EI band			A	

SAP 10 WORKSHEET FOR Conversion (As Designed) (Version 10.2, February 2022)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING

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1. Overall dwelling characteristics

		Area (m2)		Storey height (m)		Volume (m3)	
Ground floor		51.1700 (1b)	x	2.7000 (2b)	=	138.1590	(1b) - (3b)
First floor		51.1700 (1c)	x	2.9100 (2c)	=	148.9047	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	102.3400						(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	287.0637	(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	0 * 10 =	0.0000	(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) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		8.0000	(17)
Infiltration rate		0.4000	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3400	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	6.0000	5.6000	5.6000	5.0000	5.0000	4.4000	4.4000	4.3000	4.7000	5.4000	5.5000	5.9000	(22)
Wind factor	1.5000	1.4000	1.4000	1.2500	1.2500	1.1000	1.1000	1.0750	1.1750	1.3500	1.3750	1.4750	(22a)
Adj infilt rate	0.5100	0.4760	0.4760	0.4250	0.4250	0.3740	0.3740	0.3655	0.3995	0.4590	0.4675	0.5015	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation	0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)	0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	79.2000 (23c)

Effective ac	0.6140	0.5800	0.5800	0.5290	0.5290	0.4780	0.4780	0.4695	0.5035	0.5630	0.5715	0.6055	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
window (Uw = 1.20)			16.2200	1.1450	18.5725			(27)
door			3.7500	1.0000	3.7500			(26)
RL1			4.7500	1.1450	5.4389			(27a)
Heatloss Floor 1			51.1700	0.2000	10.2340			(28a)
External Wall	51.7100	3.0100	48.7000	0.2500	12.1750			(29a)
dormer wall	8.4700	4.5000	3.9700	0.1500	0.5955			(29a)
Panel wall	12.6400	12.4600	0.1800	0.2500	0.0450			(29a)
External Roof	58.0300	4.7500	53.2800	0.1000	5.3280			(30)
Total net area of external elements Aum(A, m2)			182.0200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		56.1390			(33)
Party Wall			64.3400	0.0000	0.0000			(32)
Party Floor 1			51.1700					(32d)
Party Ceiling 1			51.2000					(32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E1 Steel lintel with perforated steel base plate	12.2000	0.0400	0.4880
E3 Sill	7.5500	0.0320	0.2416
E4 Jamb	21.1200	0.0320	0.6758
E5 Ground floor (normal)	39.1200	0.0800	3.1296
E7 Party floor between dwellings (in blocks of flats)	44.4800	0.0400	1.7792

E16 Corner (normal)	17.0600	0.0450	0.7677	
E18 Party wall between dwellings	10.8400	0.0600	0.6504	
P3 Party wall - Intermediate floor between dwellings (in blocks of flats)	14.5400	0.0000	0.0000	
E6 Intermediate floor within a dwelling	7.0300	0.0300	0.2109	
E13 Gable (insulation at rafter level)	18.1800	0.0500	0.9090	
R1 Head of roof window	2.8800	0.1920	0.5530	
R2 Sill of roof window	2.8800	0.1920	0.5530	
R3 Jamb of roof window	10.4000	0.1920	1.9968	
R7 Flat ceiling (inverted)	11.2100	0.2560	2.8698	
R4 Ridge (vaulted ceiling)	7.0300	0.0960	0.6749	
R8 Roof to wall (rafter)	3.9400	0.2560	1.0086	
R9 Roof to wall (flat ceiling)	9.5800	0.1920	1.8394	

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 18.3476 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 74.4866 (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	58.1648	54.9440	54.9440	50.1127	50.1127	45.2814	45.2814	44.4762	47.6971	53.3336	54.1388	57.3596	(38)
Heat transfer coeff	132.6514	129.4305	129.4305	124.5993	124.5993	119.7680	119.7680	118.9628	122.1836	127.8201	128.6253	131.8462	(39)
Average = Sum(39)m / 12 =												125.8071	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2962	1.2647	1.2647	1.2175	1.2175	1.1703	1.1703	1.1624	1.1939	1.2490	1.2568	1.2883	(40)
HLP (average)												1.2293	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.7602 (42)
Hot water usage for mixer showers

