ENERGY & SUSTAINABILITY STATEMENT

9 The Green

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CONTENTS

EXECUTIVE SUMMARY

The sustainability and energy strategy for the 9 The Green 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 9 The Green, located in the London Borough of Richmond upon Thames.

The proposed development comprises the restoration and conversion of an existing Grade II listed building from office space into a single residential dwelling.

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 9 The Green. 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 improvement in fabric efficiency through additional internal insulation to the roof and refurbishment of the external walls.
- 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 addition of roof insulation and improved air permeability. 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 9 The Green. However, CO_2 emissions have been reduced as far as is feasible. The 45.0% reduction in regulated CO_2 emissions compared to a Part L 2021 compliant scheme, based

on the existing fabric and systems, through roof insulation, 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 to a grade II listed building.

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 site currently comprises a grade II listed three story (plus basement and attic rooms) town house containing office space. The proposal sets out a change of use, restoring the building back into its original use as a single residential dwelling using minimally invasive techniques.

The site is located in a suburban residential area with neighbouring houses either side, overlooking Richmond Green to the northwest, and lies within the Richmond Green Conservation Area.

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 energy and sustainability policies of the London Plan and of 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.

THE LONDON PLAN (2021)

The London Plan (2021) published 2nd March 2021 sets out the Mayor's overarching strategic spatial development strategy for greater London and underpins the planning framework from 2019 up to 2041. This document replaced the London Plan 2016.

The new Plan has a strong sustainability focus with many new policies addressing the concern to deliver a sustainable and zero carbon London.

Policy GG6 Increasing Efficiency and Resilience is an overarching policy references London's target to become zero carbon by 2050 and the need to design buildings and infrastructure for a changing climate, addressing water, flood and urban heat island.

Sustainability is a trend through the whole Plan but is particularly addressed in chapter 9 Sustainable Infrastructure. The following sections outline the key principles of sustainable design and construction to be incorporated in major proposals.

Policy SI1 Improving air quality requires development proposals to be at least air quality neutral and submit an Air Quality Assessment.

"...
Development plans, through relevant strategic, site specific and area-based policies should seek opportunities to identify and deliver further improvements to air quality and should not reduce air quality benefits that result from the Mayor's or boroughs' activities to improve air quality.
..."

Any mitigation required to meet the Air Quality Neutral target should be done on site preferably.

Policy SI2 Minimising greenhouse gas emissions sets the requirements for all major developments to follow the energy hierarchy and achieve net-zero-carbon for both residential and non-residential schemes (via on-site carbon reductions and offset payments) and introduces new targets at Lean stage:

"...
This means reducing greenhouse gas emissions in operation and minimising both annual and peak energy demand in accordance with the following energy hierarchy:
1) be lean: use less energy and manage demand during operation
2) be clean: exploit local energy resources (such as secondary heat) and supply energy efficiently and cleanly
3) be green: maximise opportunities for renewable energy by producing, storing and using renewable energy on-site
4) be seen: monitor, verify and report on energy performance.
..."

"...
A minimum on-site reduction of at least 35 per cent beyond Building Regulations is required for major development. Residential development should achieve 10 per cent, and non-residential development should achieve 15 per cent through energy efficiency measures. Where it is clearly demonstrated that the zero-carbon target cannot be fully achieved on-site, any shortfall should be provided, in agreement with the borough, either:
1) through a cash in lieu contribution to the borough's carbon offset fund, or
2) off-site provided that an alternative proposal is identified and delivery is certain.
..."

This policy also sets the requirements to consider whole-life carbon emissions, including embodies carbon and unregulated emissions:

"...
Major development proposals should calculate and minimise carbon emissions from any other part of the development, including plant or equipment, that are not covered by Building Regulations, i.e. unregulated emissions.

Development proposals referable to the Mayor should calculate whole lifecycle carbon emissions through a nationally recognised Whole Life-Cycle Carbon Assessment and demonstrate actions taken to reduce life-cycle carbon emissions.
..."

The policy supporting text provides additional clarifications on the requirements for major developments:

- Developments including major refurbishments should also aim to meet the net-zero carbon target.
- All developments should maximise opportunities for on-site electricity and heat production from solar technologies (photovoltaic and thermal), use innovative building materials and smart technologies.
- Recommendation to use SAP10 carbon factors as per GLA Energy Guidance.
- Recommended carbon offset price of £95 per tonne CO_2.
- Requirement for major developments to monitor and report operational energy performance to the GLA.

Policy SI 4 Managing heat risk requires:

A Development proposals should minimise adverse impacts on the urban heat island through design, layout, orientation, materials and the incorporation of green infrastructure.

B Major development proposals should demonstrate through an energy strategy how they will reduce the potential for internal overheating and reliance on air conditioning systems in accordance with the following cooling hierarchy:
1) reduce the amount of heat entering a building through orientation, shading, high albedo materials, fenestration, insulation and the provision of green infrastructure
2) minimise internal heat generation through energy efficient design
3) manage the heat within the building through exposed internal thermal mass and high ceilings
4) provide passive ventilation
5) provide mechanical ventilation
6) provide active cooling systems.

Policy SI5 Water Infrastructure sets the requirements to manage water resources efficiently:

"...
Development proposals should:
1) through the use of Planning Conditions minimise the use of mains water in line with the Optional Requirement of the Building Regulations (residential development), achieving mains water consumption of 105 litres or less per head per day (excluding allowance of up to five litres for external water consumption)
2) achieve at least the BREEAM excellent standard for the 'Wat 01' water category or equivalent (commercial development)
3) incorporate measures such as smart metering, water saving and recycling measures, including retrofitting, to help to achieve lower water consumption rates and to maximise future-proofing.
..."

Policy SI 7 Reducing waste and supporting the circular economy introduces the notion of circular economy whereby materials are retained in use at their highest value for as long as possible. For referable applications a Circular Economy Statement demonstrating how developments promote circular economy and aim to be net zero-waste must be submitted.

Policy SI12 Flood risk management and **Policy SI 13 Sustainable drainage** sets the requirements for development proposals to ensure that flood risk is minimised, and that sustainable drainage is incorporated. This should be pursued by integrating different strategies including natural flood management. Development proposals should aim to achieve greenfield run-off rates and ensure that surface water run-off is managed as close to its source as possible. For this green features should be employed, following the drainage hierarchy.

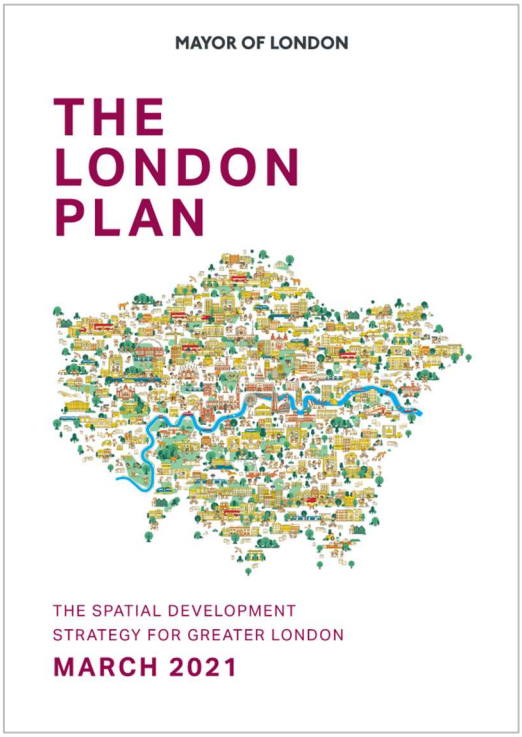
Policy D14 Noise requires that noise impacts are minimised and mitigated to avoid any adverse impacts on health and quality of life and to reflect the principles set in **Policy D13 Agent of Change** that "*places the*

responsibility for mitigating impacts from existing noise and other nuisance-generating activities or uses on the proposed new noise-sensitive development."

Policy G6 Biodiversity and access to nature states:

"…
Development proposals should manage impacts on biodiversity and aim to secure net biodiversity gain. This should be informed by the best available ecological information and addressed from the start of the development process.
…"

It is noted that the proposed scheme does not constitute 'major' development, and therefore London Plan policies, intended for major developments, are not applicable in this case.



GLA GUIDANCE ON PREPARING ENERGY ASSESSMENTS

This document (last updated in June 2022) provides guidance on preparing energy assessments to accompany strategic planning applications; it contains clarifications on Policy SI 2, of the new London Plan, carbon reduction targets in the context of zero carbon policy, as well as detailed guidelines on the content of the Energy Assessments undertaken for planning.

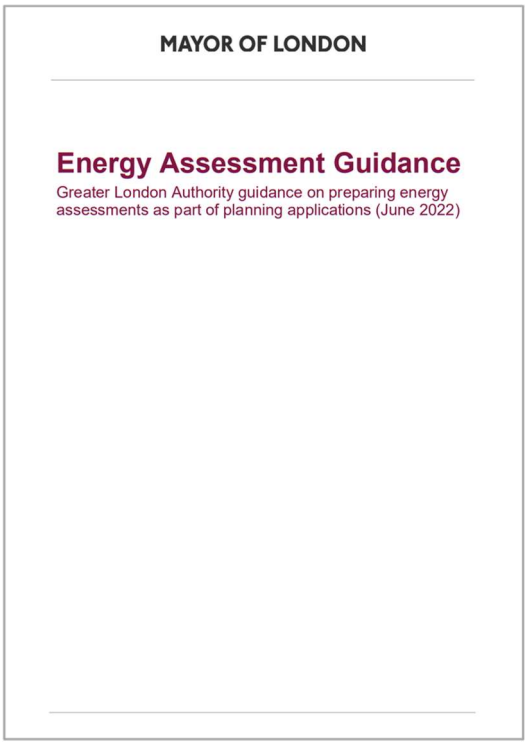
The guidance document specifies the emission reduction targets the GLA will apply to applications as follows:

"Major developments are required to achieve net zero-carbon by following the energy hierarchy (Policy SI 2). This means that regulated carbon emissions should be reduced so they are as close as possible to zero. Once on-site reductions have been maximised, the residual emissions should be offset via a payment into the relevant borough's carbon offset fund.
Major developments are required to achieve a minimum 35 per cent on-site carbon reduction over Part L 2021. ..."
"... If the net zero-carbon target cannot be met on site and the GLA and the relevant borough is satisfied that on-site savings have been maximised, then the annual remaining carbon emissions figure is multiplied by the assumed lifetime of the development's services (e.g. 30 years) to give the cumulative shortfall. The cumulative shortfall is multiplied by the carbon dioxide offset price to determine the required cash-in-lieu contribution. ..."

The new guidance also includes changes to technical requirements relating to the use of updated carbon factors, cost estimates, overheating risk analysis, the structure of the heating hierarchy and scrutiny over the performance of heat pumps. The guidance also provides information on how the new stage of the energy hierarchy 'be seen' is expected to be carried out in energy assessments, which includes calculating the unregulated carbon emissions.

The structure of this report and the presentation of the carbon emission information for the development follows the guidance in this document.

It is noted that the proposed scheme does not constitute 'major' development, and therefore GLA guidance intended for major developments, are not applicable in this case.


MAYOR OF LONDON

Energy Assessment Guidance

Greater London Authority guidance on preparing energy assessments as part of planning applications (June 2022)

LONDON BOROUGH OF RICHMOND UPON THAMES LOCAL PLAN

Policy LP 3 – Designated Heritage Assets

A. The Council will require development to conserve and, where possible, take opportunities to make a positive contribution to, the historic environment of the borough. Development proposals likely to adversely affect the significance of heritage assets will be assessed against the requirement to seek to avoid harm and the justification for the proposal. The significance (including the settings) of the borough's designated heritage assets, encompassing Conservation Areas, listed buildings, Scheduled Monuments as well as the Registered Historic Parks and Gardens, will be conserved and enhanced by the following means:

1. Give great weight to the conservation of the heritage asset when considering the impact of a proposed development on the significance of the asset.
2. Resist the demolition in whole, or in part, of listed building. Consent for demolition of Grade II listed buildings will only be granted in exceptional circumstances and for Grade II* and Grade I listed buildings in wholly exceptional circumstances following a thorough assessment of the justification for the proposal and the significance of the asset.
3. Resist the change of use of listed buildings where their significance would be harmed, particularly where the current use contributes to the character of the surrounding area and to its sense of place.
4. Require the retention and preservation of the original structure, layout, architectural features, materials as well as later features of interest within listed buildings, and resist the removal or modification of features that are both internally and externally of architectural importance or that contribute to the significance of the asset.
5. Demolitions (in whole or in part), alterations, extensions and any other modifications to listed buildings should be based on an accurate understanding of the significance of the heritage asset.
6. Require, where appropriate, the reinstatement of internal and external features of special architectural or historic significance within listed buildings, and the removal of internal and external features that harm the significance of the asset, commensurate with the extent of proposed development.
7. Require the use of appropriate materials and techniques and strongly encourage any works or repairs to a designated heritage asset to be carried out in a correct, scholarly manner by appropriate specialists.
8. Protect and enhance the borough's registered Historic Parks and Gardens by ensuring that proposals do not have an adverse effect on their significance, including their setting and/or views to and from the registered landscape.
9. Protect Scheduled Monuments by ensuring proposals do not have an adverse impact on their significance.

B. Resist substantial demolition in Conservation Areas and any changes that could harm heritage assets, unless it can be demonstrated that:

1. in the case of substantial harm or loss to the significance of the heritage asset, it is necessary to achieve substantial public benefits that outweigh that harm or loss;
2. in the case of less than substantial harm to the significance of the heritage asset, that the public benefits, including securing the optimum viable use, outweigh that harm; or
3. the building or part of the building or structure makes no positive contribution to the character or distinctiveness of the area.

C. All proposals in Conservation Areas are required to preserve and, where possible, enhance the character or the appearance of the Conservation Area.

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.

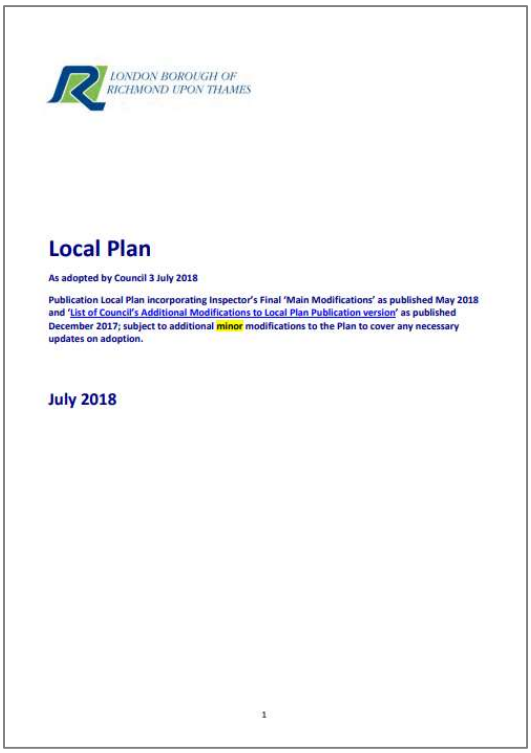
Applicants are required to consider the installation of low, or preferably ultra-low, NOx boilers to reduce the amount of NOx emitted in the borough.

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

1

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 used as the scheme will be constructed on previously developed land. The site currently comprises a grade II, three storey (plus basement and attic rooms) building used as office space. This building will be kept in its entirety and is proposed to be restored back to its original use as a single residential dwelling.

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 given its grade II listed status. 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 site benefits from a private garden to the rear of the property, which will allow residents to connect to the natural environment and enhance the occupants wellbeing as nature can significantly improve mood and happiness.

Daylight/Sunlight

By retaining the existing large windows, the proposed development ensures that occupants enjoy satisfactory levels of visual comfort and beneficial effects from daylight exposure.

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 vehicles. The provision of cycle storage spaces will also encourage the use of alternative means of transportation for longer distances trips.

WATER

Water Efficiency

The development at 9 The Green 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

Should any landscaping form part of the current proposal, potable water consumption reduction from irrigation could be improved through a combination of water reuse and use of both native and drought resistant plant species, which will thrive with little to no irrigation and rely only on natural rainfall.

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.

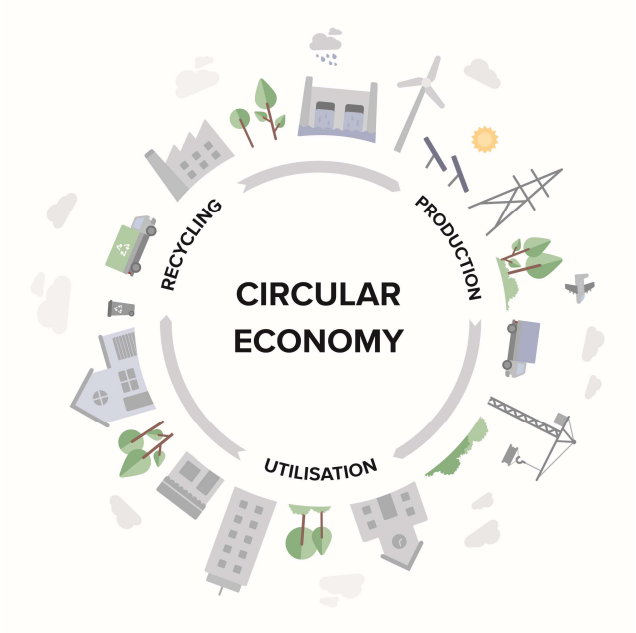
Circular Economy

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 as part of the propose development due to the building's grade II listed status, 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 on site could be enhanced through improvements to landscaped areas within the proposed private garden. If this does form part of the proposal, the recommended planting strategy for these areas is simple low level flora, with hedge planting and small ornamental trees. Native plant species should be introduced to these areas where possible. This will help to attract invertebrates, birds and other fauna to the area.

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 to the development will be provided by a new high efficiency gas boiler. All heat sources and pipe work will be sufficiently insulated to avoid excess heat loss into internal space.

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

Internal blinds on all windows 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;
- trackout; and,
- non-road mobile machinery (NRMM).

During the operational phase of the development, combustion of fossil fuels and associated combustion emissions for heating will be reduced via improved levels of insulation to the roof and air tightness for the buildings' fabric, and the specification of a new highly efficient gas boiler (for further details please refer to the Energy Strategy section of this report).

An ultra-low NOx boiler (maximum NO_x emissions of under 40mg/kWh dry NO_x at 0% excess O_2) should be proposed to further reduce impacts on air quality from the combustion of fuels on site. This is also required to ensure the relevant credits are achieved for the BREEAM Domestic Refurbishment assessment.

Noise

The development will incorporate design and building fabric measures internally to mitigate potential noise levels from the proposed development and ensure the impact of any external sources on internal ambient noise levels are within acceptable limits.

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

The development is proposing to reduce the site parking permits from the allowance of five business permits down to two, due to the change of use from office space to residential. In order to underpin the reduction of emissions from transport, the development will encourage cycling by providing two secure cycle parking spaces to the rear of the building.

Public Transport Accessibility

The site has excellent accessibility to public transport, with numerous bus routes within a few minutes' walk and Richmond Underground Station just over 300m away. The site has a PTAL 6a rating.

Proximity to Amenities

The site is a short walk to Richmond High Street. This provides the residents with access to banks, cash points, coffee shops, grocery shops and post offices and numerous food outlets within a short walking distance. The site is situated directly opposite Richmond Green, an extensive open green space which hosts local cricket matches and community fairs.

BREEAM DOMESTIC REFURBISHMENT

In addition to the above measures, which will be incorporated for the development in its entirety, the dwelling 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 61.35% and a Very Good rating is feasible. Although this does not meet the required target of 'Excellent' as set out in the Richmond Local Plan, this is unlikely to be feasible due to the proposed development involving the change of use of a grade II listed building and being situated within a conservation area. This means that there are restrictions on what updates and changes can be implemented and as a result, limitations on what credits can be achieved.

