

Cross Deep Court, Heath Road, Twickenham, TW1 4AG

Energy Strategy Report



March 2023

Ref: 22-10334

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Revision	Initial	Rev A	Rev B	Rev C
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Abbreviations

ASHP:	Air Source Heat Pump
BER:	Building Emission Rate
CO ₂ :	Carbon Dioxide
CHP:	Combined Heat and Power
CSH:	Code for Sustainable Homes
DHW:	Domestic Hot Water
ESR:	Energy Strategy Report
GHG:	Green House Gas
GSHP:	Ground Source Heat Pump
GLA:	Great London Authority
HVAC:	Heating, Ventilation, and Air Conditioning
IES VE:	Integrated Environmental Solutions Virtual Environment
KWp:	Kilo Watt Power
KWh:	Kilo Watt Hour
LZC:	Low Zero Carbon
MVHR:	Mechanical Ventilation Heat Recovery
MCS:	Microgeneration Certification Scheme
NPPF:	National Planning Policy Framework
NCM:	National Calculation Methodology
OSM:	Open Street Map
PV:	Photovoltaic
SBEM:	Simplified Building Energy Modelling
SFP:	Specific Fan Power

TER: Target Emission Rate

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1. Executive Summary

This Energy Strategy Report demonstrates the predicted energy performance and carbon emissions of the proposed development located at **Cross Deep Court, Heath Road in Twickenham TW1 4AG.** The presented figures in this study are based on the most updated information provided by the design team (i.e. **the Architect**). The development will comprise of a **new-build 6 dwellings.** The overall analysis took into consideration the national building regulations (i.e. **Part L 1A**) and the local policy requirements. Based on the study assumptions, the project shall comply with the council local polices and buildings regulations.

1.1 Buildings Policy Requirements

The national building regulations require buildings to comply with the energy efficiency requirements. This shall be accomplished through capping the project carbon emissions below the regulated target. In addition to the above, the **Richmond** local council requires new developments to incorporate sustainable design and construction measures. The table below summarises the best practice building regulations and local policy requirements the assessment adopted for the development.

Policy:	Requirement	Compliance Check
Part L 1A (Criterion 1)	The calculated CO ₂ emissions rate for the buildings (i.e. BER) must not be greater than the Target CO ₂ Emissions Rate (i.e. TER).	The project achieved criterion 1 through the Be-Lean stage, by measures of improving fabric thermal performance and efficient building services.
GLA Best Practice requirements (for new buildings)	Major developments meet the carbon emission reduction requirements a 35% carbon reduction against Building Regulations Part L.	The proposed scheme has achieved over 40% carbon reduction.
	Monitor, verify and report on energy performance at be Seen Stage.	The Smart Meters are recommended to be installed to monitor the actual in-use energy consumption to minimize the performance gap.
London Borough of Richmond Local plans for climate change	The council Local Plan will promote sustainable, high-quality design and construction and alternative energy supplies.	The project makes the best use of improved thermal performance fabric materials and has achieved the required carbon reductions.

Table 1: Building National and Local Policy Requirements.

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1.2 Assessment Methodology and Strategies

The adopted methodology to mitigate the development CO_2 emissions is in alignment with the best practice Efficient Energy Hierarchy Guidance. Calculations have been completed using standard SAP methodology (using SAP10.1 CO_2 emission factors) for residential properties. The development building has been assessed using the best practice energy hierarchy strategies (i.e. GLA minimum 35% energy category improvement) which by default demonstrates Part L compliance.

Table 2 below explains the Energy Hierarchy stages and the suggested taken strategies to help the proposed development achieve the required carbon targets.

Stages	Strategies
<u>BE LEAN</u> Carbon Efficient Design (minimising energy demand)	 Improved fabric U-values beyond Part L 1A 2021. Energy efficient lighting fittings (i.e. LED). Further information could be found in the Be Lean Section.
BE CLEAN (Availability of CHP and communal heating systems)	• Analysis for local CHPs and communal heating systems been assessed. Further information could be found in the Be Clean Section.
BE GREEN On-site renewable technologies (i.e. ASHP, PVs, etc)	 Efficient Building services by using ASHP. Further information will be presented in Be Green section below.
BE SEEN In-use monitoring	• The Smart Meters are recommended to be installed to monitor the actual operational energy use, to manage it effectively and mitigate the performance gap.

Table 2: Best practice Energy Hierarchy to achieve 35% reductions over Part L requirement.

	Domestic Unit (tCO2/annum)
Notional TER	4.778
Baseline BER	3.834
Be-Lean BER (10% reduction)	2.687
Be-Clean BER	2.687
Be-Green BER (35% reduction)	2.068
CO ₂ Shortfall (tCO ₂ .annum)	2.068
Net Zero offset Fund (Shortfall*£95/tCO ₂ *30 years)	£5,893

Table 3: Results summary

The table above explains the carbon emissions per each stage of the energy hierarchy and the final required carbon offset fund to be net-zero.