79.3109	78.1190	76.3822	73.0591	70.6067	67.8719	66.3174	68.0411	69.9306	72.8669	76.2614	79.0070	(42a)

Hot water usage for baths

30.4399	29.9878	29.3512	28.1774	27.2985	26.3239	25.7975	26.4296	27.1179	28.1608	29.3588	30.3370	(42b)

Hot water usage for other uses

42.8968	41.3369	39.7770	38.2171	36.6572	35.0974	35.0974	36.6572	38.2171	39.7770	41.3369	42.8968	(42c)

Average daily hot water use (litres/day) 140.3416 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	152.6476	149.4437	145.5104	139.4536	134.5625	129.2931	127.2122	131.1279	135.2656	140.8047	146.9570	152.2408	(44)
Energy conte	241.7564	212.8059	223.6441	190.9050	181.1469	158.9810	153.8522	162.3638	166.7960	191.0707	209.3673	238.3723	(45)
Energy content (annual)										Total = Sum(45)m =		2331.0615	
Distribution loss (46)m = 0.15 x (45)m	36.2635	31.9209	33.5466	28.6358	27.1720	23.8472	23.0778	24.3546	25.0194	28.6606	31.4051	35.7558	(46)

Water storage loss:
Store volume 269.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): 1.7700 (48)
Temperature factor from Table 2b 0.6000 (49)
Enter (49) or (54) in (55) 1.0620 (55)
Total storage loss

32.9220	29.7360	32.9220	31.8600	32.9220	31.8600	32.9220	32.9220	31.8600	32.9220	31.8600	32.9220	(56)

If cylinder contains dedicated solar storage

32.9220	29.7360	32.9220	31.8600	32.9220	31.8600	32.9220	32.9220	31.8600	32.9220	31.8600	32.9220	(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

297.9408	263.5531	279.8285	245.2770	237.3313	213.3530	210.0366	218.5482	221.1680	247.2551	263.7393	294.5567	(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)

Aperture area of solar collector 3.0000 (H1)
Zero-loss collector efficiency 0.8000 (H2)
Collector linear heat loss coefficient 1.8000 (H3)
Collector 2nd order heat loss coefficient 0.0000 (H4)
Collector loop efficiency 0.9000 (H5)
Incidence angle modifier 1.0000 (H6)
Overshading factor 0.8000 (H8)
Overall heat loss coefficient of system 6.5000 (H10)
Heat loss coefficient of collector loop 3.9667 (H11)
Dedicated solar storage volume 75.0000 (H12)
Effective solar volume 75.0000 (H14)
Reference volume 225.0000 (H15)
Storage tank correction coefficient 1.3161 (H16)
Heat delivered to hot water 769.0485 (H24)
Heat delivered to space heating 0.0000 (H29)
Solar input 769.0485

Solar input -7.0248	-24.5981	-71.4580	-96.9777	-118.5963	-117.6729	-107.0848	-101.4233	-73.0623	-40.2986	-10.8518	-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

290.9160	238.9550	208.3705	148.2993	118.7350	95.6801	102.9518	117.1249	148.1058	206.9564	252.8875	294.5567	(64)
									Total per year (kWh/year) = Sum(64)m =		2223.5390	(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

98.9939	87.5669	92.9716	81.4855	78.8413	70.8708	69.7658	72.5959	73.4693	82.1409	87.6242	97.8687	(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	165.6094	165.6094	165.6094	165.6094	165.6094	165.6094	165.6094	165.6094	165.6094	165.6094	165.6094	165.6094	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	36.4323	32.3588	26.3160	19.9229	14.8926	12.5729	13.5855	17.6590	23.7018	30.0949	35.1252	37.4448	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	388.1435	392.1712	382.0215	360.4139	333.1383	307.5031	290.3772	286.3494	296.4991	318.1067	345.3823	371.0176	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.3211	54.3211	54.3211	54.3211	54.3211	54.3211	54.3211	54.3211	54.3211	54.3211	54.3211	54.3211	(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)	-110.4063	-110.4063	-110.4063	-110.4063	-110.4063	-110.4063	-110.4063	-110.4063	-110.4063	-110.4063	-110.4063	-110.4063	(71)
Water heating gains (Table 5)	133.0564	130.3079	124.9618	113.1743	105.9695	98.4316	93.7712	97.5751	102.0407	110.4045	121.7003	131.5440	(72)