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	1.0	12.0	1.09
Health & Wellbeing	12	8.0	17.0	11.33
Energy	29	20.5	43.0	30.40
Water	5	4.5	11.0	9.90
Materials	48	11.0	8.0	1.83
Waste	5	3.0	3.0	1.80
Pollution	8	4.0	6.0	3.00
Innovation	10	2.0	10.0	2.00
BREEAM Very Good		**Total Points Scored: 61.35%**		

ENERGY STRATEGY

This section describes the predicted energy performance and carbon dioxide emissions of the proposed 9 The Green 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 45%.

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 refurbishment' specification of existing buildings. Given the grade II listed status of the building, where relevant existing U-values have been included based on the 'Appendix S: Reduced Data SAP for existing dwellings' of the Government's Standard Assessment Procedure for Energy Rating of Existing Dwellings. The inputs used can be seen in the table below.

Element	Unit	Specification
External Wall	W/m²K	2.1
Roof	W/m²K	2.3
Floor	W/m²K	1.2
Window Glazing	W/m²K	4.8 (0.85 g-value)
Roof Window Glazing	W/m²K	5.1 (0.85 g-value)
Air Permeability	m³/h m² @50 Pa	15
Thermal Bridging	W/m²K	Default
HVAC Type	-	Naturally ventilated
Heating / Hot Water	Per cent	Gas boiler with 80% summer efficiency
Cooling	SEER	None
Lighting (fixed)	Per cent	100% fluorescent lighting

REFURBISHED MODEL

INPUTS

Due to the heritage constraints associated with a grade II listed building, the refurbishment options are very limited. Following discussions with the team, the assessment includes upgraded insulation to the roof and re-pointing to the exterior, along with installing a new, more efficient gas boiler, improved pipework insulation, and both high efficiency lighting and heating controls.

These inputs can be seen in the table below.

Element	Unit	Input
External Wall (repointed and refurbished)	W/m²K	1.6
Roof (with 300mm PIR insulation added)	W/m²K	0.3
Floor	W/m²K	1.2
Window Glazing	W/m²K	4.8 (0.85 g-value)
Roof Window Glazing	W/m²K	5.1 (0.85 g-value)
Air permeability	m³/h m² @50 Pa	10
Thermal Bridging	W/m²K	Default, with 20% improvement on roof junctions
HVAC	-	Naturally ventilated

Heating System	Per cent	Gas boiler with 84% summer efficiency
Cooling	-	None
Lighting (fixed)	Per cent	100% low energy lighting

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.

Due to the grade II listed status of the building, there is limited scope to improve the u-values of the building elements. The proposed development will aim to increase the levels of insulation in the roof, in addition to improving the external walls though re-pointing and general refurbishments, in order to reduce the demand for space heating).

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 value of 15m^3/m^2 at 50Pa used in the baseline model by targeting air permeability rates of 10m^3/m^2 at 50Pa. This is expected to be achievable through improved roof insulation, re-pointing of external walls and expected internal cosmetic refurbishments including sealing of edges and air gaps.

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%, only where insulation has been added (i.e. at roof junctions), and this figure has been used within the calculations accordingly.

REDUCING THE NEED FOR ARTIFICIAL LIGHTING

As the existing building's windows are to be retained, large areas of glazing across all building elevations are present, which will optimise daylight in occupied spaces. Good internal daylight levels will translate to less dependency on artificial lighting and will indirectly deliver energy and carbon savings, together with pleasant, healthy spaces for occupants.

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.

HEAT GENERATION

As there is no scope to introduce air source heat pumps due to space, noise and planning restrictions, a new efficient gas boiler has been included for supply of space heating and hot water in the 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. The proposal includes the conversion of a grade II listed building to create a single dwelling therefore connecting to a district energy network would not be viable. Therefore, no regulated carbon savings are achieved through the use of district energy.

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 45.0%.

Element	CO_2 Emissions (tonnes per year)	Reduction (%)
Baseline	19.09	-
Proposed	10.50	45.0

CONCLUSIONS

The sustainability strategy for the scheme at 9 The Green 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 45.0% over the existing building baseline assessment which has been modelled in line with Part L 2021.

SUSTAINABILITY

The proposed 9 The Green 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 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 61.35% can be obtained, corresponding to a rating of 'Very Good'. Although this does not meet the required target of 'Excellent' as set out in the Richmond Local Plan, this is unlikely to be feasible due to the proposed development involving the change of use of a grade II listed building and being situated within a conservation area. This means that there are restrictions on what updates and changes can be implemented and as a result, limitations on what credits can be achieved.

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 45.0% (8.59 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 while staying within the boundaries of accepted alterations to a grade II listed building.

DOMESTIC CUMULATIVE SAVINGS

Table 3: CO_2 emissions before after energy efficient measures have been incorporated.

	Carbon dioxide emissions for domestic buildings (tonnes CO2 per annum)
	Regulated
Existing	19.09
Proposed	10.5

Table 4: Regulated CO_2 savings before after energy efficient measures have been incorporated.

	Regulated domestic carbon dioxide savings	
	Tonnes CO_2 per annum	% over baseline
Existing	-	-
Proposed	8.59	45.0

APPENDIX A – SAP WORKSHEETS

Full SAP Calculation Printout

Property Reference	9 The Green Baseline	Issued on Date	05/01/2024
Assessment Reference	00001	Prop Type Ref	
Property			

SAP Rating	45 E	DER		TER	
Environmental	37 F	% DER < TER			N/A
CO_2 Emissions (t/year)	19.09	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)	
Basement floor	73.1000	(1a) x	2.0000	(2a) =	146.2000	(1a) - (3a)
Ground floor	78.3000	(1b) x	3.0000	(2b) =	234.9000	(1b) - (3b)
First floor	75.0000	(1c) x	3.0000	(2c) =	225.0000	(1c) - (3c)
Second floor	70.9000	(1d) x	3.0000	(2d) =	212.7000	(1d) - (3d)
Third floor	62.2000	(1e) x	2.0000	(2e) =	124.4000	(1e) - (3e)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	359.5000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	943.2000	(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	5 * 10 =	50.0000 (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) =	50.0000 / (5) =	0.0530 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		15.0000 (17)
Infiltration rate		0.8030 (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) =	0.6826 (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	0.8703	0.8532	0.8361	0.7508	0.7338	0.6484	0.6484	0.6314	0.6826	0.7338	0.7679	0.8020	(22b)
Effective ac	0.8787	0.8640	0.8496	0.7819	0.7692	0.7102	0.7102	0.6993	0.7329	0.7692	0.7948	0.8216	(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 = 4.80)			51.1100	4.0268	205.8121			(27)
External Door			7.2700	3.0000	21.8100			(26)
T W8			0.9500	4.2359	4.0241			(27a)
T W9			0.9500	4.2359	4.0241			(27a)
T W10			0.9500	4.2359	4.0241			(27a)
Basement Floor			73.1000	1.2000	87.7200			(28a)
Ground Floor			4.4000	1.2000	5.2800			(28a)
External Wall	355.2000	58.3800	296.8200	2.1000	623.3220			(29a)
Main Roof	62.2000	2.8500	59.3500	2.3000	136.5050			(30)
Exposed Ceiling	16.7000		16.7000	2.3000	38.4100			(30)
Total net area of external elements Aum(A, m2)			511.6000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		1130.9313			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total

E2 Other lintels (including other steel lintels)	37.7400	1.0000	37.7400	
E3 Sill	34.2800	0.1000	3.4280	
E4 Jamb	136.6000	0.1000	13.6600	
E5 Ground floor (normal)	60.8000	0.3200	19.4560	
E20 Exposed floor (normal)	3.1800	0.3200	1.0176	
E22 Basement floor	36.0000	0.2200	7.9200	
E6 Intermediate floor within a dwelling	111.8500	0.1400	15.6590	
E11 Eaves (insulation at rafter level)	26.3300	0.1500	3.9495	
E15 Flat roof with parapet	23.0500	0.3000	6.9150	
E16 Corner (normal)	38.8000	0.1800	6.9840	
E17 Corner (inverted - internal area greater than external area)	25.8000	0.0000	0.0000	
E18 Party wall between dwellings	39.8000	0.2400	9.5520	
E25 Staggered party wall between dwellings	11.8000	0.2400	2.8320	
P1 Party wall - Ground floor	14.6000	0.3200	4.6720	
P2 Party wall - Intermediate floor within a dwelling	65.9000	0.0000	0.0000	
P4 Party wall - Roof (insulation at ceiling level)	7.5000	0.4800	3.6000	

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 137.3851 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 1268.3164 (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	273.4941	268.9172	264.4310	243.3592	239.4167	221.0639	221.0639	217.6652	228.1331	239.4167	247.3923	255.7304	(38)
Heat transfer coeff	1541.8106	1537.2337	1532.7474	1511.6756	1507.7332	1489.3803	1489.3803	1485.9816	1496.4495	1507.7332	1515.7087	1524.0468	(39)

Average = Sum(39)m / 12 = 1511.6567

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	4.2888	4.2760	4.2636	4.2049	4.1940	4.1429	4.1429	4.1335	4.1626	4.1940	4.2162	4.2394	(40)
HLP (average)												4.2049	
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 3.2093 (42)

Hot water usage for mixer showers

107.2899	105.6775	103.3280	98.8326	95.5151	91.8155	89.7126	92.0444	94.6004	98.5727	103.1646	106.8788	(42a)

Hot water usage for baths

35.4508	34.9243	34.1829	32.8158	31.7922	30.6572	30.0441	30.7803	31.5819	32.7965	34.1917	35.3309	(42b)

Hot water usage for other uses

49.9960	48.1780	46.3600	44.5419	42.7239	40.9058	40.9058	42.7239	44.5419	46.3600	48.1780	49.9960	(42c)

Average daily hot water use (litres/day) 177.2371 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	192.7367	188.7798	183.8708	176.1904	170.0312	163.3785	160.6626	165.5486	170.7243	177.7291	185.5343	192.2058	(44)
Energy conte	305.2478	268.8199	282.6026	241.1958	228.8947	200.8930	194.3075	204.9837	210.5201	241.1767	264.3276	300.9478	(45)

Energy content (annual) Total = Sum(45)m = 2943.9172

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

45.7872	40.3230	42.3904	36.1794	34.3342	30.1339	29.1461	30.7476	31.5780	36.1765	39.6491	45.1422	(46)

Water storage loss:

Store volume 300.0000 (47)

b) If manufacturer declared loss factor is not known :

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.1425 (51)

Volume factor from Table 2a 0.7368 (52)

Temperature factor from Table 2b 0.7800 (53)

Enter (49) or (54) in (55) 24.5688 (55)

Total storage loss

761.6330	687.9266	761.6330	737.0642	761.6330	737.0642	761.6330	761.6330	737.0642	761.6330	737.0642	761.6330	(56)

If cylinder contains dedicated solar storage

761.6330	687.9266	761.6330	737.0642	761.6330	737.0642	761.6330	761.6330	737.0642	761.6330	737.0642	761.6330	(57)
128.3772	115.9536	128.3772	124.2360	128.3772	41.9160	43.3132	43.3132	41.9160	128.3772	124.2360	128.3772	(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)

Total heat required for water heating calculated for each month

1195.2580	1072.7001	1172.6128	1102.4960	1118.9049	979.8732	999.2537	1009.9299	989.5003	1131.1869	1125.6278	1190.9580	(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)

Output from w/h

1195.2580	1072.7001	1172.6128	1102.4960	1118.9049	979.8732	999.2537	1009.9299	989.5003	1131.1869	1125.6278	1190.9580	(64)

Total per year (kWh/year) = Sum(64)m = 13088.3014 (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

204.1967	182.1455	196.6671	179.5864	178.8093	100.3297	99.2578	102.8077	103.5307	182.8930	187.2777	202.7669	(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	192.5568	192.5568	192.5568	192.5568	192.5568	192.5568	192.5568	192.5568	192.5568	192.5568	192.5568	192.5568	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	73.3237	65.1255	52.9636	40.0969	29.9729	25.3044	27.3423	35.5405	47.7024	60.5691	70.6931	75.3616	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	753.4903	761.3092	741.6059	699.6599	646.7106	596.9457	563.6997	555.8809	575.5842	617.5302	670.4795	720.2443	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	57.4650	57.4650	57.4650	57.4650	57.4650	57.4650	57.4650	57.4650	57.4650	57.4650	57.4650	57.4650	(69)
Pumps, fans	10.0000	10.0000	10.0000	10.0000	0.0000	0.0000	0.0000	0.0000	10.0000	10.0000	10.0000		(70)
Losses e.g. evaporation (negative values) (Table 5)	-128.3712	-128.3712	-128.3712	-128.3712	-128.3712	-128.3712	-128.3712	-128.3712	-128.3712	-128.3712	-128.3712	-128.3712	(71)
Water heating gains (Table 5)	274.4579	271.0499	264.3375	249.4256	240.3350	139.3468	133.4110	138.1823	143.7927	245.8239	260.1079	272.5362	(72)
Total internal gains	1232.9225	1229.1351	1190.5576	1120.8329	1048.6690	883.2475	846.1036	851.2542	888.7298	1055.5738	1132.9311	1199.7927	(73)

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6. Solar gains

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

		W/m2	or Table 6b	or Table 6c		Table 6d	
North	2.3000	10.6334	0.8500	0.7000	0.7700	10.0844	(74)
Northeast	1.9800	11.2829	0.8500	0.7000	0.7700	9.2117	(75)
Southeast	19.2200	36.7938	0.8500	0.7000	0.7700	291.5940	(77)
Southwest	0.8300	36.7938	0.8500	0.7000	0.7700	12.5922	(79)
West	2.4000	19.6403	0.8500	0.7000	0.7700	19.4361	(80)
Northwest	24.3800	11.2829	0.8500	0.7000	0.7700	113.4243	(81)
Southeast	2.8500	39.9751	0.8500	0.7000	1.0000	61.0091	(82)

Solar gains	517.3518	937.2117	1425.1612	1995.7036	2438.2545	2508.0273	2381.7679	2039.4621	1621.4697	1074.8927	630.0025	435.9816 (83)
Total gains	1750.2743	2166.3468	2615.7188	3116.5364	3486.9235	3391.2748	3227.8714	2890.7164	2510.1995	2130.4665	1762.9335	1635.7743 (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	16.1922	16.2404	16.2879	16.5150	16.5582	16.7622	16.7622	16.8005	16.6830	16.5582	16.4710	16.3809	
alpha	2.0795	2.0827	2.0859	2.1010	2.1039	2.1175	2.1175	2.1200	2.1122	2.1039	2.0981	2.0921	
util living area	0.9965	0.9943	0.9898	0.9798	0.9592	0.9248	0.8727	0.9001	0.9614	0.9870	0.9950	0.9970	(86)
MIT	16.4459	16.7068	17.2638	18.0807	18.9518	19.7657	20.2790	20.1821	19.4766	18.3954	17.3046	16.4256	(87)
Th 2	18.2440	18.2477	18.2513	18.2685	18.2718	18.2874	18.2874	18.2903	18.2813	18.2718	18.2652	18.2583	(88)
util rest of house	0.9950	0.9917	0.9847	0.9673	0.9251	0.8227	0.5913	0.6697	0.9076	0.9767	0.9922	0.9957	(89)
MIT 2	14.4956	14.7573	15.3141	16.1328	16.9898	17.7660	18.1707	18.1216	17.5153	16.4521	15.3619	14.4808	(90)
Living area fraction									fLA = Living area / (4) =			0.0577	(91)
MIT	14.6082	14.8699	15.4267	16.2453	17.1031	17.8815	18.2925	18.2406	17.6285	16.5643	15.4741	14.5931	(92)
Temperature adjustment												0.0000	
adjusted MIT	14.6082	14.8699	15.4267	16.2453	17.1031	17.8815	18.2925	18.2406	17.6285	16.5643	15.4741	14.5931	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9909	0.9854	0.9742	0.9492	0.8966	0.7923	0.5923	0.6605	0.8790	0.9627	0.9863	0.9922	(94)
Useful gains	1734.4051	2134.6571	2548.2278	2958.1194	3126.4785	2687.0665	1911.9801	1909.3545	2206.3843	2050.9849	1738.7489	1623.0699	(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	15893.3449	15326.0716	13682.4152	11103.7490	8146.4876	4887.3617	2520.7035	2735.1466	5280.2675	8992.5614	12692.7068	15839.6324	(97)
Space heating kWh	10534.2512	8864.6306	8283.8354	5864.8533	3734.8868	0.0000	0.0000	0.0000	0.0000	5164.5329	7886.8497	10577.1225	(98a)
Space heating requirement - total per year (kWh/year)												60910.9625	
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	10534.2512	8864.6306	8283.8354	5864.8533	3734.8868	0.0000	0.0000	0.0000	0.0000	5164.5329	7886.8497	10577.1225	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												60910.9625	
Space heating per m2											(98c) / (4) =	169.4324	(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 %)	75.0000 (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	10534.2512	8864.6306	8283.8354	5864.8533	3734.8868	0.0000	0.0000	0.0000	0.0000	5164.5329	7886.8497	10577.1225	(98)
Space heating efficiency (main heating system 1)	75.0000	75.0000	75.0000	75.0000	75.0000	0.0000	0.0000	0.0000	0.0000	75.0000	75.0000	75.0000	(210)
Space heating fuel (main heating system)	14045.6683	11819.5074	11045.1139	7819.8044	4979.8490	0.0000	0.0000	0.0000	0.0000	6886.0439	10515.7996	14102.8300	(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	1195.2580	1072.7001	1172.6128	1102.4960	1118.9049	979.8732	999.2537	1009.9299	989.5003	1131.1869	1125.6278	1190.9580	(64)
Efficiency of water heater												70.0000	(216)
(217)m	73.8521	73.7851	73.6075	73.2315	72.4495	65.0000	65.0000	65.0000	65.0000	72.9980	73.5976	73.8599	(217)
Fuel for water heating, kWh/month	1618.4478	1453.8174	1593.0614	1505.4932	1544.3937	1507.4972	1537.3133	1553.7383	1522.3081	1549.6145	1529.4347	1612.4558	(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	14.0137	12.6575	14.0137	13.5616	14.0137	13.5616	14.0137	14.0137	13.5616	14.0137	13.5616	14.0137	(231)
Lighting	64.1798	51.4874	46.3587	33.9644	26.2351	21.4343	23.9325	31.1084	40.4067	53.0158	59.8812	65.9636	(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	81214.6166	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	70.0000	
Water heating fuel used	18527.5756	(219)
Space cooling fuel	0.0000	(221)
Electricity for pumps and fans:		
central heating pump	165.0000	(230c)
Total electricity for the above, kWh/year	165.0000	(231)
Electricity for lighting (calculated in Appendix L)	517.9680	(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	100425.1602	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	81214.6166	3.6400	2956.2120	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	18527.5756	3.6400	674.4038	(247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000	(247a)
Pumps, fans and electric keep-hot	165.0000	16.4900	27.2085	(249)
Energy for lighting	517.9680	16.4900	85.4129	(250)
Additional standing charges			92.0000	(251)
Total energy cost			3835.2372	(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] =	3.4133	(257)
SAP value		44.6702	
SAP rating (Section 12)		45	(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	81214.6166	0.2100	17055.0695	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	18527.5756	0.2100	3890.7909	(264)
Space and water heating			20945.8604	(265)
Pumps, fans and electric keep-hot	165.0000	0.1387	22.8875	(267)
Energy for lighting	517.9680	0.1443	74.7588	(268)
Total CO2, kg/year			21043.5067	(272)
CO2 emissions per m2			58.5400	(273)
EI value			36.9610	
EI rating			37	(274)
EI band			F	