Total internal gains

	670.1564	667.3622	645.8235	606.0354	566.5246	528.0319	507.2581	511.1078	531.7659	571.1303	614.7321	652.5306	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	4.3100	15.4538	0.5000	0.7000	0.7700	16.1553	(75)
Southwest	11.9100	47.2368	0.5000	0.7000	0.7700	136.4563	(79)
Northeast	4.7500	23.9035	0.5000	0.7000	1.0000	35.7656	(82)

Solar gains	188.3772	287.6975	437.3732	624.7282	729.7689	804.3079	705.8822	641.9521	512.0869	334.9817	220.8273	152.9757	(83)
Total gains	858.5335	955.0596	1083.1966	1230.7636	1296.2935	1332.3399	1213.1403	1153.0599	1043.8528	906.1120	835.5594	805.5063	(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	53.5761	54.9093	54.9093	57.0384	57.0384	59.3393	59.3393	59.7409	58.1661	55.6011	55.2531	53.9033	
alpha	4.5717	4.6606	4.6606	4.8026	4.8026	4.9560	4.9560	4.9827	4.8777	4.7067	4.6835	4.5936	
util living area	0.9874	0.9790	0.9561	0.8896	0.7680	0.5666	0.4677	0.4780	0.6929	0.9131	0.9733	0.9893	(86)
MIT	19.8483	20.0205	20.2699	20.6245	20.8569	20.9754	20.9921	20.9917	20.9390	20.6413	20.2497	19.8474	(87)
Th 2	19.8438	19.8686	19.8686	19.9060	19.9060	19.9438	19.9438	19.9502	19.9249	19.8810	19.8748	19.8500	(88)
util rest of house	0.9828	0.9717	0.9412	0.8557	0.7050	0.4820	0.3679	0.3748	0.5983	0.8741	0.9619	0.9853	(89)
MIT 2	18.8446	19.0321	19.2721	19.6284	19.8195	19.9336	19.9417	19.9480	19.8978	19.6332	19.2634	18.8490	(90)
Living area fraction									fLA = Living area / (4) =			0.4599	(91)
MIT	19.3062	19.4867	19.7310	20.0865	20.2966	20.4128	20.4248	20.4280	20.3767	20.0969	19.7170	19.3082	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.3062	19.4867	19.7310	20.0865	20.2966	20.4128	20.4248	20.4280	20.3767	20.0969	19.7170	19.3082	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9801	0.9686	0.9390	0.8620	0.7289	0.5204	0.4139	0.4224	0.6401	0.8828	0.9599	0.9828	(94)
Useful gains	841.4143	925.0525	1017.1364	1060.8593	944.8991	693.3493	502.1081	487.0495	668.1531	799.9571	802.0627	791.6382	(95)
Ext temp.	6.1000	6.4000	7.5000	9.3000	11.9000	14.5000	16.2000	16.3000	14.6000	11.8000	9.0000	6.4000	(96)
Heat loss rate W	1751.8252	1693.8201	1583.0642	1343.9919	1046.2155	708.1642	505.9990	491.0831	705.8184	1060.5066	1378.4822	1701.9008	(97)
Space heating kWh	677.3457	516.6118	421.0503	203.8554	75.3794	0.0000	0.0000	0.0000	0.0000	193.8488	415.0221	677.2354	(98a)
Space heating requirement - total per year (kWh/year)												3180.3489	
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	677.3457	516.6118	421.0503	203.8554	75.3794	0.0000	0.0000	0.0000	0.0000	193.8488	415.0221	677.2354	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												3180.3489	
Space heating per m2										(98c) / (4) =		31.0763	(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 %)	219.3000	(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	677.3457	516.6118	421.0503	203.8554	75.3794	0.0000	0.0000	0.0000	0.0000	193.8488	415.0221	677.2354	(98)
Space heating efficiency (main heating system 1)	219.3000	219.3000	219.3000	219.3000	219.3000	0.0000	0.0000	0.0000	0.0000	219.3000	219.3000	219.3000	(210)
Space heating fuel (main heating system)	308.8671	235.5731	191.9974	92.9573	34.3727	0.0000	0.0000	0.0000	0.0000	88.3943	189.2486	308.8169	(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	290.9160	238.9550	208.3705	148.2993	118.7350	95.6801	102.9518	117.1249	148.1058	206.9564	252.8875	294.5567	(64)
Efficiency of water heater												190.4000	(216)
(217)m	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	(217)
Fuel for water heating, kWh/month	152.7920	125.5016	109.4383	77.8883	62.3608	50.2522	54.0713	61.5152	77.7866	108.6956	132.8191	154.7041	(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	33.1928	29.9806	33.1928	32.1220	33.1928	32.1220	33.1928	33.1928	32.1220	33.1928	32.1220	33.1928	(231)
Lighting	31.8890	25.5825	23.0342	16.8758	13.0354	10.6500	11.8913	15.4568	20.0768	26.3419	29.7531	32.7752	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-50.0050	-64.7116	-96.7916	-110.3503	-113.3316	-106.3200	-101.3855	-98.5028	-87.4628	-74.1771	-53.7944	-41.4086	(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	1450.2275	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	190.4000	
Water heating fuel used	1167.8251	(219)
Space cooling fuel	0.0000	(221)
Electricity for pumps and fans:		
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.8875)		
mechanical ventilation fans (SFP = 0.8875)	310.8182	(230a)
pump for solar water heating	80.0000	(230g)
Total electricity for the above, kWh/year	390.8182	(231)
Electricity for lighting (calculated in Appendix L)	257.3621	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-998.2414	(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	2267.9915	(238)

10a. Fuel costs - using BEDF prices (536)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1450.2275	25.1600	364.8772	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1167.8251	25.1600	293.8248	(247)
Energy for instantaneous electric shower(s)	0.0000	25.1600	0.0000	(247a)
Pumps, fans and electric keep-hot	310.8182	25.1600	78.2019	(249)
Pump for solar water heating	80.0000	25.1600	20.1280	(249)
Energy for lighting	257.3621	25.1600	64.7523	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-998.2414	25.1600	-251.1575	
PV Unit electricity exported	0.0000	5.8100	0.0000	
Total			-251.1575	(252)
Total energy cost			570.6267	(255)

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	1450.2275	0.1560	226.1781	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1167.8251	0.1452	169.5660	(264)
Space and water heating			395.7440	(265)
Pumps, fans and electric keep-hot	390.8182	0.1387	54.2113	(267)
Energy for lighting	257.3621	0.1443	37.1453	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-998.2414	0.1350	-134.7293	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-134.7293	(269)
Total CO2, kg/year			352.3714	(272)

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	1450.2275	1.5774	2287.5986	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1167.8251	1.5371	1795.0391	(278)
Space and water heating			4082.6377	(279)
Pumps, fans and electric keep-hot	390.8182	1.5128	591.2298	(281)
Energy for lighting	257.3621	1.5338	394.7506	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-998.2414	1.4988	-1496.1952	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-1496.1952	(283)
Total Primary energy kWh/year			3572.4229	(286)