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)	
Basement floor	73.1000	(1a) x	2.0000	(2a) =	146.2000	(1a) - (3a)
Ground floor	78.3000	(1b) x	3.0000	(2b) =	234.9000	(1b) - (3b)
First floor	75.0000	(1c) x	3.0000	(2c) =	225.0000	(1c) - (3c)
Second floor	70.9000	(1d) x	3.0000	(2d) =	212.7000	(1d) - (3d)
Third floor	62.2000	(1e) x	2.0000	(2e) =	124.4000	(1e) - (3e)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 359.5000						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		943.2000	(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	5 * 10 =	50.0000	(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) =	50.0000 / (5) =	0.0530 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		15.0000 (17)
Infiltration rate		0.8030 (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) =	0.6826 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.7167	0.6826	0.6826	0.6314	0.6314	0.5631	0.5802	0.5460	0.5631	0.5972	0.5972	0.6484	(22b)
Effective ac	0.7568	0.7329	0.7329	0.6993	0.6993	0.6585	0.6683	0.6491	0.6585	0.6783	0.6783	0.7102	(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 = 4.80)			51.1100	4.0268	205.8121			(27)
External Door			7.2700	3.0000	21.8100			(26)
T W8			0.9500	4.2359	4.0241			(27a)
T W9			0.9500	4.2359	4.0241			(27a)
T W10			0.9500	4.2359	4.0241			(27a)
Basement Floor			73.1000	1.2000	87.7200			(28a)
Ground Floor			4.4000	1.2000	5.2800			(28a)
External Wall	355.2000	58.3800	296.8200	2.1000	623.3220			(29a)
Main Roof	62.2000	2.8500	59.3500	2.3000	136.5050			(30)
Exposed Ceiling	16.7000		16.7000	2.3000	38.4100			(30)
Total net area of external elements Aum(A, m2)			511.6000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		1130.9313			(33)

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

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	37.7400	1.0000	37.7400
E3 Sill	34.2800	0.1000	3.4280
E4 Jamb	136.6000	0.1000	13.6600
E5 Ground floor (normal)	60.8000	0.3200	19.4560
E20 Exposed floor (normal)	3.1800	0.3200	1.0176
E22 Basement floor	36.0000	0.2200	7.9200
E6 Intermediate floor within a dwelling	111.8500	0.1400	15.6590
E11 Eaves (insulation at rafter level)	26.3300	0.1500	3.9495
E15 Flat roof with parapet	23.0500	0.3000	6.9150
E16 Corner (normal)	38.8000	0.1800	6.9840
E17 Corner (inverted - internal area greater than external area)	25.8000	0.0000	0.0000
E18 Party wall between dwellings	39.8000	0.2400	9.5520
E25 Staggered party wall between dwellings	11.8000	0.2400	2.8320
P1 Party wall - Ground floor	14.6000	0.3200	4.6720
P2 Party wall - Intermediate floor within a dwelling	65.9000	0.0000	0.0000
P4 Party wall - Roof (insulation at ceiling level)	7.5000	0.4800	3.6000

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		137.3851 (36)
Point Thermal bridges	(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =	1268.3164 (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	235.5649	228.1331	228.1331	217.6652	217.6652	204.9768	208.0129	202.0313	204.9768	211.1397	211.1397	221.0639	(38)
Heat transfer coeff	1503.8813	1496.4495	1496.4495	1485.9816	1485.9816	1473.2932	1476.3294	1470.3477	1473.2932	1479.4562	1479.4562	1489.3803	(39)
Average = Sum(39)m / 12 =												1484.1917	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	4.1833	4.1626	4.1626	4.1335	4.1335	4.0982	4.1066	4.0900	4.0982	4.1153	4.1153	4.1429	(40)
HLP (average)												4.1285	
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		3.2093 (42)

Hot water usage for mixer showers

107.2899	105.6775	103.3280	98.8326	95.5151	91.8155	89.7126	92.0444	94.6004	98.5727	103.1646	106.8788	(42a)

Hot water usage for baths

35.4508	34.9243	34.1829	32.8158	31.7922	30.6572	30.0441	30.7803	31.5819	32.7965	34.1917	35.3309	(42b)

Hot water usage for other uses

49.9960	48.1780	46.3600	44.5419	42.7239	40.9058	40.9058	42.7239	44.5419	46.3600	48.1780	49.9960	(42c)

Average daily hot water use (litres/day)		177.2371 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	192.7367	188.7798	183.8708	176.1904	170.0312	163.3785	160.6626	165.5486	170.7243	177.7291	185.5343	192.2058	(44)
Energy conte	305.2478	268.8199	282.6026	241.1958	228.8947	200.8930	194.3075	204.9837	210.5201	241.1767	264.3276	300.9478	(45)
Energy content (annual)										Total = Sum(45)m =		2943.9172	
Distribution loss (46)m = 0.15 x (45)m	45.7872	40.3230	42.3904	36.1794	34.3342	30.1339	29.1461	30.7476	31.5780	36.1765	39.6491	45.1422	(46)

Water storage loss:		
Store volume		300.0000 (47)
b) If manufacturer declared loss factor is not known :		
Hot water storage loss factor from Table 2 (kWh/litre/day)		0.1425 (51)
Volume factor from Table 2a		0.7368 (52)
Temperature factor from Table 2b		0.7800 (53)
Enter (49) or (54) in (55)		24.5688 (55)

Total storage loss

761.6330	687.9266	761.6330	737.0642	761.6330	737.0642	761.6330	761.6330	737.0642	761.6330	737.0642	761.6330	(56)

If cylinder contains dedicated solar storage

761.6330	687.9266	761.6330	737.0642	761.6330	737.0642	761.6330	761.6330	737.0642	761.6330	737.0642	761.6330	(57)
Primary loss 128.3772	115.9536	128.3772	124.2360	128.3772	41.9160	43.3132	43.3132	41.9160	128.3772	124.2360	128.3772	(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													
	1195.2580	1072.7001	1172.6128	1102.4960	1118.9049	979.8732	999.2537	1009.9299	989.5003	1131.1869	1125.6278	1190.9580	(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													
	1195.2580	1072.7001	1172.6128	1102.4960	1118.9049	979.8732	999.2537	1009.9299	989.5003	1131.1869	1125.6278	1190.9580	(64)
										Total per year (kWh/year) = Sum(64)m =		13088.3014	(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													
	204.1967	182.1455	196.6671	179.5864	178.8093	100.3297	99.2578	102.8077	103.5307	182.8930	187.2777	202.7669	(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	192.5568	192.5568	192.5568	192.5568	192.5568	192.5568	192.5568	192.5568	192.5568	192.5568	192.5568	192.5568	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	73.3237	65.1255	52.9636	40.0969	29.9729	25.3044	27.3423	35.5405	47.7024	60.5691	70.6931	75.3616	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	753.4903	761.3092	741.6059	699.6599	646.7106	596.9457	563.6997	555.8809	575.5842	617.5302	670.4795	720.2443	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	57.4650	57.4650	57.4650	57.4650	57.4650	57.4650	57.4650	57.4650	57.4650	57.4650	57.4650	57.4650	(69)
Pumps, fans	10.0000	10.0000	10.0000	10.0000	10.0000	0.0000	0.0000	0.0000	0.0000	10.0000	10.0000	10.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-128.3712	-128.3712	-128.3712	-128.3712	-128.3712	-128.3712	-128.3712	-128.3712	-128.3712	-128.3712	-128.3712	-128.3712	(71)
Water heating gains (Table 5)													
	274.4579	271.0499	264.3375	249.4256	240.3350	139.3468	133.4110	138.1823	143.7927	245.8239	260.1079	272.5362	(72)
Total internal gains													
	1232.9225	1229.1351	1190.5576	1120.8329	1048.6690	883.2475	846.1036	851.2542	888.7298	1055.5738	1132.9311	1199.7927	(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	
North	2.3000	11.9814	0.8500	0.7000	0.7700	11.3628	(74)
Northeast	1.9800	12.9236	0.8500	0.7000	0.7700	10.5511	(75)
Southeast	19.2200	40.4699	0.8500	0.7000	0.7700	320.7273	(77)
Southwest	0.8300	40.4699	0.8500	0.7000	0.7700	13.8503	(79)
West	2.4000	22.3313	0.8500	0.7000	0.7700	22.0992	(80)
Northwest	24.3800	12.9236	0.8500	0.7000	0.7700	129.9170	(81)
Southeast	2.8500	44.7612	0.8500	0.7000	1.0000	68.3134	(82)

Solar gains	576.8211	943.0138	1423.1904	2063.0624	2460.9714	2710.3748	2545.6477	2226.0213	1758.6152	1156.7492	720.1728	481.0609	(83)
Total gains	1809.7436	2172.1489	2613.7480	3183.8952	3509.6404	3593.6223	3391.7513	3077.2756	2647.3449	2212.3230	1853.1039	1680.8535	(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	16.6006	16.6830	16.6830	16.8005	16.8005	16.9452	16.9104	16.9792	16.9452	16.8746	16.8746	16.7622	
alpha	2.1067	2.1122	2.1122	2.1200	2.1200	2.1297	2.1274	2.1319	2.1297	2.1250	2.1250	2.1175	
util living area													
	0.9960	0.9938	0.9886	0.9752	0.9457	0.8758	0.7750	0.8097	0.9416	0.9830	0.9937	0.9966	(86)
MIT	16.7535	16.9786	17.5790	18.4132	19.3445	20.1815	20.6224	20.5702	19.8258	18.7285	17.6328	16.7532	(87)
Th 2	18.2750	18.2813	18.2813	18.2903	18.2903	18.3014	18.2987	18.3040	18.3014	18.2960	18.2960	18.2874	(88)
util rest of house													
	0.9941	0.9909	0.9823	0.9582	0.8910	0.6605	0.1701	0.2319	0.8393	0.9676	0.9900	0.9950	(89)
MIT 2	14.8150	15.0420	15.6405	16.4710	17.3757	18.1041	18.2965	18.2987	17.8460	16.7924	15.7020	14.8198	(90)
Living area fraction										fLA = Living area / (4) =		0.0577	(91)
MIT	14.9269	15.1538	15.7525	16.5831	17.4894	18.2241	18.4308	18.4299	17.9604	16.9042	15.8135	14.9314	(92)
Temperature adjustment												0.0000	
adjusted MIT	14.9269	15.1538	15.7525	16.5831	17.4894	18.2241	18.4308	18.4299	17.9604	16.9042	15.8135	14.9314	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9895	0.9841	0.9708	0.9373	0.8596	0.6486	0.2231	0.2843	0.8107	0.9503	0.9828	0.9909	(94)
Useful gains	1790.6811	2137.6316	2537.3221	2984.1936	3017.0562	2330.7049	756.6374	874.8933	2146.2513	2102.4388	1821.1893	1665.6319	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W													
	14778.5406	14296.8071	12499.0723	9930.9907	6671.1797	3276.6806	783.6005	926.1329	4066.8136	7847.3900	11559.7172	14642.7067	(97)
Space heating kWh													
	9662.9674	8170.9659	7411.5421	5001.6940	2718.6679	0.0000	0.0000	0.0000	0.0000	4274.2437	7011.7401	9654.9436	(98a)
Space heating requirement - total per year (kWh/year)												53906.7648	
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													
	9662.9674	8170.9659	7411.5421	5001.6940	2718.6679	0.0000	0.0000	0.0000	0.0000	4274.2437	7011.7401	9654.9436	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												53906.7648	
Space heating per m2											(98c) / (4) =	149.9493	(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 %)												75.0000	(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													
	9662.9674	8170.9659	7411.5421	5001.6940	2718.6679	0.0000	0.0000	0.0000	0.0000	4274.2437	7011.7401	9654.9436	(98)
Space heating efficiency (main heating system 1)													
	75.0000	75.0000	75.0000	75.0000	75.0000	0.0000	0.0000	0.0000	0.0000	75.0000	75.0000	75.0000	(210)
Space heating fuel (main heating system)													
	12883.9566	10894.6212	9882.0562	6668.9253	3624.8905	0.0000	0.0000	0.0000	0.0000	5698.9916	9348.9868	12873.2582	(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													
	1195.2580	1072.7001	1172.6128	1102.4960	1118.9049	979.8732	999.2537	1009.9299	989.5003	1131.1869	1125.6278	1190.9580	(64)
Efficiency of water heater												70.0000	(216)
(217)m	73.7614	73.6954	73.4687	72.9878	71.8011	65.0000	65.0000	65.0000	65.0000	72.6778	73.4497	73.7644	(217)
Fuel for water heating, kWh/month													
	1620.4375	1455.5867	1596.0709	1510.5215	1558.3403	1507.4972	1537.3133	1553.7383	1522.3081	1556.4411	1532.5143	1614.5421	(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	14.0137	12.6575	14.0137	13.5616	14.0137	13.5616	14.0137	14.0137	13.5616	14.0137	13.5616	14.0137	(231)
Lighting	64.1798	51.4874	46.3587	33.9644	26.2351	21.4343	23.9325	31.1084	40.4067	53.0158	59.8812	65.9636	(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												71875.6864	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												70.0000	
Water heating fuel used												18565.3113	(219)
Space cooling fuel												0.0000	(221)
Electricity for pumps and fans:													
central heating pump												165.0000	(230c)
Total electricity for the above, kWh/year												165.0000	(231)
Electricity for lighting (calculated in Appendix L)												517.9680	(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												91123.9657	(238)

10a. Fuel costs - using BEDF prices (533)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	71875.6864	4.8000	3450.0329	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	18565.3113	4.8000	891.1349	(247)
Energy for instantaneous electric shower(s)	0.0000	21.5100	0.0000	(247a)
Pumps, fans and electric keep-hot	165.0000	21.5100	35.4915	(249)
Energy for lighting	517.9680	21.5100	111.4149	(250)
Additional standing charges			98.0000	(251)
Total energy cost			4586.0743	(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	71875.6864	0.2100	15093.8941	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	18565.3113	0.2100	3898.7154	(264)
Space and water heating			18992.6095	(265)
Pumps, fans and electric keep-hot	165.0000	0.1387	22.8875	(267)
Energy for lighting	517.9680	0.1443	74.7588	(268)
Total CO2, kg/year			19090.2558	(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	71875.6864	1.1300	81219.5256	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	18565.3113	1.1300	20978.8018	(278)
Space and water heating			102198.3274	(279)

Pumps, fans and electric keep-hot	165.0000	1.5128	249.6120 (281)
Energy for lighting	517.9680	1.5338	794.4766 (282)
Total Primary energy kWh/year			103242.4160 (286)

SAP 10 EPC IMPROVEMENTS

00001

Current energy efficiency rating: E 45
Current environmental impact rating: F 37

N Solar water heating — Cancelled by user
U Solar photovoltaic panels — Cancelled by user
V2 Wind turbine — Not applicable

Recommended measures:	SAP change	Cost change	CO2 change
(none)			

Recommended measures	Typical annual savings		Energy efficiency	Environmental impact
(none)				
Total Savings	£0	0.00 kg/m²		

Potential energy efficiency rating: E 45
Potential environmental impact rating: F 37

Fuel prices for cost data on this page from database revision number 533 TEST (30 Nov 2023)
Recommendation texts revision number 6.1 (11 Jun 2019)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£147	£147	£0
Mains gas	£4439	£4439	£0
Space heating	£3584	£3584	£0
Water heating	£891	£891	£0
Lighting	£111	£111	£0
Total cost of fuels	£4586	£4586	£0
Total cost of uses	£4586	£4586	£0
Delivered energy	253 kWh/m²	253 kWh/m²	0 kWh/m²
Carbon dioxide emissions	19 tonnes	19 tonnes	0.0 tonnes
CO2 emissions per m²	53 kg/m²	53 kg/m²	0 kg/m²
Primary energy	287 kWh/m²	287 kWh/m²	0 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)	
Basement floor	73.1000	(1a)	x 2.0000	(2a) =	146.2000	(1a) - (3a)
Ground floor	78.3000	(1b)	x 3.0000	(2b) =	234.9000	(1b) - (3b)
First floor	75.0000	(1c)	x 3.0000	(2c) =	225.0000	(1c) - (3c)
Second floor	70.9000	(1d)	x 3.0000	(2d) =	212.7000	(1d) - (3d)
Third floor	62.2000	(1e)	x 2.0000	(2e) =	124.4000	(1e) - (3e)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	359.5000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		943.2000	(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	5 * 10 =	50.0000	(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) =	50.0000 / (5) =	0.0530	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		15.0000	(17)
Infiltration rate		0.8030	(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) =	0.6826	(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													
	0.8703	0.8532	0.8361	0.7508	0.7338	0.6484	0.6484	0.6314	0.6826	0.7338	0.7679	0.8020	(22b)
Effective ac	0.8787	0.8640	0.8496	0.7819	0.7692	0.7102	0.7102	0.6993	0.7329	0.7692	0.7948	0.8216	(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 = 4.80)			51.1100	4.0268	205.8121			(27)
External Door			7.2700	3.0000	21.8100			(26)
T W8			0.9500	4.2359	4.0241			(27a)
T W9			0.9500	4.2359	4.0241			(27a)
T W10			0.9500	4.2359	4.0241			(27a)
Basement Floor			73.1000	1.2000	87.7200			(28a)
Ground Floor			4.4000	1.2000	5.2800			(28a)
External Wall	355.2000	58.3800	296.8200	2.1000	623.3220			(29a)
Main Roof	62.2000	2.8500	59.3500	2.3000	136.5050			(30)
Exposed Ceiling	16.7000		16.7000	2.3000	38.4100			(30)
Total net area of external elements Aum(A, m2)			511.6000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	1130.9313			(33)

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

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	37.7400	1.0000	37.7400
E3 Sill	34.2800	0.1000	3.4280
E4 Jamb	136.6000	0.1000	13.6600
E5 Ground floor (normal)	60.8000	0.3200	19.4560
E20 Exposed floor (normal)	3.1800	0.3200	1.0176
E22 Basement floor	36.0000	0.2200	7.9200
E6 Intermediate floor within a dwelling	111.8500	0.1400	15.6590
E11 Eaves (insulation at rafter level)	26.3300	0.1500	3.9495
E15 Flat roof with parapet	23.0500	0.3000	6.9150
E16 Corner (normal)	38.8000	0.1800	6.9840
E17 Corner (inverted - internal area greater than external area)	25.8000	0.0000	0.0000
E18 Party wall between dwellings	39.8000	0.2400	9.5520
E25 Staggered party wall between dwellings	11.8000	0.2400	2.8320
P1 Party wall - Ground floor	14.6000	0.3200	4.6720
P2 Party wall - Intermediate floor within a dwelling	65.9000	0.0000	0.0000
P4 Party wall - Roof (insulation at ceiling level)	7.5000	0.4800	3.6000

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 137.3851 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 1268.3164 (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	273.4941	268.9172	264.4310	243.3592	239.4167	221.0639	221.0639	217.6652	228.1331	239.4167	247.3923	255.7304	(38)
Heat transfer coeff	1541.8106	1537.2337	1532.7474	1511.6756	1507.7332	1489.3803	1489.3803	1485.9816	1496.4495	1507.7332	1515.7087	1524.0468	(39)
Average = Sum(39)m / 12 =												1511.6567	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	4.2888	4.2760	4.2636	4.2049	4.1940	4.1429	4.1429	4.1335	4.1626	4.1940	4.2162	4.2394	(40)
HLP (average)												4.2049	
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 3.2093 (42)

Hot water usage for mixer showers

107.2899	105.6775	103.3280	98.8326	95.5151	91.8155	89.7126	92.0444	94.6004	98.5727	103.1646	106.8788	(42a)

Hot water usage for baths

35.4508	34.9243	34.1829	32.8158	31.7922	30.6572	30.0441	30.7803	31.5819	32.7965	34.1917	35.3309	(42b)

Hot water usage for other uses

49.9960	48.1780	46.3600	44.5419	42.7239	40.9058	40.9058	42.7239	44.5419	46.3600	48.1780	49.9960	(42c)

Average daily hot water use (litres/day) 177.2371 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	192.7367	188.7798	183.8708	176.1904	170.0312	163.3785	160.6626	165.5486	170.7243	177.7291	185.5343	192.2058	(44)
Energy conte	305.2478	268.8199	282.6026	241.1958	228.8947	200.8930	194.3075	204.9837	210.5201	241.1767	264.3276	300.9478	(45)
Energy content (annual)										Total = Sum(45)m =		2943.9172	
Distribution loss (46)m = 0.15 x (45)m	45.7872	40.3230	42.3904	36.1794	34.3342	30.1339	29.1461	30.7476	31.5780	36.1765	39.6491	45.1422	(46)