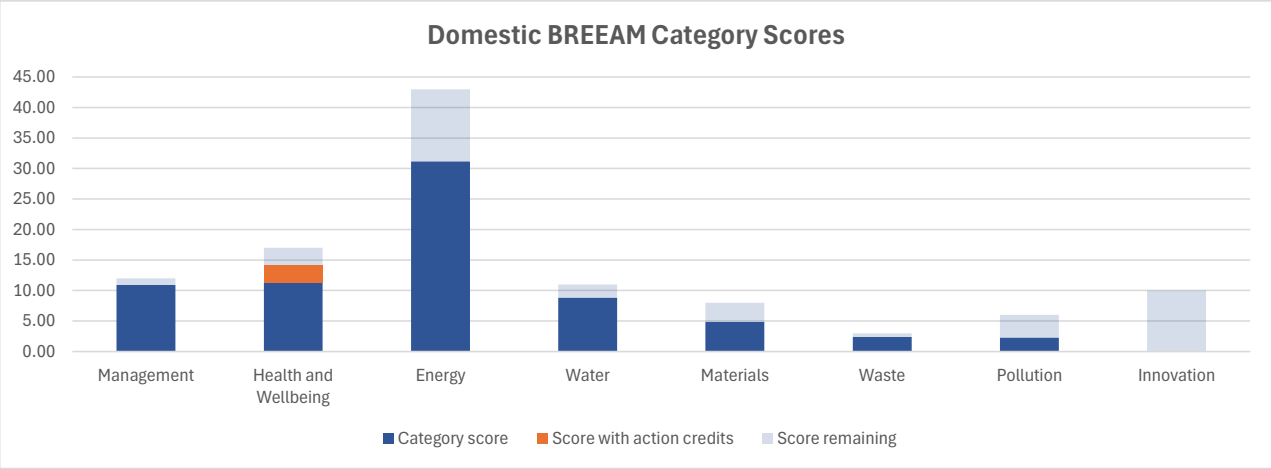
APPENDIX B – BREEAM PRE-ASSESSMENT

Project name: 10 Orleans Road
Building type: 2 Residential dwellings
Date: 14/02/2024

Domestic Refurbishment:

BREEAM Category	Credits available	Targeted credits	Potential credits	% credits achieved	Weighting	Targeted score	Potential score	Credit value
Management	11	10	0	90.91%	12.00	10.91	10.91	1.09
Health and Wellbeing	12	8	2	66.67%	17.00	11.33	14.17	1.42
Energy	29	21	0	72.41%	43.00	31.14	31.14	1.48
Water	5	4	0	80.00%	11.00	8.80	8.80	2.20
Materials	48	29	0	60.42%	8.00	4.83	4.83	0.17
Waste	5	4	0	80.00%	3.00	2.40	2.40	0.60
Pollution	8	3	0	37.50%	6.00	2.25	2.25	0.75
Innovation	10	0	0	0.00%	10.00	0.00	0.00	1.00
					Total score:	**71.66**	**74.50**	
					Rating:	**EXCELLENT**	**EXCELLENT**	

BREEAM Rating	% Score
Outstanding	85
Excellent	70
Very Good	55
Good	45
Pass	30
Unclassified	<30