Water storage loss:

Store volume 300.0000 (47)

b) If manufacturer declared loss factor is not known :

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.1425 (51)

Volume factor from Table 2a 0.7368 (52)

Temperature factor from Table 2b 0.7800 (53)

Enter (49) or (54) in (55) 24.5688 (55)

Total storage loss

761.6330	687.9266	761.6330	737.0642	761.6330	737.0642	761.6330	761.6330	737.0642	761.6330	737.0642	761.6330	(56)

If cylinder contains dedicated solar storage

761.6330	687.9266	761.6330	737.0642	761.6330	737.0642	761.6330	761.6330	737.0642	761.6330	737.0642	761.6330	(57)
128.3772	115.9536	128.3772	124.2360	128.3772	41.9160	43.3132	43.3132	41.9160	128.3772	124.2360	128.3772	(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)

Total heat required for water heating calculated for each month

1195.2580	1072.7001	1172.6128	1102.4960	1118.9049	979.8732	999.2537	1009.9299	989.5003	1131.1869	1125.6278	1190.9580	(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)

Output from w/h

1195.2580	1072.7001	1172.6128	1102.4960	1118.9049	979.8732	999.2537	1009.9299	989.5003	1131.1869	1125.6278	1190.9580	(64)

Total per year (kWh/year) = Sum(64)m = 13088.3014 (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

204.1967	182.1455	196.6671	179.5864	178.8093	100.3297	99.2578	102.8077	103.5307	182.8930	187.2777	202.7669	(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	192.5568	192.5568	192.5568	192.5568	192.5568	192.5568	192.5568	192.5568	192.5568	192.5568	192.5568	192.5568	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	73.3237	65.1255	52.9636	40.0969	29.9729	25.3044	27.3423	35.5405	47.7024	60.5691	70.6931	75.3616	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	753.4903	761.3092	741.6059	699.6599	646.7106	596.9457	563.6997	555.8809	575.5842	617.5302	670.4795	720.2443	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	57.4650	57.4650	57.4650	57.4650	57.4650	57.4650	57.4650	57.4650	57.4650	57.4650	57.4650	57.4650	(69)
Pumps, fans	10.0000	10.0000	10.0000	10.0000	10.0000	0.0000	0.0000	0.0000	0.0000	10.0000	10.0000	10.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-128.3712	-128.3712	-128.3712	-128.3712	-128.3712	-128.3712	-128.3712	-128.3712	-128.3712	-128.3712	-128.3712	-128.3712	(71)
Water heating gains (Table 5)													
	274.4579	271.0499	264.3375	249.4256	240.3350	139.3468	133.4110	138.1823	143.7927	245.8239	260.1079	272.5362	(72)
Total internal gains													
	1232.9225	1229.1351	1190.5576	1120.8329	1048.6690	883.2475	846.1036	851.2542	888.7298	1055.5738	1132.9311	1199.7927	(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	
North	2.3000	10.6334	0.8500	0.7000	0.7700	10.0844	(74)
Northeast	1.9800	11.2829	0.8500	0.7000	0.7700	9.2117	(75)
Southeast	19.2200	36.7938	0.8500	0.7000	0.7700	291.5940	(77)
Southwest	0.8300	36.7938	0.8500	0.7000	0.7700	12.5922	(79)
West	2.4000	19.6403	0.8500	0.7000	0.7700	19.4361	(80)
Northwest	24.3800	11.2829	0.8500	0.7000	0.7700	113.4243	(81)
Southeast	2.8500	39.9751	0.8500	0.7000	1.0000	61.0091	(82)

Solar gains	517.3518	937.2117	1425.1612	1995.7036	2438.2545	2508.0273	2381.7679	2039.4621	1621.4697	1074.8927	630.0025	435.9816	(83)
Total gains	1750.2743	2166.3468	2615.7188	3116.5364	3486.9235	3391.2748	3227.8714	2890.7164	2510.1995	2130.4665	1762.9335	1635.7743	(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, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	16.1922	16.2404	16.2879	16.5150	16.5582	16.7622	16.7622	16.8005	16.6830	16.5582	16.4710	16.3809	
alpha	2.0795	2.0827	2.0859	2.1010	2.1039	2.1175	2.1175	2.1200	2.1122	2.1039	2.0981	2.0921	
util living area													
	0.9965	0.9943	0.9898	0.9798	0.9592	0.9248	0.8727	0.9001	0.9614	0.9870	0.9950	0.9970	(86)
MIT	16.4459	16.7068	17.2638	18.0807	18.9518	19.7657	20.2790	20.1821	19.4766	18.3954	17.3046	16.4256	(87)
Th 2	18.2440	18.2477	18.2513	18.2685	18.2718	18.2874	18.2874	18.2903	18.2813	18.2718	18.2652	18.2583	(88)
util rest of house													
	0.9950	0.9917	0.9847	0.9673	0.9251	0.8227	0.5913	0.6697	0.9076	0.9767	0.9922	0.9957	(89)
MIT 2	14.4956	14.7573	15.3141	16.1328	16.9898	17.7660	18.1707	18.1216	17.5153	16.4521	15.3619	14.4808	(90)
Living area fraction									fLA = Living area / (4) =			0.0577	(91)
MIT	14.6082	14.8699	15.4267	16.2453	17.1031	17.8815	18.2925	18.2406	17.6285	16.5643	15.4741	14.5931	(92)
Temperature adjustment												0.0000	
adjusted MIT	14.6082	14.8699	15.4267	16.2453	17.1031	17.8815	18.2925	18.2406	17.6285	16.5643	15.4741	14.5931	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9909	0.9854	0.9742	0.9492	0.8966	0.7923	0.5923	0.6605	0.8790	0.9627	0.9863	0.9922	(94)
Useful gains	1734.4051	2134.6571	2548.2278	2958.1194	3126.4785	2687.0665	1911.9801	1909.3545	2206.3843	2050.9849	1738.7489	1623.0699	(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													
	15893.3449	15326.0716	13682.4152	11103.7490	8146.4876	4887.3617	2520.7035	2735.1466	5280.2675	8992.5614	12692.7068	15839.6324	(97)
Space heating kWh													
	10534.2512	8864.6306	8283.8354	5864.8533	3734.8868	0.0000	0.0000	0.0000	0.0000	5164.5329	7886.8497	10577.1225	(98a)
Space heating requirement - total per year (kWh/year)												60910.9625	
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													
	10534.2512	8864.6306	8283.8354	5864.8533	3734.8868	0.0000	0.0000	0.0000	0.0000	5164.5329	7886.8497	10577.1225	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												60910.9625	
Space heating per m2											(98c) / (4) =	169.4324	(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 %)	75.0000	(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													
	10534.2512	8864.6306	8283.8354	5864.8533	3734.8868	0.0000	0.0000	0.0000	0.0000	5164.5329	7886.8497	10577.1225	(98)
Space heating efficiency (main heating system 1)													
	75.0000	75.0000	75.0000	75.0000	75.0000	0.0000	0.0000	0.0000	0.0000	75.0000	75.0000	75.0000	(210)
Space heating fuel (main heating system)													
	14045.6683	11819.5074	11045.1139	7819.8044	4979.8490	0.0000	0.0000	0.0000	0.0000	6886.0439	10515.7996	14102.8300	(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												
	1195.2580	1072.7001	1172.6128	1102.4960	1118.9049	979.8732	999.2537	1009.9299	989.5003	1131.1869	1125.6278	1190.9580 (64)
Efficiency of water heater												70.0000 (216)
(217)m	73.8521	73.7851	73.6075	73.2315	72.4495	65.0000	65.0000	65.0000	65.0000	72.9980	73.5976	73.8599 (217)
Fuel for water heating, kWh/month												
	1618.4478	1453.8174	1593.0614	1505.4932	1544.3937	1507.4972	1537.3133	1553.7383	1522.3081	1549.6145	1529.4347	1612.4558 (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	14.0137	12.6575	14.0137	13.5616	14.0137	13.5616	14.0137	14.0137	13.5616	14.0137	13.5616	14.0137 (231)
Lighting	64.1798	51.4874	46.3587	33.9644	26.2351	21.4343	23.9325	31.1084	40.4067	53.0158	59.8812	65.9636 (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	81214.6166 (211)
Space heating fuel - main system 2	0.0000 (213)
Space heating fuel - secondary	0.0000 (215)
Efficiency of water heater	70.0000
Water heating fuel used	18527.5756 (219)
Space cooling fuel	0.0000 (221)
Electricity for pumps and fans:	
central heating pump	165.0000 (230c)
Total electricity for the above, kWh/year	165.0000 (231)
Electricity for lighting (calculated in Appendix L)	517.9680 (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	100425.1602 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	81214.6166	3.6400	2956.2120	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	18527.5756	3.6400	674.4038	(247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000	(247a)
Pumps, fans and electric keep-hot	165.0000	16.4900	27.2085	(249)
Energy for lighting	517.9680	16.4900	85.4129	(250)
Additional standing charges			92.0000	(251)
Total energy cost			3835.2372	(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] =	3.4133	(257)
SAP value		44.6702	
SAP rating (Section 12)		45	(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	81214.6166	0.2100	17055.0695	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	18527.5756	0.2100	3890.7909	(264)
Space and water heating			20945.8604	(265)
Pumps, fans and electric keep-hot	165.0000	0.1387	22.8875	(267)
Energy for lighting	517.9680	0.1443	74.7588	(268)
Total CO2, kg/year			21043.5067	(272)
CO2 emissions per m2			58.5400	(273)
EI value			36.9610	
EI rating			37	(274)
EI band			F	

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

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Basement floor	73.1000	(1a)	x 2.0000	(2a) =	146.2000	(1a) - (3a)
Ground floor	78.3000	(1b)	x 3.0000	(2b) =	234.9000	(1b) - (3b)
First floor	75.0000	(1c)	x 3.0000	(2c) =	225.0000	(1c) - (3c)
Second floor	70.9000	(1d)	x 3.0000	(2d) =	212.7000	(1d) - (3d)
Third floor	62.2000	(1e)	x 2.0000	(2e) =	124.4000	(1e) - (3e)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	359.5000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		943.2000	(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	5 * 10 =	50.0000	(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) =	50.0000 / (5) =	0.0530	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		15.0000	(17)
Infiltration rate		0.8030	(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) =	0.6826	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.7167	0.6826	0.6826	0.6314	0.6314	0.5631	0.5802	0.5460	0.5631	0.5972	0.5972	0.6484	(22b)
Effective ac	0.7568	0.7329	0.7329	0.6993	0.6993	0.6585	0.6683	0.6491	0.6585	0.6783	0.6783	0.7102	(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 = 4.80)			51.1100	4.0268	205.8121			(27)
External Door			7.2700	3.0000	21.8100			(26)
T W8			0.9500	4.2359	4.0241			(27a)
T W9			0.9500	4.2359	4.0241			(27a)
T W10			0.9500	4.2359	4.0241			(27a)
Basement Floor			73.1000	1.2000	87.7200			(28a)
Ground Floor			4.4000	1.2000	5.2800			(28a)
External Wall	355.2000	58.3800	296.8200	2.1000	623.3220			(29a)
Main Roof	62.2000	2.8500	59.3500	2.3000	136.5050			(30)
Exposed Ceiling	16.7000		16.7000	2.3000	38.4100			(30)
Total net area of external elements Aum(A, m2)			511.6000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	1130.9313			(33)

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

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	37.7400	1.0000	37.7400
E3 Sill	34.2800	0.1000	3.4280
E4 Jamb	136.6000	0.1000	13.6600
E5 Ground floor (normal)	60.8000	0.3200	19.4560
E20 Exposed floor (normal)	3.1800	0.3200	1.0176
E22 Basement floor	36.0000	0.2200	7.9200
E6 Intermediate floor within a dwelling	111.8500	0.1400	15.6590
E11 Eaves (insulation at rafter level)	26.3300	0.1500	3.9495
E15 Flat roof with parapet	23.0500	0.3000	6.9150
E16 Corner (normal)	38.8000	0.1800	6.9840
E17 Corner (inverted - internal area greater than external area)	25.8000	0.0000	0.0000
E18 Party wall between dwellings	39.8000	0.2400	9.5520
E25 Staggered party wall between dwellings	11.8000	0.2400	2.8320
P1 Party wall - Ground floor	14.6000	0.3200	4.6720
P2 Party wall - Intermediate floor within a dwelling	65.9000	0.0000	0.0000
P4 Party wall - Roof (insulation at ceiling level)	7.5000	0.4800	3.6000

Thermal bridges (Sum(L x Psi) calculated using Appendix K): 137.3851 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 1268.3164 (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	235.5649	228.1331	228.1331	217.6652	217.6652	204.9768	208.0129	202.0313	204.9768	211.1397	211.1397	221.0639	(38)
Heat transfer coeff	1503.8813	1496.4495	1496.4495	1485.9816	1485.9816	1473.2932	1476.3294	1470.3477	1473.2932	1479.4562	1479.4562	1489.3803	(39)

Average = Sum(39)m / 12 = 1484.1917

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	4.1833	4.1626	4.1626	4.1335	4.1335	4.0982	4.1066	4.0900	4.0982	4.1153	4.1153	4.1429	(40)
HLP (average)												4.1285	
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												3.2093	(42)
Hot water usage for mixer showers													
	107.2899	105.6775	103.3280	98.8326	95.5151	91.8155	89.7126	92.0444	94.6004	98.5727	103.1646	106.8788	(42a)
Hot water usage for baths													
	35.4508	34.9243	34.1829	32.8158	31.7922	30.6572	30.0441	30.7803	31.5819	32.7965	34.1917	35.3309	(42b)
Hot water usage for other uses													
	49.9960	48.1780	46.3600	44.5419	42.7239	40.9058	40.9058	42.7239	44.5419	46.3600	48.1780	49.9960	(42c)
Average daily hot water use (litres/day)												177.2371	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	192.7367	188.7798	183.8708	176.1904	170.0312	163.3785	160.6626	165.5486	170.7243	177.7291	185.5343	192.2058	(44)
Energy conte	305.2478	268.8199	282.6026	241.1958	228.8947	200.8930	194.3075	204.9837	210.5201	241.1767	264.3276	300.9478	(45)
Energy content (annual)										Total = Sum(45)m =		2943.9172	
Distribution loss (46)m = 0.15 x (45)m													
	45.7872	40.3230	42.3904	36.1794	34.3342	30.1339	29.1461	30.7476	31.5780	36.1765	39.6491	45.1422	(46)
Water storage loss:													
Store volume												300.0000	(47)
b) If manufacturer declared loss factor is not known :													
Hot water storage loss factor from Table 2 (kWh/litre/day)												0.1425	(51)
Volume factor from Table 2a												0.7368	(52)
Temperature factor from Table 2b												0.7800	(53)
Enter (49) or (54) in (55)												24.5688	(55)
Total storage loss													
	761.6330	687.9266	761.6330	737.0642	761.6330	737.0642	761.6330	761.6330	737.0642	761.6330	737.0642	761.6330	(56)
If cylinder contains dedicated solar storage													
	761.6330	687.9266	761.6330	737.0642	761.6330	737.0642	761.6330	761.6330	737.0642	761.6330	737.0642	761.6330	(57)
Primary loss	128.3772	115.9536	128.3772	124.2360	128.3772	41.9160	43.3132	43.3132	41.9160	128.3772	124.2360	128.3772	(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													
	1195.2580	1072.7001	1172.6128	1102.4960	1118.9049	979.8732	999.2537	1009.9299	989.5003	1131.1869	1125.6278	1190.9580	(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													
	1195.2580	1072.7001	1172.6128	1102.4960	1118.9049	979.8732	999.2537	1009.9299	989.5003	1131.1869	1125.6278	1190.9580	(64)
										Total per year (kWh/year) = Sum(64)m =		13088.3014	(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													
	204.1967	182.1455	196.6671	179.5864	178.8093	100.3297	99.2578	102.8077	103.5307	182.8930	187.2777	202.7669	(65)

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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	192.5568	192.5568	192.5568	192.5568	192.5568	192.5568	192.5568	192.5568	192.5568	192.5568	192.5568	192.5568	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	73.3237	65.1255	52.9636	40.0969	29.9729	25.3044	27.3423	35.5405	47.7024	60.5691	70.6931	75.3616	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	753.4903	761.3092	741.6059	699.6599	646.7106	596.9457	563.6997	555.8809	575.5842	617.5302	670.4795	720.2443	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	57.4650	57.4650	57.4650	57.4650	57.4650	57.4650	57.4650	57.4650	57.4650	57.4650	57.4650	57.4650	(69)
Pumps, fans	10.0000	10.0000	10.0000	10.0000	10.0000	0.0000	0.0000	0.0000	0.0000	10.0000	10.0000	10.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-128.3712	-128.3712	-128.3712	-128.3712	-128.3712	-128.3712	-128.3712	-128.3712	-128.3712	-128.3712	-128.3712	-128.3712	(71)
Water heating gains (Table 5)													
	274.4579	271.0499	264.3375	249.4256	240.3350	139.3468	133.4110	138.1823	143.7927	245.8239	260.1079	272.5362	(72)
Total internal gains													
	1232.9225	1229.1351	1190.5576	1120.8329	1048.6690	883.2475	846.1036	851.2542	888.7298	1055.5738	1132.9311	1199.7927	(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	
North	2.3000	11.9814	0.8500	0.7000	0.7700	11.3628	(74)
Northeast	1.9800	12.9236	0.8500	0.7000	0.7700	10.5511	(75)
Southeast	19.2200	40.4699	0.8500	0.7000	0.7700	320.7273	(77)
Southwest	0.8300	40.4699	0.8500	0.7000	0.7700	13.8503	(79)
West	2.4000	22.3313	0.8500	0.7000	0.7700	22.0992	(80)
Northwest	24.3800	12.9236	0.8500	0.7000	0.7700	129.9170	(81)
Southeast	2.8500	44.7612	0.8500	0.7000	1.0000	68.3134	(82)