BREEAM UK Refurbishment 2014 - Domestic Buildings

Score Sheet and Evidence Requirements

Project name: 10 Orleans Road
Building type: Residential
Date: 14/02/2024

Target score: 71.66
Target rating: EXCELLENT

71.66 74.50

Credit issue	Credits available	Credits targeted	Potential credits	Credit requirements	Notes
Management					
Man 01: Home User Guide	3	3		Credits awarded for production of Home User Guide containing the information listed in the 'user guide contents list' (must be supplied to all homes).	
Man 02: Responsible construction practices	2	2		Large-scale projects: 1 credit - Achieve a CCS score of at least 27, with at least 9 points in each section 2 credits - Achieve a CCS score of at least 35, with at least 11 points in each section Small-scale porjects: 1 credit - Where 50% of Checklist A3 items have been addressed 2 credits: Where 80% of Checklist A3 items have been addressed	
Man 03: Construction site impacts	1	1		Carry out at least 2 of the following: i) Monitor, report and set targets for energy use arising from site activities (and associated CO2 emissions. ii) Monitor, report and set targets for water consumption arising from site activities. iii) Main contractor operates an environmental materials policy (sustainable procurement plan). iv) Main contractor is ISO 14001 certified. v) At least 80% of site timber is either reclaimed, reused or responsible soured (FSC certified).	
Man 04: Security	2	1		One credit-Secure windows and doors - Where retained, external doors and accessible windows complywith the minimum security requirements asset out in CN6. - Where the following newly added features are appropriately certified: a External door sets. b Windows. Two credits- Secured by Design Where the principles and guidance of Secured byDesign Section 2 – Physical Security are complied with	
Man 05: Protection and enhancement of ecological features	1	1		Ecology survey carried out and all existing features of ecology value are protected during construction.	Suitable Qualified Ecologist (SQE) to be appointed
Man 06: Project management	2	2		First credit: Roles and responsibilities are assigned to all members of the project team across key design and refurbishment stages. Second credit: Handover meeting arranged and at least two of the following actions carried out: i) A site inspection within three months of occupation. ii) Conduct post-occupancy interviews with building occupants or a survey via phone or posted information within three months of occupation. iii) Longer term after care (e.g. a helpline, nominated individual or other appropriate system) to support building users for at least the first 12 months of occupation.	
Total credits:	**11**	**10**	**0**		
Health and Wellbeing					
Hea 01: Daylighting	2	0	1	First credit: Complete Checklist A7 to confirm the refurbishment results in a neutral impact on ADFs in kitchens, living rooms, dining rooms and studies. Second credit: Each dwelling meets the minimum daylighting requirements .	
Hea 02: Sound insulation	4	3	1	For noise transmittance between dwellings (separating walls and floors): 2 credits: Part E compliance 3 credits: 3dB improvement (airborne and impact sound insulation) 4 credits: 5dB improvement (airborne and impact sound insulation)	Suitable Qualified Acoustician (SQA) to be appointed
Hea 03: Volatile organic compounds	1	1		All decorative paints and varnishes meet the minimum VOC content levels and all products specified within at least five of the following product categories do not exceed the stated levels VOC emissions levels: wood panels, timber structures, wood flooring, resilient, textile and laminated floor coverings, suspended ceiling tiles, flooring adhesives, wall coverings, adhesives for hanging flexible wall coverings.	
Hea 04: Inclusive design	2	1		One credit: Complete sections 1 of Checklist A8. Two credits: Complete sections 1 and 2 of Checklist A8.	
Hea 05: Ventilation	2	2		One credit: Minimum levels of background, extract and purge ventilation provided in accordance with Building Regulations Part F. Two credits: Project complies in full with Section 5 of Building Regulations Part F.	Minimum requirements: 1 credit for any rating
Hea 06: Safety	1	1		All dwellings provided with compliant fire detection and alarm systems. Where mains gas is used within dwellings compliant carbon monoxide detection and alarm systems must be installed.	Minimum requirements: 1 credit for any rating
Total credits:	**12**	**8**	**2**		

BREEAM UK Refurbishment 2014 - Domestic Buildings

Score Sheet and Evidence Requirements

Project name: 10 Orleans Road
Building type: Residential
Date: 14/02/2024

Target score: 71.66
Target rating: EXCELLENT

71.66 74.50

Credit issue	Credits available	Credits targeted	Potential credits	Credit requirements	Notes
Energy					
Ene 01: Improvement in energy efficiency rating	6	2.5		Credits awarded based on the improvement in each dwelling's EPC rating.	Please note two SAP calculations are required: one for the existing, pre-refurbishment development and one for the post-refurbishment development.
Ene 02: Energy efficiency rating post-refurbishment	4	3		Credits awarded based on energy efficiency rating post-refurbishment.	Minimum requirements: 3.5 credits for Outstanding (EER of 80) 2.5 credits for Excellent (EER of 70) 2 credits for Very Good (EER of 65) 1 credit for Good (EER of 58) 0.5 credit for Pass (EER of 50)
Ene 03: Primary energy demand	7	6.5		Credits awarded based on primary energy demand post refurbishment.	
Ene 04: Renewable technologies	2	0		One credit: At least 10% of each dwelling's primary energy demand per annum is supplied by low or zero carbon technologies. Two credits: At least 15% of each dwelling's primary energy demand per annum is supplied by low or zero carbon technologies.	
Ene 05: Energy labelled white goods	2	2		First credit: fridges, freezers and fridge/freezers are E rated Second credit: washing machines are B rated, dishwashers D rated and waster-dryers / tumble dryers D rated.	
Ene 06: Drying space	1	1		At least 4m of fixed drying line provided for 1-2 bedroom properties and at least 6m for 3+ bedroom properties.	
Ene 07: Lighting	2	2		**Internal lighting (one credit):** Internal lighting has a average wattage per dwelling of no more than 9 Watts/m^2. **External lighting (one credit):** External lighting and lighting in communal areas has an efficiency of greater than 45 lumens per circuit Watt.	
Ene 08: Energy display devices	2	2		Compliant, fixed, display screens are installed in each unit allowing for monitoring of electricity and gas consumption.	System must be capable of displaying the following information: 1. Local time 2. Current (real time) energy consumption (kilowatts and kilowatt hours) 3. Current (real time) estimated emissions (g/kg CO2) 4. Current (real time) tariff 5. Current (real time) cost (per hour) 6. Visual presentation of data (i.e. non-numeric) to allow consumers to easily identify high and low level of usage
Ene 09: Cycle storage	2	2		One credit: 1 cycle storage space provided per dwelling Two credits: 2 cycle storage spaces provided per dwelling	
Ene 10: Home office	1	0		Study cannot be located in kitchen or living room. One or two bedroom dwellings: study can be located in master bedroom. Home office must have: two double power sockets; telephone point; window; adequate ventilation; and sufficient space to allow a desk, chair and filing cabinet or bookshelf.	
Total credits:	**29**	**21**	**0**		
Water					
Wat 01: Internal water use	3	2		Credits are awarded based on calculated water consumption. 1 credit: less than 140 litres/person/day 2 credits = less than 118 litres/person/day 2.5 credits = less than 107 litres/person/day	Minimum requirements: 3 credits for Outstanding 2 credits for Excellent 1 credit for Very Good
Wat 02: External water use	1	1		Compliant rainwater collection system specified for external or internal irrigation.	Credit can be awarded by default if no individual or communal external space is provided.
Wat 03: water meter	1	1		Water meter linked to internal display screen to provide a visible display of mains potable water consumption to occupants.	
Total credits:	**5**	**4**	**0**		
Materials					
Mat 01: Environmental impact of materials	25	15		The BREEAM Domestic Refurbishment Mat 01 calculator is used to determine the number of credits awarded. Credits are awarded according to the impact of new materials according to their Green Guide rating and their impact on improving the thermal performance of each dwelling.	
Mat 02: Responsible sourcing of materials	15	6		All timber and timber-based products used on the project meets the UK Government's definition of 'legally harvested and traded timber'. Where the principal contractor sources materials for the project in accordance with a documented sustainable procurement plan. The available RSM credits can be awarded where the applicable building materials are responsibly sourced in accordance with the BREEAM methodology.	This is a minimum requirement for all BREEAM ratings.
Mat 03: Insulation	8	8		4 credits: insulation index for new insulation used in the building is ≥ 2. 4 credits: where ≥ 80% of the new thermal insulation used in the building elements is responsibly sourced.	
Total credits:	**48**	**29**	**0**		

BREEAM UK Refurbishment 2014 - Domestic Buildings

Score Sheet and Evidence Requirements

Project name: 10 Orleans Road
Building type: Residential
Date: 14/02/2024

Target score: 71.66
Target rating: EXCELLENT

71.66 74.50

Credit issue	Credits available	Credits targeted	Potential credits	Credit requirements	Notes
Waste					
Wst 01: Household waste	2	1		First credit: internal and external recycling facilities provided in accordance with BREEAM requirements. Second credit: internal and external composting facilities provided in accordance with BREEAM requirements.	Internal storage dependent on collection scheme. If waste is sorted post-collection, one internal bin can be provided; if waste streams are collected separately, three internal bins must be provided. Recycling bins must be provided in addition to general waste bins. Adequate external storage must also be provided.
Wst 02: Refurbishment site waste management	3	3		Compliant Site Waste Management Plan in place. Non-hazardous construction waste generate per £100,000 of project value no greater than 16.9 tonnes. At least 65% of non-hazardous construction waste and 90% of non-hazardous demolition waste must be diverted from landfill.	
Total credits:	**5**	**4**	**0**		
Pollution					
Pol 01: Nitrogen oxide emissions	3	0		Credits are dependent on the NOx emissions associated with space heating and hot water systems. No credits can be awarded if systems are powered by mains grid electricity (e.g. heat pumps).	
Pol 02: Surface water run-off	3	1		One credit: Neutral impact on surface water Two credits: Reducing run-off from site (basic) Three credits: Reducing run-off from site (advanced)	
Pol 03: Flooding	2	2		FRA has been carried out and either the site is confirmed as 'low flood risk' or mitigation measures are implemented.	Minimum requirements: 2 credits for Excellent & Outstanding

XCO2
56 Kingsway Place, Sans Walk
London EC1R 0LU

+44 (0)20 7700 1000
mail@xco2.com
xco2.com