Solar gains	576.8211	943.0138	1423.1904	2063.0624	2460.9714	2710.3748	2545.6477	2226.0213	1758.6152	1156.7492	720.1728	481.0609	(83)
Total gains	1809.7436	2172.1489	2613.7480	3183.8952	3509.6404	3593.6223	3391.7513	3077.2756	2647.3449	2212.3230	1853.1039	1680.8535	(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	16.6006	16.6830	16.6830	16.8005	16.8005	16.9452	16.9104	16.9792	16.9452	16.8746	16.8746	16.7622	
alpha	2.1067	2.1122	2.1122	2.1200	2.1200	2.1297	2.1274	2.1319	2.1297	2.1250	2.1250	2.1175	
util living area													
	0.9960	0.9938	0.9886	0.9752	0.9457	0.8758	0.7750	0.8097	0.9416	0.9830	0.9937	0.9966	(86)
MIT	16.7535	16.9786	17.5790	18.4132	19.3445	20.1815	20.6224	20.5702	19.8258	18.7285	17.6328	16.7532	(87)
Th 2	18.2750	18.2813	18.2813	18.2903	18.2903	18.3014	18.2987	18.3040	18.3014	18.2960	18.2960	18.2874	(88)
util rest of house													
	0.9941	0.9909	0.9823	0.9582	0.8910	0.6605	0.1701	0.2319	0.8393	0.9676	0.9900	0.9950	(89)
MIT 2	14.8150	15.0420	15.6405	16.4710	17.3757	18.1041	18.2965	18.2987	17.8460	16.7924	15.7020	14.8198	(90)
Living area fraction										fLA = Living area / (4) =		0.0577	(91)
MIT	14.9269	15.1538	15.7525	16.5831	17.4894	18.2241	18.4308	18.4299	17.9604	16.9042	15.8135	14.9314	(92)
Temperature adjustment												0.0000	

adjusted MIT	14.9269	15.1538	15.7525	16.5831	17.4894	18.2241	18.4308	18.4299	17.9604	16.9042	15.8135	14.9314	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9895	0.9841	0.9708	0.9373	0.8596	0.6486	0.2231	0.2843	0.8107	0.9503	0.9828	0.9909	(94)
Useful gains	1790.6811	2137.6316	2537.3221	2984.1936	3017.0562	2330.7049	756.6374	874.8933	2146.2513	2102.4388	1821.1893	1665.6319	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	14778.5406	14296.8071	12499.0723	9930.9907	6671.1797	3276.6806	783.6005	926.1329	4066.8136	7847.3900	11559.7172	14642.7067	(97)
Space heating kWh	9662.9674	8170.9659	7411.5421	5001.6940	2718.6679	0.0000	0.0000	0.0000	0.0000	4274.2437	7011.7401	9654.9436	(98a)
Space heating requirement - total per year (kWh/year)												53906.7648	
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	9662.9674	8170.9659	7411.5421	5001.6940	2718.6679	0.0000	0.0000	0.0000	0.0000	4274.2437	7011.7401	9654.9436	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												53906.7648	
Space heating per m2											(98c) / (4) =	149.9493	(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 %)												75.0000	(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	9662.9674	8170.9659	7411.5421	5001.6940	2718.6679	0.0000	0.0000	0.0000	0.0000	4274.2437	7011.7401	9654.9436	(98)
Space heating efficiency (main heating system 1)	75.0000	75.0000	75.0000	75.0000	75.0000	0.0000	0.0000	0.0000	0.0000	75.0000	75.0000	75.0000	(210)
Space heating fuel (main heating system)	12883.9566	10894.6212	9882.0562	6668.9253	3624.8905	0.0000	0.0000	0.0000	0.0000	5698.9916	9348.9868	12873.2582	(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	1195.2580	1072.7001	1172.6128	1102.4960	1118.9049	979.8732	999.2537	1009.9299	989.5003	1131.1869	1125.6278	1190.9580	(64)
Efficiency of water heater												70.0000	(216)
(217)m	73.7614	73.6954	73.4687	72.9878	71.8011	65.0000	65.0000	65.0000	65.0000	72.6778	73.4497	73.7644	(217)
Fuel for water heating, kWh/month	1620.4375	1455.5867	1596.0709	1510.5215	1558.3403	1507.4972	1537.3133	1553.7383	1522.3081	1556.4411	1532.5143	1614.5421	(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	14.0137	12.6575	14.0137	13.5616	14.0137	13.5616	14.0137	14.0137	13.5616	14.0137	13.5616	14.0137	(231)
Lighting	64.1798	51.4874	46.3587	33.9644	26.2351	21.4343	23.9325	31.1084	40.4067	53.0158	59.8812	65.9636	(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	71875.6864	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	70.0000	
Water heating fuel used	18565.3113	(219)
Space cooling fuel	0.0000	(221)
Electricity for pumps and fans:		
central heating pump	165.0000	(230c)
Total electricity for the above, kWh/year	165.0000	(231)
Electricity for lighting (calculated in Appendix L)	517.9680	(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	91123.9657	(238)

10a. Fuel costs - using BEDF prices (533)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	71875.6864	4.8000	3450.0329	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	18565.3113	4.8000	891.1349	(247)
Energy for instantaneous electric shower(s)	0.0000	21.5100	0.0000	(247a)
Pumps, fans and electric keep-hot	165.0000	21.5100	35.4915	(249)

Energy for lighting	517.9680	21.5100	111.4149	(250)
Additional standing charges			98.0000	(251)
Total energy cost			4586.0743	(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	71875.6864	0.2100	15093.8941	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	18565.3113	0.2100	3898.7154	(264)
Space and water heating			18992.6095	(265)
Pumps, fans and electric keep-hot	165.0000	0.1387	22.8875	(267)
Energy for lighting	517.9680	0.1443	74.7588	(268)
Total CO2, kg/year			19090.2558	(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	71875.6864	1.1300	81219.5256	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	18565.3113	1.1300	20978.8018	(278)
Space and water heating			102198.3274	(279)
Pumps, fans and electric keep-hot	165.0000	1.5128	249.6120	(281)
Energy for lighting	517.9680	1.5338	794.4766	(282)
Total Primary energy kWh/year			103242.4160	(286)

Full SAP Calculation Printout

Property Reference	9 The Green Proposed	**Issued on Date**	05/01/2024
Assessment Reference	00001_Copy	**Prop Type Ref**	
Property	9, The Green, Richmond, TW10		

SAP Rating	67 D	**DER**		**TER**	
Environmental	59 D	**% DER < TER**			N/A
CO_2 Emissions (t/year)	10.5	**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)	
Basement floor	73.1000 (1a)	x	2.0000 (2a)	=	146.2000	(1a) - (3a)
Ground floor	78.3000 (1b)	x	3.0000 (2b)	=	234.9000	(1b) - (3b)
First floor	75.0000 (1c)	x	3.0000 (2c)	=	225.0000	(1c) - (3c)
Second floor	70.9000 (1d)	x	3.0000 (2d)	=	212.7000	(1d) - (3d)
Third floor	62.2000 (1e)	x	2.0000 (2e)	=	124.4000	(1e) - (3e)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	359.5000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	943.2000	(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	5 * 10 =	50.0000	(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) =	50.0000 / (5) =	0.0530	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		10.0000	(17)
Infiltration rate		0.5530	(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) =	0.4701	(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	0.5993	0.5876	0.5758	0.5171	0.5053	0.4466	0.4466	0.4348	0.4701	0.5053	0.5288	0.5523	(22b)
Effective ac	0.6796	0.6726	0.6658	0.6337	0.6277	0.5997	0.5997	0.5945	0.6105	0.6277	0.6398	0.6525	(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 = 4.80)			51.1100	4.0268	205.8121			(27)
External Door			7.2700	3.0000	21.8100			(26)
T W8			0.9500	4.2359	4.0241			(27a)
T W9			0.9500	4.2359	4.0241			(27a)
T W10			0.9500	4.2359	4.0241			(27a)
Basement Floor			73.1000	1.2000	87.7200			(28a)
Ground Floor			4.4000	1.2000	5.2800			(28a)
External Wall	355.2000	58.3800	296.8200	1.6000	474.9120			(29a)
Main Roof	62.2000	2.8500	59.3500	0.3000	17.8050			(30)
Exposed Ceiling	16.7000		16.7000	0.3000	5.0100			(30)
Total net area of external elements Aum(A, m2)			511.6000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		830.4213			(33)

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

List of Thermal Bridges

K1	Element	Length	Psi-value	Total

E2 Other lintels (including other steel lintels)	37.7400	1.0000	37.7400	
E3 Sill	34.2800	0.1000	3.4280	
E4 Jamb	136.6000	0.1000	13.6600	
E5 Ground floor (normal)	60.8000	0.3200	19.4560	
E20 Exposed floor (normal)	3.1800	0.3200	1.0176	
E22 Basement floor	36.0000	0.2200	7.9200	
E6 Intermediate floor within a dwelling	111.8500	0.1400	15.6590	
E11 Eaves (insulation at rafter level)	26.3300	0.1200	3.1596	
E15 Flat roof with parapet	23.0500	0.2400	5.5320	
E16 Corner (normal)	38.8000	0.1800	6.9840	
E17 Corner (inverted - internal area greater than external area)	25.8000	0.0000	0.0000	
E18 Party wall between dwellings	39.8000	0.2400	9.5520	
E25 Staggered party wall between dwellings	11.8000	0.2400	2.8320	
P1 Party wall - Ground floor	14.6000	0.3200	4.6720	
P2 Party wall - Intermediate floor within a dwelling	65.9000	0.0000	0.0000	
P4 Party wall - Roof (insulation at ceiling level)	7.5000	0.4800	3.6000	

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 135.2122 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 965.6335 (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	211.5282	209.3575	207.2299	197.2362	195.3664	186.6622	186.6622	185.0503	190.0149	195.3664	199.1489	203.1034	(38)
Heat transfer coeff	1177.1618	1174.9911	1172.8634	1162.8697	1160.9999	1152.2957	1152.2957	1150.6838	1155.6485	1160.9999	1164.7825	1168.7370	(39)

Average = Sum(39)m / 12 = 1162.8607

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	3.2744	3.2684	3.2625	3.2347	3.2295	3.2053	3.2053	3.2008	3.2146	3.2295	3.2400	3.2510	(40)
HLP (average)												3.2347	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy 3.2093 (42)

Hot water usage for mixer showers

68.2754	67.2493	65.7542	62.8935	60.7823	58.4280	57.0899	58.5737	60.2002	62.7281	65.6502	68.0138	(42a)

Hot water usage for baths

33.6782	33.1781	32.4737	31.1750	30.2026	29.1243	28.5419	29.2413	30.0028	31.1566	32.4821	33.5644	(42b)

Hot water usage for other uses

47.4962	45.7691	44.0420	42.3148	40.5877	38.8606	38.8606	40.5877	42.3148	44.0420	45.7691	47.4962	(42c)

Average daily hot water use (litres/day) 137.3510 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	149.4499	146.1965	142.2699	136.3834	131.5727	126.4129	124.4923	128.4027	132.5179	137.9267	143.9014	149.0744	(44)
Energy conte	236.6920	208.1819	218.6635	186.7020	177.1221	155.4394	150.5627	158.9894	163.4079	187.1652	205.0139	233.4145	(45)
Energy content (annual)											Total = Sum(45)m =	2281.3544	
Distribution loss (46)m = 0.15 x (45)m	35.5038	31.2273	32.7995	28.0053	26.5683	23.3159	22.5844	23.8484	24.5112	28.0748	30.7521	35.0122	(46)

Water storage loss:
Store volume 300.0000 (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 0.7368 (52)
Temperature factor from Table 2b 0.5400 (53)
Enter (49) or (54) in (55) 3.9420 (55)

Total storage loss

122.2022	110.3762	122.2022	118.2602	122.2022	118.2602	122.2022	122.2022	118.2602	122.2022	118.2602	122.2022	(56)

If cylinder contains dedicated solar storage

122.2022	110.3762	122.2022	118.2602	122.2022	118.2602	122.2022	122.2022	118.2602	122.2022	118.2602	122.2022	(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

382.1567	339.5693	364.1281	327.4742	322.5867	296.2117	296.0273	304.4540	304.1801	332.6298	345.7861	378.8791	(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

382.1567	339.5693	364.1281	327.4742	322.5867	296.2117	296.0273	304.4540	304.1801	332.6298	345.7861	378.8791	(64)
										Total per year (kWh/year) = Sum(64)m =	3994.0831	(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

195.0718	174.3304	189.0773	174.6962	175.2648	164.3014	166.4338	169.2357	166.9509	178.6041	180.7849	193.9820	(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	192.5568	192.5568	192.5568	192.5568	192.5568	192.5568	192.5568	192.5568	192.5568	192.5568	192.5568	192.5568	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	57.9672	51.4859	41.8712	31.6992	23.6955	20.0047	21.6158	28.0971	37.7118	47.8838	55.8875	59.5782	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	753.4903	761.3092	741.6059	699.6599	646.7106	596.9457	563.6997	555.8809	575.5842	617.5302	670.4795	720.2443	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	57.4650	57.4650	57.4650	57.4650	57.4650	57.4650	57.4650	57.4650	57.4650	57.4650	57.4650	57.4650	(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)	-128.3712	-128.3712	-128.3712	-128.3712	-128.3712	-128.3712	-128.3712	-128.3712	-128.3712	-128.3712	-128.3712	-128.3712	(71)
Water heating gains (Table 5)	262.1933	259.4202	254.1362	242.6336	235.5710	228.1964	223.7013	227.4673	231.8762	240.0593	251.0901	260.7285	(72)
Total internal gains	1198.3013	1196.8659	1162.2638	1098.6432	1030.6276	966.7974	930.6674	933.0958	966.8228	1030.1239	1102.1076	1165.2017	(73)

6. Solar gains

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

		W/m2	or Table 6b	or Table 6c		Table 6d	
North		2.3000	10.6334	0.8500	0.7000	0.7700	10.0844 (74)
Northeast		1.9800	11.2829	0.8500	0.7000	0.7700	9.2117 (75)
Southeast		19.2200	36.7938	0.8500	0.7000	0.7700	291.5940 (77)
Southwest		0.8300	36.7938	0.8500	0.7000	0.7700	12.5922 (79)
West		2.4000	19.6403	0.8500	0.7000	0.7700	19.4361 (80)
Northwest		24.3800	11.2829	0.8500	0.7000	0.7700	113.4243 (81)
Southeast		2.8500	39.9751	0.8500	0.7000	1.0000	61.0091 (82)

Solar gains	517.3518	937.2117	1425.1612	1995.7036	2438.2545	2508.0273	2381.7679	2039.4621	1621.4697	1074.8927	630.0025	435.9816 (83)
Total gains	1715.6531	2134.0776	2587.4250	3094.3468	3468.8821	3474.8247	3312.4353	2972.5579	2588.2925	2105.0165	1732.1101	1601.1833 (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	21.2080	21.2472	21.2858	21.4687	21.5033	21.6657	21.6657	21.6960	21.6028	21.5033	21.4334	21.3609	
alpha	2.4139	2.4165	2.4191	2.4312	2.4336	2.4444	2.4444	2.4464	2.4402	2.4336	2.4289	2.4241	
util living area	0.9975	0.9954	0.9911	0.9803	0.9563	0.9092	0.8408	0.8762	0.9557	0.9882	0.9961	0.9979	(86)
MIT	17.1415	17.3868	17.8901	18.6146	19.3823	20.0854	20.5042	20.4163	19.8081	18.8386	17.8760	17.1102	(87)
Th 2	18.6191	18.6218	18.6245	18.6372	18.6396	18.6509	18.6509	18.6530	18.6465	18.6396	18.6348	18.6297	(88)
util rest of house	0.9964	0.9934	0.9867	0.9686	0.9225	0.8053	0.5832	0.6599	0.9012	0.9792	0.9940	0.9970	(89)
MIT 2	14.4405	14.7557	15.4007	16.3283	17.2917	18.1304	18.5307	18.4772	17.8341	16.6214	15.3885	14.4046	(90)
Living area fraction									fLA = Living area / (4) =			0.0577	(91)
MIT	14.5965	14.9076	15.5444	16.4603	17.4125	18.2433	18.6447	18.5892	17.9481	16.7494	15.5322	14.5609	(92)
Temperature adjustment												0.0000	
adjusted MIT	14.5965	14.9076	15.5444	16.4603	17.4125	18.2433	18.6447	18.5892	17.9481	16.7494	15.5322	14.5609	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9923	0.9867	0.9749	0.9474	0.8895	0.7733	0.5820	0.6491	0.8679	0.9633	0.9878	0.9936	(94)
Useful gains	1702.4982	2105.7293	2522.4658	2931.4785	3085.7369	2686.9793	1927.8269	1929.4602	2246.3907	2027.8604	1710.9748	1590.8718	(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	12120.6441	11758.8493	10607.9016	8791.6414	6632.1732	4198.1894	2356.0937	2519.0569	4447.0882	7139.4412	9821.6654	12109.1086	(97)
Space heating kWh	7751.1005	6486.8967	6015.5642	4219.3173	2638.5486	0.0000	0.0000	0.0000	0.0000	3803.0161	5839.6972	7825.5682	(98a)
Space heating requirement - total per year (kWh/year)												44579.7088	
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	7751.1005	6486.8967	6015.5642	4219.3173	2638.5486	0.0000	0.0000	0.0000	0.0000	3803.0161	5839.6972	7825.5682	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												44579.7088	
Space heating per m2											(98c) / (4) =	124.0048	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11) 0.0000 (201)
Fraction of space heat from main system(s) 1.0000 (202)
Efficiency of main space heating system 1 (in %) 84.0000 (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	7751.1005	6486.8967	6015.5642	4219.3173	2638.5486	0.0000	0.0000	0.0000	0.0000	3803.0161	5839.6972	7825.5682	(98)
Space heating efficiency (main heating system 1)	84.0000	84.0000	84.0000	84.0000	84.0000	0.0000	0.0000	0.0000	0.0000	84.0000	84.0000	84.0000	(210)
Space heating fuel (main heating system)	9227.5006	7722.4960	7161.3860	5022.9968	3141.1293	0.0000	0.0000	0.0000	0.0000	4527.4001	6952.0205	9316.1526	(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	382.1567	339.5693	364.1281	327.4742	322.5867	296.2117	296.0273	304.4540	304.1801	332.6298	345.7861	378.8791	(64)
Efficiency of water heater												74.0000	(216)
(217)m	83.4700	83.4391	83.3571	83.1903	82.7813	74.0000	74.0000	74.0000	74.0000	83.0968	83.3702	83.4790	(217)
Fuel for water heating, kWh/month	457.8371	406.9665	436.8293	393.6446	389.6854	400.2860	400.0369	411.4243	411.0542	400.2918	414.7599	453.8613	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting	50.7383	40.7042	36.6496	26.8511	20.7405	16.9452	18.9202	24.5932	31.9441	41.9124	47.3400	52.1485	(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	53071.0819	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	74.0000	
Water heating fuel used	4976.6775	(219)
Space cooling fuel	0.0000	(221)
Electricity for pumps and fans:		
central heating pump	41.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	86.0000	(231)
Electricity for lighting (calculated in Appendix L)	409.4873	(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	58543.2467	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	53071.0819	3.6400	1931.7874	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	4976.6775	3.6400	181.1511	(247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000	(247a)
Pumps, fans and electric keep-hot	86.0000	16.4900	14.1814	(249)
Energy for lighting	409.4873	16.4900	67.5245	(250)
Additional standing charges			92.0000	(251)
Total energy cost			2286.6443	(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] =	2.0351	(257)
SAP value		67.0113	
SAP rating (Section 12)		67	(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	53071.0819	0.2100	11144.9272	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	4976.6775	0.2100	1045.1023	(264)
Space and water heating			12190.0295	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	409.4873	0.1443	59.1017	(268)
Total CO2, kg/year			12261.0604	(272)
CO2 emissions per m2			34.1100	(273)
EI value			59.2471	
EI rating			59	(274)
EI band			D	

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)	
Basement floor		73.1000 (1a)	x	2.0000 (2a)	=	146.2000	(1a) - (3a)
Ground floor		78.3000 (1b)	x	3.0000 (2b)	=	234.9000	(1b) - (3b)
First floor		75.0000 (1c)	x	3.0000 (2c)	=	225.0000	(1c) - (3c)
Second floor		70.9000 (1d)	x	3.0000 (2d)	=	212.7000	(1d) - (3d)
Third floor		62.2000 (1e)	x	2.0000 (2e)	=	124.4000	(1e) - (3e)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	359.5000						(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	943.2000	(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	5 * 10 =	50.0000 (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) =	50.0000 / (5) =	0.0530 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		10.0000 (17)
Infiltration rate		0.5530 (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) =	0.4701 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	3.8000	3.5000	3.5000	3.3000	3.4000	3.0000	3.2000	3.0000	2.9000	3.1000	3.1000	3.4000	(22)
Wind factor	0.9500	0.8750	0.8750	0.8250	0.8500	0.7500	0.8000	0.7500	0.7250	0.7750	0.7750	0.8500	(22a)
Adj infilt rate	0.4466	0.4113	0.4113	0.3878	0.3996	0.3525	0.3760	0.3525	0.3408	0.3643	0.3643	0.3996	(22b)
Effective ac	0.5997	0.5846	0.5846	0.5752	0.5798	0.5621	0.5707	0.5621	0.5581	0.5664	0.5664	0.5798	(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 = 4.80)			51.1100	4.0268	205.8121			(27)
External Door			7.2700	3.0000	21.8100			(26)
T W8			0.9500	4.2359	4.0241			(27a)
T W9			0.9500	4.2359	4.0241			(27a)
T W10			0.9500	4.2359	4.0241			(27a)
Basement Floor			73.1000	1.2000	87.7200			(28a)
Ground Floor			4.4000	1.2000	5.2800			(28a)
External Wall	355.2000	58.3800	296.8200	1.6000	474.9120			(29a)
Main Roof	62.2000	2.8500	59.3500	0.3000	17.8050			(30)
Exposed Ceiling	16.7000		16.7000	0.3000	5.0100			(30)
Total net area of external elements Aum(A, m2)			511.6000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		830.4213			(33)

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

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	37.7400	1.0000	37.7400
E3 Sill	34.2800	0.1000	3.4280
E4 Jamb	136.6000	0.1000	13.6600
E5 Ground floor (normal)	60.8000	0.3200	19.4560
E20 Exposed floor (normal)	3.1800	0.3200	1.0176
E22 Basement floor	36.0000	0.2200	7.9200
E6 Intermediate floor within a dwelling	111.8500	0.1400	15.6590
E11 Eaves (insulation at rafter level)	26.3300	0.1200	3.1596
E15 Flat roof with parapet	23.0500	0.2400	5.5320
E16 Corner (normal)	38.8000	0.1800	6.9840
E17 Corner (inverted - internal area greater than external area)	25.8000	0.0000	0.0000
E18 Party wall between dwellings	39.8000	0.2400	9.5520
E25 Staggered party wall between dwellings	11.8000	0.2400	2.8320
P1 Party wall - Ground floor	14.6000	0.3200	4.6720
P2 Party wall - Intermediate floor within a dwelling	65.9000	0.0000	0.0000
P4 Party wall - Roof (insulation at ceiling level)	7.5000	0.4800	3.6000

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		135.2122 (36)
Point Thermal bridges	(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =	965.6335 (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	186.6622	181.9555	181.9555	179.0326	180.4725	174.9706	177.6356	174.9706	173.7026	176.2816	176.2816	180.4725	(38)
Heat transfer coeff	1152.2957	1147.5890	1147.5890	1144.6661	1146.1061	1140.6042	1143.2692	1140.6042	1139.3362	1141.9152	1141.9152	1146.1061	(39)
Average = Sum(39)m / 12 =												1144.3330	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	3.2053	3.1922	3.1922	3.1841	3.1881	3.1728	3.1802	3.1728	3.1692	3.1764	3.1764	3.1881	(40)
HLP (average)												3.1831	
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		3.2093 (42)

Hot water usage for mixer showers

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
68.2754	67.2493	65.7542	62.8935	60.7823	58.4280	57.0899	58.5737	60.2002	62.7281	65.6502	68.0138	(42a)

Hot water usage for baths

33.6782	33.1781	32.4737	31.1750	30.2026	29.1243	28.5419	29.2413	30.0028	31.1566	32.4821	33.5644	(42b)

Hot water usage for other uses

47.4962	45.7691	44.0420	42.3148	40.5877	38.8606	38.8606	40.5877	42.3148	44.0420	45.7691	47.4962	(42c)

Average daily hot water use (litres/day)	137.3510 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	149.4499	146.1965	142.2699	136.3834	131.5727	126.4129	124.4923	128.4027	132.5179	137.9267	143.9014	149.0744	(44)
Energy conte	236.6920	208.1819	218.6635	186.7020	177.1221	155.4394	150.5627	158.9894	163.4079	187.1652	205.0139	233.4145	(45)
Energy content (annual)										Total = Sum(45)m =		2281.3544	

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

35.5038	31.2273	32.7995	28.0053	26.5683	23.3159	22.5844	23.8484	24.5112	28.0748	30.7521	35.0122	(46)

Water storage loss:	
Store volume	300.0000 (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	0.7368 (52)
Temperature factor from Table 2b	0.5400 (53)
Enter (49) or (54) in (55)	3.9420 (55)

Total storage loss

122.2022	110.3762	122.2022	118.2602	122.2022	118.2602	122.2022	122.2022	118.2602	122.2022	118.2602	122.2022	(56)

If cylinder contains dedicated solar storage

122.2022	110.3762	122.2022	118.2602	122.2022	118.2602	122.2022	122.2022	118.2602	122.2022	118.2602	122.2022	(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													
	382.1567	339.5693	364.1281	327.4742	322.5867	296.2117	296.0273	304.4540	304.1801	332.6298	345.7861	378.8791	(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													
	382.1567	339.5693	364.1281	327.4742	322.5867	296.2117	296.0273	304.4540	304.1801	332.6298	345.7861	378.8791	(64)
										Total per year (kWh/year) = Sum(64)m =		3994.0831	(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													
	195.0718	174.3304	189.0773	174.6962	175.2648	164.3014	166.4338	169.2357	166.9509	178.6041	180.7849	193.9820	(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	192.5568	192.5568	192.5568	192.5568	192.5568	192.5568	192.5568	192.5568	192.5568	192.5568	192.5568	192.5568	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	57.9672	51.4859	41.8712	31.6992	23.6955	20.0047	21.6158	28.0971	37.7118	47.8838	55.8875	59.5782	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	753.4903	761.3092	741.6059	699.6599	646.7106	596.9457	563.6997	555.8809	575.5842	617.5302	670.4795	720.2443	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	57.4650	57.4650	57.4650	57.4650	57.4650	57.4650	57.4650	57.4650	57.4650	57.4650	57.4650	57.4650	(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)													
	-128.3712	-128.3712	-128.3712	-128.3712	-128.3712	-128.3712	-128.3712	-128.3712	-128.3712	-128.3712	-128.3712	-128.3712	(71)
Water heating gains (Table 5)													
	262.1933	259.4202	254.1362	242.6336	235.5710	228.1964	223.7013	227.4673	231.8762	240.0593	251.0901	260.7285	(72)
Total internal gains													
	1198.3013	1196.8659	1162.2638	1098.6432	1030.6276	966.7974	930.6674	933.0958	966.8228	1030.1239	1102.1076	1165.2017	(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	
North	2.3000	11.9531	0.8500	0.7000	0.7700	11.3360	(74)
Northeast	1.9800	12.9148	0.8500	0.7000	0.7700	10.5439	(75)
Southeast	19.2200	40.2665	0.8500	0.7000	0.7700	319.1151	(77)
Southwest	0.8300	40.2665	0.8500	0.7000	0.7700	13.7807	(79)
West	2.4000	22.2970	0.8500	0.7000	0.7700	22.0652	(80)
Northwest	24.3800	12.9148	0.8500	0.7000	0.7700	129.8288	(81)
Southeast	2.8500	44.6209	0.8500	0.7000	1.0000	68.0993	(82)

Solar gains	574.7690	906.5130	1405.5382	2034.2948	2434.2870	2671.9150	2531.9379	2211.1085	1741.6157	1153.5098	699.2898	479.3031	(83)
Total gains	1773.0704	2103.3789	2567.8020	3132.9380	3464.9146	3638.7124	3462.6053	3144.2043	2708.4385	2183.6336	1801.3974	1644.5048	(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	21.6657	21.7545	21.7545	21.8101	21.7827	21.8878	21.8367	21.8878	21.9121	21.8626	21.8626	21.7827	
alpha	2.4444	2.4503	2.4503	2.4540	2.4522	2.4592	2.4558	2.4592	2.4608	2.4575	2.4575	2.4522	
util living area													
	0.9968	0.9948	0.9891	0.9730	0.9328	0.8205	0.6398	0.7035	0.9238	0.9824	0.9947	0.9973	(86)
MIT	17.5333	17.7385	18.2846	19.0233	19.8336	20.5321	20.8601	20.8109	20.1793	19.2289	18.2566	17.4936	(87)
Th 2	18.6509	18.6570	18.6570	18.6608	18.6589	18.6661	18.6626	18.6661	18.6678	18.6644	18.6644	18.6589	(88)
util rest of house													
	0.9953	0.9923	0.9830	0.9545	0.8674	0.5650	0.0537	0.1320	0.8045	0.9664	0.9915	0.9961	(89)
MIT 2	14.9554	15.2202	15.9182	16.8557	17.8477	18.5501	18.6626	18.6654	18.2677	17.1273	15.8878	14.9076	(90)
Living area fraction										fLA = Living area / (4) =		0.0577	(91)
MIT	15.1043	15.3657	16.0548	16.9809	17.9624	18.6646	18.7895	18.7893	18.3781	17.2487	16.0246	15.0570	(92)
Temperature adjustment												0.0000	
adjusted MIT	15.1043	15.3657	16.0548	16.9809	17.9624	18.6646	18.7895	18.7893	18.3781	17.2487	16.0246	15.0570	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9902	0.9848	0.9691	0.9287	0.8321	0.5647	0.0953	0.1754	0.7754	0.9452	0.9834	0.9919	(94)
Useful gains	1755.6949	2071.4321	2488.5301	2909.6151	2883.0850	2054.8875	330.0210	551.5437	2100.1016	2063.8977	1771.5242	1631.1200	(95)
Ext temp.	5.6000	6.1000	7.9000	10.4000	13.5000	16.5000	18.5000	18.3000	15.5000	12.0000	8.4000	5.5000	(96)
Heat loss rate W													
	10951.7070	10633.1713	9358.4113	7532.9472	5114.3396	2468.9319	330.9592	558.0989	3279.0829	5993.5280	8706.6564	10953.3086	(97)
Space heating kWh													
	6841.8330	5753.4888	5111.1916	3328.7991	1660.0535	0.0000	0.0000	0.0000	0.0000	2923.6449	4993.2952	6935.7084	(98a)
Space heating requirement - total per year (kWh/year)												37548.0144	
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													
	6841.8330	5753.4888	5111.1916	3328.7991	1660.0535	0.0000	0.0000	0.0000	0.0000	2923.6449	4993.2952	6935.7084	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												37548.0144	
Space heating per m2											(98c) / (4) =	104.4451	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												84.0000	(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													
	6841.8330	5753.4888	5111.1916	3328.7991	1660.0535	0.0000	0.0000	0.0000	0.0000	2923.6449	4993.2952	6935.7084	(98)
Space heating efficiency (main heating system 1)													
	84.0000	84.0000	84.0000	84.0000	84.0000	0.0000	0.0000	0.0000	0.0000	84.0000	84.0000	84.0000	(210)
Space heating fuel (main heating system)													
	8145.0393	6849.3914	6084.7519	3962.8561	1976.2541	0.0000	0.0000	0.0000	0.0000	3480.5297	5944.3990	8256.7957	(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													
	382.1567	339.5693	364.1281	327.4742	322.5867	296.2117	296.0273	304.4540	304.1801	332.6298	345.7861	378.8791	(64)
Efficiency of water heater												74.0000	(216)
(217)m	83.4038	83.3721	83.2518	82.9955	82.1928	74.0000	74.0000	74.0000	74.0000	82.8562	83.2712	83.4161	(217)
Fuel for water heating, kWh/month													
	458.2007	407.2936	437.3816	394.5688	392.4756	400.2860	400.0369	411.4243	411.0542	401.4541	415.2529	454.2038	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting	50.7383	40.7042	36.6496	26.8511	20.7405	16.9452	18.9202	24.5932	31.9441	41.9124	47.3400	52.1485	(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												44700.0172	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												74.0000	
Water heating fuel used												4983.6325	(219)
Space cooling fuel												0.0000	(221)
Electricity for pumps and fans:													
central heating pump												41.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												86.0000	(231)
Electricity for lighting (calculated in Appendix L)												409.4873	(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												50179.1370	(238)

10a. Fuel costs - using BEDF prices (533)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	44700.0172	4.8000	2145.6008	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	4983.6325	4.8000	239.2144	(247)
Energy for instantaneous electric shower(s)	0.0000	21.5100	0.0000	(247a)
Pumps, fans and electric keep-hot	86.0000	21.5100	18.4986	(249)
Energy for lighting	409.4873	21.5100	88.0807	(250)
Additional standing charges			98.0000	(251)
Total energy cost			2589.3945	(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	44700.0172	0.2100	9387.0036	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	4983.6325	0.2100	1046.5628	(264)
Space and water heating			10433.5664	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	409.4873	0.1443	59.1017	(268)
Total CO2, kg/year			10504.5974	(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	44700.0172	1.1300	50511.0194	(275)
Total CO2 associated with community systems			0.0000	(473)

Water heating (other fuel)	4983.6325	1.1300	5631.5048 (278)
Space and water heating			56142.5242 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	409.4873	1.5338	628.0853 (282)
Total Primary energy kWh/year			56900.7103 (286)

SAP 10 EPC IMPROVEMENTS

00001_Copy

Current energy efficiency rating: D 67
Current environmental impact rating: D 59

N Solar water heating — SAP increase too small
U Solar photovoltaic panels — Recommended
V2 Wind turbine — Not applicable

Recommended measures:	SAP change	Cost change	CO2 change
U Solar photovoltaic panels	+ 2.3	-£ 214	-133 kg (1.3%)

Measures omitted - SAP change or cost saving too small:

N Solar water heating	+ 0.5	-£ 51	-286 kg (2.7%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar photovoltaic panels	£214	0.37 kg/m²	C 69	D 60
Total Savings	£214	0.37 kg/m²		

Potential energy efficiency rating: C 69
Potential environmental impact rating: D 60

Fuel prices for cost data on this page from database revision number 533 TEST (30 Nov 2023)
Recommendation texts revision number 6.1 (11 Jun 2019)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£107	£107	£0
Mains gas	£2483	£2483	£0
Space heating	£2262	£2262	£0
Water heating	£239	£239	£0
Lighting	£88	£88	£0
Generated (PV)	-£0	-£214	£214
Total cost of fuels	£2590	£2376	£214
Total cost of uses	£2589	£2375	£214
Delivered energy	140 kWh/m²	137 kWh/m²	3 kWh/m²
Carbon dioxide emissions	11 tonnes	10 tonnes	0.1 tonnes
CO2 emissions per m²	29 kg/m²	29 kg/m²	0 kg/m²
Primary energy	158 kWh/m²	154 kWh/m²	4 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)	
Basement floor	73.1000	(1a)	x 2.0000	(2a) =	146.2000	(1a) - (3a)
Ground floor	78.3000	(1b)	x 3.0000	(2b) =	234.9000	(1b) - (3b)
First floor	75.0000	(1c)	x 3.0000	(2c) =	225.0000	(1c) - (3c)
Second floor	70.9000	(1d)	x 3.0000	(2d) =	212.7000	(1d) - (3d)
Third floor	62.2000	(1e)	x 2.0000	(2e) =	124.4000	(1e) - (3e)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	359.5000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		943.2000	(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	5 * 10 =	50.0000	(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) =	50.0000 / (5) =	0.0530	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		10.0000	(17)
Infiltration rate		0.5530	(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) = 0.4701 (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	0.5993	0.5876	0.5758	0.5171	0.5053	0.4466	0.4466	0.4348	0.4701	0.5053	0.5288	0.5523	(22b)
Effective ac	0.6796	0.6726	0.6658	0.6337	0.6277	0.5997	0.5997	0.5945	0.6105	0.6277	0.6398	0.6525	(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 = 4.80)			51.1100	4.0268	205.8121			(27)
External Door			7.2700	3.0000	21.8100			(26)
T W8			0.9500	4.2359	4.0241			(27a)
T W9			0.9500	4.2359	4.0241			(27a)
T W10			0.9500	4.2359	4.0241			(27a)
Basement Floor			73.1000	1.2000	87.7200			(28a)
Ground Floor			4.4000	1.2000	5.2800			(28a)
External Wall	355.2000	58.3800	296.8200	1.6000	474.9120			(29a)
Main Roof	62.2000	2.8500	59.3500	0.3000	17.8050			(30)
Exposed Ceiling	16.7000		16.7000	0.3000	5.0100			(30)
Total net area of external elements Aum(A, m2)			511.6000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	830.4213			(33)

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

	K1 Element	Length	Psi-value	Total
E2	Other lintels (including other steel lintels)	37.7400	1.0000	37.7400
E3	Sill	34.2800	0.1000	3.4280
E4	Jamb	136.6000	0.1000	13.6600
E5	Ground floor (normal)	60.8000	0.3200	19.4560
E20	Exposed floor (normal)	3.1800	0.3200	1.0176
E22	Basement floor	36.0000	0.2200	7.9200
E6	Intermediate floor within a dwelling	111.8500	0.1400	15.6590
E11	Eaves (insulation at rafter level)	26.3300	0.1200	3.1596
E15	Flat roof with parapet	23.0500	0.2400	5.5320
E16	Corner (normal)	38.8000	0.1800	6.9840
E17	Corner (inverted - internal area greater than external area)	25.8000	0.0000	0.0000
E18	Party wall between dwellings	39.8000	0.2400	9.5520
E25	Staggered party wall between dwellings	11.8000	0.2400	2.8320
P1	Party wall - Ground floor	14.6000	0.3200	4.6720
P2	Party wall - Intermediate floor within a dwelling	65.9000	0.0000	0.0000
P4	Party wall - Roof (insulation at ceiling level)	7.5000	0.4800	3.6000

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 135.2122 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 965.6335 (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	211.5282	209.3575	207.2299	197.2362	195.3664	186.6622	186.6622	185.0503	190.0149	195.3664	199.1489	203.1034	(38)
Heat transfer coeff	1177.1618	1174.9911	1172.8634	1162.8697	1160.9999	1152.2957	1152.2957	1150.6838	1155.6485	1160.9999	1164.7825	1168.7370	(39)
Average = Sum(39)m / 12 =												1162.8607	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	3.2744	3.2684	3.2625	3.2347	3.2295	3.2053	3.2053	3.2008	3.2146	3.2295	3.2400	3.2510	(40)
HLP (average)												3.2347	
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 3.2093 (42)
Hot water usage for mixer showers
68.2754 67.2493 65.7542 62.8935 60.7823 58.4280 57.0899 58.5737 60.2002 62.7281 65.6502 68.0138 (42a)
Hot water usage for baths
33.6782 33.1781 32.4737 31.1750 30.2026 29.1243 28.5419 29.2413 30.0028 31.1566 32.4821 33.5644 (42b)
Hot water usage for other uses
47.4962 45.7691 44.0420 42.3148 40.5877 38.8606 38.8606 40.5877 42.3148 44.0420 45.7691 47.4962 (42c)
Average daily hot water use (litres/day) 137.3510 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	149.4499	146.1965	142.2699	136.3834	131.5727	126.4129	124.4923	128.4027	132.5179	137.9267	143.9014	149.0744	(44)
Energy conte	236.6920	208.1819	218.6635	186.7020	177.1221	155.4394	150.5627	158.9894	163.4079	187.1652	205.0139	233.4145	(45)
Energy content (annual)											Total = Sum(45)m =	2281.3544	
Distribution loss (46)m = 0.15 x (45)m	35.5038	31.2273	32.7995	28.0053	26.5683	23.3159	22.5844	23.8484	24.5112	28.0748	30.7521	35.0122	(46)
Water storage loss:													
Store volume												300.0000	(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												0.7368	(52)
Temperature factor from Table 2b												0.5400	(53)
Enter (49) or (54) in (55)												3.9420	(55)
Total storage loss	122.2022	110.3762	122.2022	118.2602	122.2022	118.2602	122.2022	122.2022	118.2602	122.2022	118.2602	122.2022	(56)
If cylinder contains dedicated solar storage	122.2022	110.3762	122.2022	118.2602	122.2022	118.2602	122.2022	122.2022	118.2602	122.2022	118.2602	122.2022	(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	382.1567	339.5693	364.1281	327.4742	322.5867	296.2117	296.0273	304.4540	304.1801	332.6298	345.7861	378.8791	(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	382.1567	339.5693	364.1281	327.4742	322.5867	296.2117	296.0273	304.4540	304.1801	332.6298	345.7861	378.8791	(64)

											Total per year (kWh/year) = Sum(64)m =	3994.0831	(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	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													
195.0718	174.3304	189.0773	174.6962	175.2648	164.3014	166.4338	169.2357	166.9509	178.6041	180.7849	193.9820	(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	192.5568	192.5568	192.5568	192.5568	192.5568	192.5568	192.5568	192.5568	192.5568	192.5568	192.5568	192.5568	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	57.9672	51.4859	41.8712	31.6992	23.6955	20.0047	21.6158	28.0971	37.7118	47.8838	55.8875	59.5782	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	753.4903	761.3092	741.6059	699.6599	646.7106	596.9457	563.6997	555.8809	575.5842	617.5302	670.4795	720.2443	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	57.4650	57.4650	57.4650	57.4650	57.4650	57.4650	57.4650	57.4650	57.4650	57.4650	57.4650	57.4650	(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)													
	-128.3712	-128.3712	-128.3712	-128.3712	-128.3712	-128.3712	-128.3712	-128.3712	-128.3712	-128.3712	-128.3712	-128.3712	(71)
Water heating gains (Table 5)													
	262.1933	259.4202	254.1362	242.6336	235.5710	228.1964	223.7013	227.4673	231.8762	240.0593	251.0901	260.7285	(72)
Total internal gains													
	1198.3013	1196.8659	1162.2638	1098.6432	1030.6276	966.7974	930.6674	933.0958	966.8228	1030.1239	1102.1076	1165.2017	(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	
North	2.3000	10.6334	0.8500	0.7000	0.7700	10.0844	(74)
Northeast	1.9800	11.2829	0.8500	0.7000	0.7700	9.2117	(75)
Southeast	19.2200	36.7938	0.8500	0.7000	0.7700	291.5940	(77)
Southwest	0.8300	36.7938	0.8500	0.7000	0.7700	12.5922	(79)
West	2.4000	19.6403	0.8500	0.7000	0.7700	19.4361	(80)
Northwest	24.3800	11.2829	0.8500	0.7000	0.7700	113.4243	(81)
Southeast	2.8500	39.9751	0.8500	0.7000	1.0000	61.0091	(82)

Solar gains	517.3518	937.2117	1425.1612	1995.7036	2438.2545	2508.0273	2381.7679	2039.4621	1621.4697	1074.8927	630.0025	435.9816	(83)
Total gains	1715.6531	2134.0776	2587.4250	3094.3468	3468.8821	3474.8247	3312.4353	2972.5579	2588.2925	2105.0165	1732.1101	1601.1833	(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	21.2080	21.2472	21.2858	21.4687	21.5033	21.6657	21.6657	21.6960	21.6028	21.5033	21.4334	21.3609	
alpha	2.4139	2.4165	2.4191	2.4312	2.4336	2.4444	2.4444	2.4464	2.4402	2.4336	2.4289	2.4241	
util living area													
	0.9975	0.9954	0.9911	0.9803	0.9563	0.9092	0.8408	0.8762	0.9557	0.9882	0.9961	0.9979	(86)
MIT	17.1415	17.3868	17.8901	18.6146	19.3823	20.0854	20.5042	20.4163	19.8081	18.8386	17.8760	17.1102	(87)
Th 2	18.6191	18.6218	18.6245	18.6372	18.6396	18.6509	18.6509	18.6530	18.6465	18.6396	18.6348	18.6297	(88)
util rest of house													
	0.9964	0.9934	0.9867	0.9686	0.9225	0.8053	0.5832	0.6599	0.9012	0.9792	0.9940	0.9970	(89)
MIT 2	14.4405	14.7557	15.4007	16.3283	17.2917	18.1304	18.5307	18.4772	17.8341	16.6214	15.3885	14.4046	(90)
Living area fraction										fLA = Living area / (4) =		0.0577	(91)
MIT	14.5965	14.9076	15.5444	16.4603	17.4125	18.2433	18.6447	18.5892	17.9481	16.7494	15.5322	14.5609	(92)
Temperature adjustment												0.0000	
adjusted MIT	14.5965	14.9076	15.5444	16.4603	17.4125	18.2433	18.6447	18.5892	17.9481	16.7494	15.5322	14.5609	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9923	0.9867	0.9749	0.9474	0.8895	0.7733	0.5820	0.6491	0.8679	0.9633	0.9878	0.9936	(94)
Useful gains	1702.4982	2105.7293	2522.4658	2931.4785	3085.7369	2686.9793	1927.8269	1929.4602	2246.3907	2027.8604	1710.9748	1590.8718	(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													
12120.6441	11758.8493	10607.9016	8791.6414	6632.1732	4198.1894	2356.0937	2519.0569	4447.0882	7139.4412	9821.6654	12109.1086	(97)	
Space heating kWh													
7751.1005	6486.8967	6015.5642	4219.3173	2638.5486	0.0000	0.0000	0.0000	0.0000	3803.0161	5839.6972	7825.5682	(98a)	
Space heating requirement - total per year (kWh/year)												44579.7088	
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													
7751.1005	6486.8967	6015.5642	4219.3173	2638.5486	0.0000	0.0000	0.0000	0.0000	3803.0161	5839.6972	7825.5682	(98c)	
Space heating requirement after solar contribution - total per year (kWh/year)												44579.7088	
Space heating per m2											(98c) / (4) =	124.0048	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												84.0000	(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													
	7751.1005	6486.8967	6015.5642	4219.3173	2638.5486	0.0000	0.0000	0.0000	0.0000	3803.0161	5839.6972	7825.5682	(98)
Space heating efficiency (main heating system 1)													

	84.0000	84.0000	84.0000	84.0000	84.0000	0.0000	0.0000	0.0000	0.0000	84.0000	84.0000	84.0000 (210)
Space heating fuel (main heating system)												
	9227.5006	7722.4960	7161.3860	5022.9968	3141.1293	0.0000	0.0000	0.0000	0.0000	4527.4001	6952.0205	9316.1526 (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												
	382.1567	339.5693	364.1281	327.4742	322.5867	296.2117	296.0273	304.4540	304.1801	332.6298	345.7861	378.8791 (64)
Efficiency of water heater												74.0000 (216)
(217)m	83.4700	83.4391	83.3571	83.1903	82.7813	74.0000	74.0000	74.0000	74.0000	83.0968	83.3702	83.4790 (217)
Fuel for water heating, kWh/month												
	457.8371	406.9665	436.8293	393.6446	389.6854	400.2860	400.0369	411.4243	411.0542	400.2918	414.7599	453.8613 (219)
Space cooling fuel requirement												
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041 (231)
Lighting	50.7383	40.7042	36.6496	26.8511	20.7405	16.9452	18.9202	24.5932	31.9441	41.9124	47.3400	52.1485 (232)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233a)m	-37.8598	-56.9899	-87.5316	-105.2832	-119.4192	-113.5030	-111.8865	-102.5154	-87.2397	-67.8548	-42.8118	-32.3041 (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	53071.0819 (211)
Space heating fuel - main system 2	0.0000 (213)
Space heating fuel - secondary	0.0000 (215)
Efficiency of water heater	74.0000
Water heating fuel used	4976.6775 (219)
Space cooling fuel	0.0000 (221)
Electricity for pumps and fans:	
central heating pump	41.0000 (230c)
main heating flue fan	45.0000 (230e)
Total electricity for the above, kWh/year	86.0000 (231)
Electricity for lighting (calculated in Appendix L)	409.4873 (232)
Energy saving/generation technologies (Appendices M ,N and Q)	
PV generation	-965.1988 (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	57578.0480 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	53071.0819	3.6400	1931.7874	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	4976.6775	3.6400	181.1511	(247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000	(247a)
Pumps, fans and electric keep-hot	86.0000	16.4900	14.1814	(249)
Energy for lighting	409.4873	16.4900	67.5245	(250)
Additional standing charges			92.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-965.1988	16.4900	-159.1613	
PV Unit electricity exported	0.0000	5.5900	0.0000	
Total			-159.1613	(252)
Total energy cost			2127.4830	(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] =	1.8934 (257)
SAP value		69.3074
SAP rating (Section 12)		69 (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	53071.0819	0.2100	11144.9272	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	4976.6775	0.2100	1045.1023	(264)
Space and water heating			12190.0295	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	409.4873	0.1443	59.1017	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-965.1988	0.1333	-128.6238	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-128.6238	(269)

Total CO2, kg/year	12132.4366	(272)
CO2 emissions per m2	33.7500	(273)
EI value	59.6822	
EI rating	60	(274)
EI band	D	

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

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Basement floor	73.1000	(1a) x	2.0000	(2a) =	146.2000	(1a) - (3a)
Ground floor	78.3000	(1b) x	3.0000	(2b) =	234.9000	(1b) - (3b)
First floor	75.0000	(1c) x	3.0000	(2c) =	225.0000	(1c) - (3c)
Second floor	70.9000	(1d) x	3.0000	(2d) =	212.7000	(1d) - (3d)
Third floor	62.2000	(1e) x	2.0000	(2e) =	124.4000	(1e) - (3e)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	359.5000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		943.2000	(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	5 * 10 =	50.0000	(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) =	50.0000 / (5) =	0.0530	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		10.0000	(17)
Infiltration rate		0.5530	(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) =	0.4701	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	3.8000	3.5000	3.5000	3.3000	3.4000	3.0000	3.2000	3.0000	2.9000	3.1000	3.1000	3.4000	(22)
Wind factor	0.9500	0.8750	0.8750	0.8250	0.8500	0.7500	0.8000	0.7500	0.7250	0.7750	0.7750	0.8500	(22a)
Adj infilt rate	0.4466	0.4113	0.4113	0.3878	0.3996	0.3525	0.3760	0.3525	0.3408	0.3643	0.3643	0.3996	(22b)
Effective ac	0.5997	0.5846	0.5846	0.5752	0.5798	0.5621	0.5707	0.5621	0.5581	0.5664	0.5664	0.5798	(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 = 4.80)			51.1100	4.0268	205.8121			(27)
External Door			7.2700	3.0000	21.8100			(26)
T W8			0.9500	4.2359	4.0241			(27a)
T W9			0.9500	4.2359	4.0241			(27a)
T W10			0.9500	4.2359	4.0241			(27a)
Basement Floor			73.1000	1.2000	87.7200			(28a)
Ground Floor			4.4000	1.2000	5.2800			(28a)
External Wall	355.2000	58.3800	296.8200	1.6000	474.9120			(29a)
Main Roof	62.2000	2.8500	59.3500	0.3000	17.8050			(30)
Exposed Ceiling	16.7000		16.7000	0.3000	5.0100			(30)
Total net area of external elements Aum(A, m2)			511.6000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		830.4213			(33)

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

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	37.7400	1.0000	37.7400
E3 Sill	34.2800	0.1000	3.4280
E4 Jamb	136.6000	0.1000	13.6600
E5 Ground floor (normal)	60.8000	0.3200	19.4560
E20 Exposed floor (normal)	3.1800	0.3200	1.0176
E22 Basement floor	36.0000	0.2200	7.9200
E6 Intermediate floor within a dwelling	111.8500	0.1400	15.6590
E11 Eaves (insulation at rafter level)	26.3300	0.1200	3.1596
E15 Flat roof with parapet	23.0500	0.2400	5.5320
E16 Corner (normal)	38.8000	0.1800	6.9840
E17 Corner (inverted - internal area greater than external area)	25.8000	0.0000	0.0000
E18 Party wall between dwellings	39.8000	0.2400	9.5520
E25 Staggered party wall between dwellings	11.8000	0.2400	2.8320
P1 Party wall - Ground floor	14.6000	0.3200	4.6720
P2 Party wall - Intermediate floor within a dwelling	65.9000	0.0000	0.0000
P4 Party wall - Roof (insulation at ceiling level)	7.5000	0.4800	3.6000
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			135.2122 (36)
Point Thermal bridges		(36a) =	0.0000

Total fabric heat loss (33) + (36) + (36a) = 965.6335 (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	186.6622	181.9555	181.9555	179.0326	180.4725	174.9706	177.6356	174.9706	173.7026	176.2816	176.2816	180.4725	(38)
Heat transfer coeff	1152.2957	1147.5890	1147.5890	1144.6661	1146.1061	1140.6042	1143.2692	1140.6042	1139.3362	1141.9152	1141.9152	1146.1061	(39)
Average = Sum(39)m / 12 =												1144.3330	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	3.2053	3.1922	3.1922	3.1841	3.1881	3.1728	3.1802	3.1728	3.1692	3.1764	3.1764	3.1881	(40)
HLP (average)												3.1831	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy 3.2093 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	68.2754	67.2493	65.7542	62.8935	60.7823	58.4280	57.0899	58.5737	60.2002	62.7281	65.6502	68.0138	(42a)
Hot water usage for baths	33.6782	33.1781	32.4737	31.1750	30.2026	29.1243	28.5419	29.2413	30.0028	31.1566	32.4821	33.5644	(42b)
Hot water usage for other uses	47.4962	45.7691	44.0420	42.3148	40.5877	38.8606	38.8606	40.5877	42.3148	44.0420	45.7691	47.4962	(42c)
Average daily hot water use (litres/day)												137.3510	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	149.4499	146.1965	142.2699	136.3834	131.5727	126.4129	124.4923	128.4027	132.5179	137.9267	143.9014	149.0744	(44)
Energy conte	236.6920	208.1819	218.6635	186.7020	177.1221	155.4394	150.5627	158.9894	163.4079	187.1652	205.0139	233.4145	(45)
Energy content (annual)										Total = Sum(45)m =		2281.3544	
Distribution loss (46)m = 0.15 x (45)m	35.5038	31.2273	32.7995	28.0053	26.5683	23.3159	22.5844	23.8484	24.5112	28.0748	30.7521	35.0122	(46)
Water storage loss:													
Store volume												300.0000	(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												0.7368	(52)
Temperature factor from Table 2b												0.5400	(53)
Enter (49) or (54) in (55)												3.9420	(55)
Total storage loss	122.2022	110.3762	122.2022	118.2602	122.2022	118.2602	122.2022	122.2022	118.2602	122.2022	118.2602	122.2022	(56)
If cylinder contains dedicated solar storage	122.2022	110.3762	122.2022	118.2602	122.2022	118.2602	122.2022	122.2022	118.2602	122.2022	118.2602	122.2022	(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	382.1567	339.5693	364.1281	327.4742	322.5867	296.2117	296.0273	304.4540	304.1801	332.6298	345.7861	378.8791	(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	382.1567	339.5693	364.1281	327.4742	322.5867	296.2117	296.0273	304.4540	304.1801	332.6298	345.7861	378.8791	(64)
									Total per year (kWh/year) = Sum(64)m =			3994.0831	(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	195.0718	174.3304	189.0773	174.6962	175.2648	164.3014	166.4338	169.2357	166.9509	178.6041	180.7849	193.9820	(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	192.5568	192.5568	192.5568	192.5568	192.5568	192.5568	192.5568	192.5568	192.5568	192.5568	192.5568	192.5568	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	57.9672	51.4859	41.8712	31.6992	23.6955	20.0047	21.6158	28.0971	37.7118	47.8838	55.8875	59.5782	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	753.4903	761.3092	741.6059	699.6599	646.7106	596.9457	563.6997	555.8809	575.5842	617.5302	670.4795	720.2443	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	57.4650	57.4650	57.4650	57.4650	57.4650	57.4650	57.4650	57.4650	57.4650	57.4650	57.4650	57.4650	(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)	-128.3712	-128.3712	-128.3712	-128.3712	-128.3712	-128.3712	-128.3712	-128.3712	-128.3712	-128.3712	-128.3712	-128.3712	(71)
Water heating gains (Table 5)	262.1933	259.4202	254.1362	242.6336	235.5710	228.1964	223.7013	227.4673	231.8762	240.0593	251.0901	260.7285	(72)
Total internal gains	1198.3013	1196.8659	1162.2638	1098.6432	1030.6276	966.7974	930.6674	933.0958	966.8228	1030.1239	1102.1076	1165.2017	(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	
North	2.3000	11.9531	0.8500	0.7000	0.7700	11.3360	(74)
Northeast	1.9800	12.9148	0.8500	0.7000	0.7700	10.5439	(75)
Southeast	19.2200	40.2665	0.8500	0.7000	0.7700	319.1151	(77)
Southwest	0.8300	40.2665	0.8500	0.7000	0.7700	13.7807	(79)
West	2.4000	22.2970	0.8500	0.7000	0.7700	22.0652	(80)
Northwest	24.3800	12.9148	0.8500	0.7000	0.7700	129.8288	(81)
Southeast	2.8500	44.6209	0.8500	0.7000	1.0000	68.0993	(82)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	574.7690	906.5130	1405.5382	2034.2948	2434.2870	2671.9150	2531.9379	2211.1085	1741.6157	1153.5098	699.2898	479.3031	(83)
Total gains	1773.0704	2103.3789	2567.8020	3132.9380	3464.9146	3638.7124	3462.6053	3144.2043	2708.4385	2183.6336	1801.3974	1644.5048	(84)

7. Mean internal temperature (heating season)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
tau	21.6657	21.7545	21.7545	21.8101	21.7827	21.8878	21.8367	21.8878	21.9121	21.8626	21.8626	21.7827	
alpha	2.4444	2.4503	2.4503	2.4540	2.4522	2.4592	2.4558	2.4592	2.4608	2.4575	2.4575	2.4522	
util living area	0.9968	0.9948	0.9891	0.9730	0.9328	0.8205	0.6398	0.7035	0.9238	0.9824	0.9947	0.9973	(86)
MIT	17.5333	17.7385	18.2846	19.0233	19.8336	20.5321	20.8601	20.8109	20.1793	19.2289	18.2566	17.4936	(87)
Th 2	18.6509	18.6570	18.6570	18.6608	18.6589	18.6661	18.6626	18.6661	18.6678	18.6644	18.6644	18.6589	(88)
util rest of house	0.9953	0.9923	0.9830	0.9545	0.8674	0.5650	0.0537	0.1320	0.8045	0.9664	0.9915	0.9961	(89)
MIT 2	14.9554	15.2202	15.9182	16.8557	17.8477	18.5501	18.6626	18.6654	18.2677	17.1273	15.8878	14.9076	(90)
Living area fraction									fLA = Living area / (4) =			0.0577	(91)
MIT	15.1043	15.3657	16.0548	16.9809	17.9624	18.6646	18.7895	18.7893	18.3781	17.2487	16.0246	15.0570	(92)
Temperature adjustment												0.0000	
adjusted MIT	15.1043	15.3657	16.0548	16.9809	17.9624	18.6646	18.7895	18.7893	18.3781	17.2487	16.0246	15.0570	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9902	0.9848	0.9691	0.9287	0.8321	0.5647	0.0953	0.1754	0.7754	0.9452	0.9834	0.9919	(94)
Useful gains	1755.6949	2071.4321	2488.5301	2909.6151	2883.0850	2054.8875	330.0210	551.5437	2100.1016	2063.8977	1771.5242	1631.1200	(95)
Ext temp.	5.6000	6.1000	7.9000	10.4000	13.5000	16.5000	18.5000	18.3000	15.5000	12.0000	8.4000	5.5000	(96)
Heat loss rate W	10951.7070	10633.1713	9358.4113	7532.9472	5114.3396	2468.9319	330.9592	558.0989	3279.0829	5993.5280	8706.6564	10953.3086	(97)
Space heating kWh	6841.8330	5753.4888	5111.1916	3328.7991	1660.0535	0.0000	0.0000	0.0000	0.0000	2923.6449	4993.2952	6935.7084	(98a)
Space heating requirement - total per year (kWh/year)												37548.0144	
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	6841.8330	5753.4888	5111.1916	3328.7991	1660.0535	0.0000	0.0000	0.0000	0.0000	2923.6449	4993.2952	6935.7084	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												37548.0144	
Space heating per m2											(98c) / (4) =	104.4451	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	84.0000	(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	6841.8330	5753.4888	5111.1916	3328.7991	1660.0535	0.0000	0.0000	0.0000	0.0000	2923.6449	4993.2952	6935.7084	(98)
Space heating efficiency (main heating system 1)	84.0000	84.0000	84.0000	84.0000	84.0000	0.0000	0.0000	0.0000	0.0000	84.0000	84.0000	84.0000	(210)
Space heating fuel (main heating system)	8145.0393	6849.3914	6084.7519	3962.8561	1976.2541	0.0000	0.0000	0.0000	0.0000	3480.5297	5944.3990	8256.7957	(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	382.1567	339.5693	364.1281	327.4742	322.5867	296.2117	296.0273	304.4540	304.1801	332.6298	345.7861	378.8791	(64)
Efficiency of water heater												74.0000	(216)
(217)m	83.4038	83.3721	83.2518	82.9955	82.1928	74.0000	74.0000	74.0000	74.0000	82.8562	83.2712	83.4161	(217)
Fuel for water heating, kWh/month	458.2007	407.2936	437.3816	394.5688	392.4756	400.2860	400.0369	411.4243	411.0542	401.4541	415.2529	454.2038	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting	50.7383	40.7042	36.6496	26.8511	20.7405	16.9452	18.9202	24.5932	31.9441	41.9124	47.3400	52.1485	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-41.6260	-55.6503	-86.6062	-106.3776	-118.8272	-117.6601	-115.8282	-107.6982	-91.5605	-71.7422	-46.8835	-35.2524	(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	44700.0172	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	74.0000	
Water heating fuel used	4983.6325	(219)
Space cooling fuel	0.0000	(221)
Electricity for pumps and fans:		
central heating pump	41.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	86.0000	(231)
Electricity for lighting (calculated in Appendix L)	409.4873	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-995.7123	(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	49183.4247	(238)

10a. Fuel costs - using BEDF prices (533)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	44700.0172	4.8000	2145.6008	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	4983.6325	4.8000	239.2144	(247)
Energy for instantaneous electric shower(s)	0.0000	21.5100	0.0000	(247a)
Pumps, fans and electric keep-hot	86.0000	21.5100	18.4986	(249)
Energy for lighting	409.4873	21.5100	88.0807	(250)
Additional standing charges			98.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-995.7123	21.5100	-214.1777	
PV Unit electricity exported	0.0000	5.5900	0.0000	
Total			-214.1777	(252)
Total energy cost			2375.2168	(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	44700.0172	0.2100	9387.0036	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	4983.6325	0.2100	1046.5628	(264)
Space and water heating			10433.5664	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	409.4873	0.1443	59.1017	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-995.7123	0.1332	-132.6282	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-132.6282	(269)
Total CO2, kg/year			10371.9692	(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	44700.0172	1.1300	50511.0194	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	4983.6325	1.1300	5631.5048	(278)
Space and water heating			56142.5242	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	409.4873	1.5338	628.0853	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-995.7123	1.4922	-1485.7923	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-1485.7923	(283)
Total Primary energy kWh/year			55414.9180	(286)

APPENDIX B – BREEAM PRE-ASSESSMENT

BREEAM UK Refurbishment 2014 - Domestic Buildings
Score Sheet and Evidence Requirements

Project name: 9 The Green
Building type: Residential
Date: 04/01/2024
Version 15

Target score: 61.35
Target rating: VERY GOOD

Credit issue	Credits available	Credits targeted	Potential credits	Credit requirements	Evidence Required	Responsibility	Status	Notes
Management								
Man 01: Home User Guide	3	0	3	Credits awarded for production of Home User Guide containing the information listed in the 'user guide contents list' for future owners. Alternative a case study can be submitted on the BRE website for this credit.	Copy of the Home User Guide **OR**	Contractor	Outstanding	
					Case study submitted on BRE website	Contractor / Ridge	Outstanding	
Man 02: Responsible construction practices	2	0	2	Achieve a CCS score of at least 35, with at least 7 points in each section.	Compliance letter.	Contractor (if targeted)	Outstanding	Not currently targeted - usually only larger contractors ar able to comply with the requirements of CCS
					Final CCS report	Contractor (if targeted)	Outstanding	As above
Man 03: Construction site impacts	1	0	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).	Completed Checklist A4	Contractor	Outstanding	
					Final figures for energy and water consumption.	Contractor	Outstanding	
					List of all timber suppliers and corresponding PEFC/FSC certification	Contractor	Outstanding	
Man 04: Security	2	0	2	**Two credits:** Scheme complies with the principles of Secured by Design Section 2 - Physical Security.	SbD meeting minutes; and letter confirming intention to achieve full SbD certification	Contractor	Outstanding	Not currently targeted
					Confirmation of the start and end of design stage (RIBA Stages 2-4).	Contractor	Outstanding	Not currently targeted
					Secured by Design certificate confirming that the dwelling is SbD certified and that the principles and guidance of Section 2 (Physical Security) have been complied with.	Contractor	Outstanding	Not currently targeted
Man 05: Protection and enhancement of ecological features	1	1	0	Ecology survey carried out and all existing features of ecology value are protected during construction.	Ecology Report	Ecologist	Appointment Required	
Man 06: Project management	2	0	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.	Signed compliance letter confirming roles and responsibilities	Ridge	Outstanding	Not currently targeted
					Meeting minutes from handover meeting to introduce the aftercare team and home user guide; present key information about how the building operates; and answer questions. Where appropriate this should also include demonstrations of newly installed equipment and an insight into their advantages. Information should be presented in a clear manner and with an appropriate level of technical terminology.	Ridge	Outstanding	
					Example meeting minutes from construction stage progress meeting	Ridge	Outstanding	
					Project brief	Ridge	Outstanding	
					Example of contractor's regular progress report	Ridge	Outstanding	
Total credits:	**11**	**1**	**10**					

BREEAM UK Refurbishment 2014 - Domestic Buildings
Score Sheet and Evidence Requirements

Project name: 9 The Green
Building type: Residential
Date: 04/01/2024
Version 15

Target score: 61.35
Target rating: VERY GOOD

Credit issue	Credits available	Credits targeted	Potential credits	Credit requirements	Evidence Required	Responsibility	Status	Notes
Health and Wellbeing								
Hea 01: Daylighting	2	0	2	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 room meets the minimum daylighting requirements .	Completed Checklist A7; and ADF and uniformity calculations for kitchen, living room, dining rooms and studies.	Daylight Consultant	Appointment Required	Not currently targeted. Minimum daylighting levels: - Kitchens: ADF of at least 2% - Living rooms, dining rooms and studies: ADF of at least 1.5% - At least 80% of the working plan receives direct light from the sky.
Hea 02: Sound insulation	4	2	0	For noise transmittance between dwellings (separating walls and floors) for a historic building: 1 credit: No worse than the values determined pre-refurbishment 2 credits: 3dB improvement (airbourne amd impact sound insulation) 3 credits: 5dB improvement (airbourne amd impact sound insulation) 4 credits: 8dB improvement (airbourne amd impact sound insulation)	Acoustic report confirming airborne sound insulation values at least 5dB higher than Part E; and impact sound insulation values at least 5dB lower than Part E.	Acoustic Consultant	Appointment Required	
Hea 03: Volatile organic compounds	1	1	0	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.	Finishes schedule clearly showing the make/model and manufacturer for all finishes used on walls, floors and ceilings.	Architect	Outstanding	
					Corresponding certification confirming VOC emissions achieved and standard against which each product has been tested.	Architect & Contractor	Outstanding	
Hea 04: Inclusive design	2	2	0	Complete sections 1, 2 and 3 of Checklist A8.	Checklist A8 completed by access expert	Architect or Access Consultant	Outstanding	
Hea 05: Ventilation	2	2	0	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.	Confirmation that the ventilation system has been designed to comply with Section 5 of Building Regulations Part F.	M&E consultant	Appointment Required	Project must achieve at least 1 credit in order to obtain a BREEAM rating.
					As-built information confirming Part F has been achieved in full.	Contractor	Outstanding	
Hea 06: Safety	1	1	0	Dwelling provided with compliant fire detection and alarm systems. Where mains gas is used within dwelling, compliant carbon monoxide detection and alarm systems must be installed.	Written statement confirming fire detection and alarm systems; and layouts showing location of detectors and alarms.	M&E consultant	Outstanding	Project must achieve at least 1 credit in order to obtain a BREEAM rating.
					As-built drawings confirming location of smoke detectors and alarms	Architect or Contractor	Outstanding	
Total credits:	**12**	**8**	**2**					
Energy								
Ene 01: Improvement in energy efficiency rating	6	2.5	3.5	Credits awarded based on the improvement in the dwelling's EPC rating (see 'additional information tab' for details).	Pre-refurbishment (existing) and post-refurbishment (as-built) SAP worksheets for the dwelling	XCO2	Appointment Required	Please note two SAP calculations are required: one for the existing, pre-refurbishment development and one for the post-refurbishment development. **NOTE:** XCO2 will provide a preliminary assessment pre-planning, but the final as-built analysis would fall under a separate appointment.
Ene 02: Energy efficiency rating post-refurbishment	4	2	1.5	Credits awarded based on energy efficiency rating post-refurbishment (see 'additional information tab' for details).	Post-refurbishment (as-built) SAP worksheet for the dwelling.	XCO2	Appointment Required	Project must achieve at least 2 credits for "VERY GOOD". **NOTE:** XCO2 will provide a preliminary assessment pre-planning, but the final as-built analysis would fall under a separate appointment.
Ene 03: Primary energy demand	7	6	0	Credits awarded based on primary energy demand post refurbishment (see 'additional information tab' for details).	Post-refurbishment (as-built) SAP worksheet for the dwelling.	XCO2	Appointment Required	**NOTE:** XCO2 will provide a preliminary assessment pre-planning, but the final as-built analysis would fall under a separate appointment.
Ene 04: Renewable technologies	2	0	2	One credit: at least 10% of the dwelling's primary energy demand per annum is supplied by low or zero carbon technologies. Two credits: at least 15% of the dwelling's primary energy demand per annum is supplied by low or zero carbon technologies.	Post-refurbishment (proposed) SAP worksheet for the dwelling confirming LZC technologies (such as PVs) provide at least 15% of the dwelling's primary energy demand.	XCO2	Appointment Required	To achieve credits for this issue the development must achieve a primary energy demand for the dwelling of no greater than 220 kWh/m^2/year. **NOTE**: XCO2 will provide a preliminary assessment pre-planning, but the final as-built analysis would fall under a separate appointment.
Ene 05: Energy labelled white goods	2	2	0	First credit: fridges, freezers and fridge/freezers are A+ rated Second credit: washing machines are A++ rated, dishwashers A+ rated and waster-dryers / tumble dryers A rated.	Manufacturer's literature for all installed white goods (fridge-freezers, washing machines, tumble dryers and dishwashers).	Contractor	Outstanding	

BREEAM UK Refurbishment 2014 - Domestic Buildings
Score Sheet and Evidence Requirements

Project name: 9 The Green
Building type: Residential
Date: 04/01/2024
Version 15

Target score: 61.35
Target rating: VERY GOOD

Credit issue	Credits available	Credits targeted	Potential credits	Credit requirements	Evidence Required	Responsibility	Status	Notes
Ene 06: Drying space	1	1	0	At least 6m of fixed drying line provided for 3+ bedroom properties.	List of all installed white goods (including make/model and manufacturer)	Architect or Contractor	Outstanding	
					Manufacturer's specification for proprietary system installed	Architect or Contractor	Outstanding	
Ene 07: Lighting	2	2	0	**Internal lighting (one credit):** Internal lighting has an average wattage of no more than 9 Watts/m^2.	As-built internal lighting layouts confirming location and type of installed light fittings	Architect or Contractor	Outstanding	
					Manufacturer's literature for installed light fittings confirming wattage.	Contractor	Outstanding	
				External lighting (one credit): External lighting and lighting in communal areas has an efficiency of greater than 45 lumens per circuit Watt.	As-built lighting schedule confirming location and type of light fittings in communal areas (entrances, stairs, etc.).	n/a	Complete	External lighting must include automatic control to prevent operation during daylight hours.
					Manufacturer's literature for each installed luminaire type confirming an energy efficiency of greater than 45 lumens per circuit watt.	n/a	Complete	
					As-built external lighting schedule confirming location and type of all external luminaires.	Contractor	Outstanding	
					Confirmation that external lighting will be controlled by a time clock or daylight sensor to avoid operation during daylight hours.	Contractor	Outstanding	
					List of all installed security lighting (if present) confirming burglar security lights have a maximum wattage of 150W, PIR control and daylight cut-off sensors. Confirmation that any other security lighting has energy efficiency of greater than 45 lumens per circuit watt and is fitted with daylight cut-off sensors or timers.	Contractor	Outstanding	
					Written confirmation that the lighting design follows the requirements of CIBSE LG9 and does not compromise the safety of any persons using the building.	Contractor	Outstanding	
Ene 08: Energy display devices	2	2	0	Compliant, fixed, display screen is installed 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	Compliant M&E Specification AND Manufacturer's Literature confirming compliance with requirements.	M&E consultant or Contractor	Appointment Required	
Ene 09: Cycle storage	2	2	0	One credit: 1 cycle storage space provided Two credits: 2 cycle storage spaces provided	Drawing confirming location of cycle store; confirmation of number of spaces provided and security arrangements.	Architect	Complete	Shown on drawings, therefore complete as far as the Design Stage Assessment goes
Ene 10: Home office	1	1	0	Study cannot be located in kitchen or living room. 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.	Drawing showing location of home office; electrical layout confirming allocated room has sufficient services; GA drawings confirming allocated room has sufficient space.	Architect + M&E consultant	Outstanding	
Total credits:	**29**	**20.5**	**7**					

BREEAM UK Refurbishment 2014 - Domestic Buildings
Score Sheet and Evidence Requirements

Project name: 9 The Green
Building type: Residential
Date: 04/01/2024
Version 15

Target score: 61.35
Target rating: VERY GOOD

Credit issue	Credits available	Credits targeted	Potential credits	Credit requirements	Evidence Required	Responsibility	Status	Notes
Water								
Wat 01: Internal water use	3	2.5	0	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	Completed as-built water use schedule confirming type of water fittings installed	Architect or Contractor	Outstanding	Minimum standard for Very Good = 1 credit.
					Manufacturer's literature for each water using component confirming flow rate.	Contractor	Outstanding	
Wat 02: External water use	1	1	0	Compliant rainwater collection system specified for external or internal irrigation.	Manufacturer's literature for proprietary system installed (e.g. water butt).	Architect or Contractor	Outstanding	
Wat 03: Water meter	1	1	0	Water meter linked to internal display screen to provide a visible display of mains potable water consumption to occupants.	Compliance letter confirming specification of water meter with visible display; M&E specification; manufacturer's literature.	M&E consultant	Appointment Required	
Total credits:	**5**	**4.5**	**0**					
Materials								
Mat 01: Environmental impact of materials	25	0	12	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 the dwelling.	Completed as-built materials schedule including Green Guide ratings for build-ups and quantity information.	Contractor	Outstanding	Not currently targeted. To determine the actual number of credits achieved information must be provided for all newly specified materials (build-ups and areas).
Mat 02: Responsible sourcing of materials	n/a	n/a	n/a	All timber and timber-based products used on the project meets the UK Government's definition of 'legally harvested and traded timber'.	Confirmation of all timber suppliers and corresponding FSC/PEFC certificates	Contractor	Outstanding	This is a minimum requirement for all BREEAM ratings.
	n/a	n/a	n/a	Where the principal contractor sources materials for the project in accordance with a documented sustainable procurement plan **OR**	Not targeted - assuming contractor is a 'Micro-enterprise (see below)	n/a	Outstanding	Not targeted - instead option for small contractors is targeted - see line item below
	3	3	0	Where the principal contractor is a Micro-enterprise (<10 employees): Where the principal contractor addresses parts 1, 2 AND 3 of Checklist A-9: Sustainable procurement statement three credits can be awarded	Completed Checklist A9	Contractor	Outstanding	
	12	0	4	The available RSM credits can be awarded where the applicable building materials are responsibly sourced in accordance with the BREEAM methodology.	As-built materials schedule confirming supplier information and responsible sourcing certifications.	Contractor	Outstanding	Four credits have been estimated as 'potenital' at this stage, for achieving at least 18% of the available RSM points.
Mat 03: Insulation	8	8	n/a	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.	As-built materials schedule confirming insulation suppliers and products.	Contractor	Outstanding	
Total credits:	**48**	**11**	**16**					
Waste								
Wst 01: Household waste	2	2	0	First credit: internal and external recycling 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.	As-built drawings confirming location and size of internal and external bins.	Architect	Outstanding	
					Details of waste management/collection	Architect	Outstanding	
				For dwellings with significant external private space, all of the following must be met: 1 Where a composting service or facility is provided for green/garden waste; 2 Where a composting service or facility is provided for kitchen waste; 3 Where an interior container is provided for kitchen composting waste of at least seven litres.	Details of composting storage OR food waste collection scheme in place (incl internal and external caddy storage space)	Architect	Outstanding	
Wst 02: Refurbishment site waste management	3	1	2	Projects between £100,000 to £300,000: First credit: Compliant Site Waste Management Plan in place. Non-hazardous construction waste generated per £100,000 of project value no greater than 16.9 tonnes. At least 65% of non-hazardous construction waste (by weight) and 90% of non-hazardous demolition waste must be diverted from landfill.	Site Waste Management Plan	Contractor	Outstanding	
					Final figures for construction waste generation and recycling rates.	Contractor	Outstanding	Note: Further requirements come into play if the project value is greaterthan £300,000
Total credits:	**5**	**3**	**2**					

BREEAM UK Refurbishment 2014 - Domestic Buildings
Score Sheet and Evidence Requirements

Project name: 9 The Green
Building type: Residential
Date: 04/01/2024
Version 15

Target score: 61.35
Target rating: VERY GOOD

Credit issue	Credits available	Credits targeted	Potential credits	Credit requirements	Evidence Required	Responsibility	Status	Notes
Pollution								
Pol 01: Nitrogen Oxide (NOx) emissions	3	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).	Confirmation that the new boiler will generate no more than 40mg/kWh (Dry NOx)	M&E consultant and Contractor	Appointment Required	
Pol 02: Surface water run-off	3	1	1	One credit: Neutral impact on surface water Two credits: Reducing run-off from site (basic) Three credits: Reducing run-off from site (advanced)	Compliance letter; pre- and post-refurbishment drawings confirming no increase in impermeable area; drainage calculations.	Civil engineer and Contractor	Appointment Required	Neutral impact: Where there is no change in the size of the building footprint or hardstanding as a result of the refurbishment., OR where any new hardstanding areas are proposed, these are permeable, this must include all new pavements, driveways and where applicable public rights of way, car parks and non-adoptable roads).
					As-built drawings confirming no increase in impermeable area as a result of the development.	Contractor	Outstanding	
Pol 03: Flooding	2	0	2	FRA has been carried out and either the site is confirmed as 'low flood risk' or mitigation measures are implemented.	Flood risk assessment.	Civil Engineer / Flood Risk Consultant	Appointment Required	Not currently targeted
					Written confirmation that all recommendations within the flood risk assessment have been implemented.	Contractor	Outstanding	
Total credits:	**8**	**4**	**3**					
Innovation								
Man 05: Ecological enhancement	1	0	1	Implement all recommendations for enhancing site ecology (as listed in the Ecology Report).	Ecology Report	Ecologist	Appointment Required	This is already being carried out for the Non-Domestic RFO assessment.
Man 06: Early design input	n/a	n/a	n/a	Appointment of BREEAM AP to oversee key stages. OR	Compliance letter; early meeting minutes; BREEAM AP reports.	BREEAM AP	Outstanding	Not targeted - instead option for small projects is targeted - see line item below
	1	1	0	For small-scale projects (<5 dwellings): Appointment of BREEAM Assessor from early stages (prior to the production of a refurbishment specification).	Compliance letter; early meeting minutes; BREEAM Assessor notes.	BREEAM Assessor	Appointment Required	**Note:** XCO2's appointment covers this at the pre-planning stage, but continued appointment is required throughout the construction stages to award the credit
Man 06: Thermographic survey and air tightness testing	1	0	1	Where thermographic surveying and airtightness testing have been carried out at both pre-refurbishment and post-refurbishment stages.	Compliance letter.	Energy Consultant or Contractor	Appointment Required	If targeted, please note there is a requirement to complete two thermographic surveys - one before and one after the refurbishment works.
Hea 04: Inclusive design	1	0	1	Complete sections 1, 2 and 3 of Checklist A8.	Checklist A8 (sections 1-3) completed by access expert	Architect or Contractor	Outstanding	
Ene 08: Energy display devices	1	1	0	In addition to displaying information regarding electricity and gas use each device must be capable of recording historic consumption data for a minimum of two years.	Compliant M&E Specification AND Manufacturer's Literature confirming compliance with requirements.	M&E consultant	Appointment Required	
Total credits:	**12**	**2**	**3**	**A maximum of 10 Innovation credits can be achieved per assessment.**				

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