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1.3 Assessment Results

1.1.1. Residential Flats

The new build residential dwellings has been simulated under four conditions to analyse the improvements hierarchy. The first simulation assessed the flats under the same notional building specifications. The function of this first simulation is to generate the regulated carbon target (TER) and the actual Dwelling Emission Rate (DER). The second calculation analysed the carbon reductions achieved after improving the building fabric thermal performance by adopting improved thermal Uvalue (i.e. Be Lean). The fourth simulation analysed the carbon reductions after considering renewable technologies as an effective design measure to achieve the 35% reductions beyond Part L1A requirements (i.e. Be Green).

Cross Place, Twickenham - Baseline scenario									
Dwelling Name	DER	TER	DPER	TPER	DFEE	TFEE	Total Floor Area	Total Floor Area	394.89
Unit 01 - Baseline	9.44	12.65	70.39	66.66	53.2	50.1	84.55	Average DER	9.71
Unit 03 - Baseline	9.05	12.1	68.42	63.78	50.2	47.3	84.71	Average TER	12.1
Unit 02 - Baseline	9.6	11.32	75.69	60.64	46.8	44.5	61.3	Average DPER	75.01
Unit 04 - Baseline	10.92	12.76	85.09	69.27	56.8	53.3	51.52	Average TPER	64.6
Unit 05 - Baseline	10.07	12.57	78.12	67.29	53	51.1	60.99	Average DFEE	51.06
Unit 06 - Baseline	9.73	10.91	78.87	59.45	46	44	51.82	Average TFEE	48.4

Cross Place, Twickenham - Be Lean scenario										
Dwelling Name	DER	TER	DPER	TPER	DFEE	TFEE	Total Floor Area	Total Floor Area	394.89	
Unit 01 - Be Lean	6.37	12.65	66.81	66.66	49.9	50.1	84.55	Average DER	6.8	
Unit 03 - Be Lean	6.16	12.1	64.71	63.78	46.7	47.3	84.71	Average TER	12.1	
Unit 02 - Be Lean	6.88	11.32	72.5	60.64	43	44.5	61.3	Average DPER	71.58	
Unit 04 - Be Lean	7.76	12.76	81.7	69.27	52.8	53.3	51.52	Average TPER	64.6	
Unit 05 - Be Lean	7.09	12.57	74.58	67.29	49	51.1	60.99	Average DFEE	47.31	
Unit 06 - Be Lean	7.19	10.91	75.93	59.45	41.7	44	51.82	Average TFEE	48.4	

	(Cross Place,	Twickenhai	n - Be Greer	n scenario				
Dwelling Name	DER	TER	DPER	TPER	DFEE	TFEE	Total Floor Area	Total Floor Area	394.89
Unit 04 - Be Green	5.94	12.76	62.3	69.27	52.8	53.3	51.52	Average DER	5.24
Unit 05 - Be Green	5.45	12.57	57.19	67.29	49	51.1	60.99	Average TER	12.1
Unit 06 - Be Green	5.39	10.91	56.73	59.45	41.7	44	51.82	Average DPER	54.91
Unit 01 - Be Green	4.99	12.65	52.16	66.66	49.9	50.1	84.55	Average TPER	64.6
Unit 03 - Be Green	4.81	12.1	50.37	63.78	46.7	47.3	84.71	Average DFEE	47.31
Unit 02 - Be Green	5.23	11.32	54.97	60.64	43	44.5	61.3	Average TFEE	48.4

Image 1: Domestic Carbon Emissions after each stage of the proposed strategy





2. Introduction

This energy strategy statement (ESR) has been prepared by Syntegra on behalf of the client (the Applicant) in support of a full planning application, (the Application), submitted to London Borough of Richmond for the residential redevelopment of Cross Deep Court, Heath Road in Twickenham, TW1 4AG (the Site), as shown within a red line drawing within the planning statement. Image 2 below display the site plan.

The site contains an existing four-storey corner-plot building, Cross Deep Court, located on the south Side of Heath Road and facing Cross Deep/King Street Parade to the east.

The proposal concerns two retail units within Cross Deep Court, Units 3 and 15. Unit 3 faces Cross Deep/King Street Parade to the east and comprises a ground floor pharmacy and an entrance to a gym, located on the upper floor(operated by Escape Fitness). Unit 15 fronts Heath Road to the north and comprises a ground and first floor retail unit and ancillary storage area (operated by Stevenson's sports shop). The upper levels from second floor and above are not covered by this application and are occupied by residential units.

This ESR provides Richmond Council with the energy strategies studied for the proposed scheme. The report presents how the annual energy consumption and related carbon emissions will be minimised to meet the regulated targeted carbon emissions **(i.e. PL 1A TER)**. Furthermore, the report explains how to reach the required energy targets to achieve the required carbon reductions for the development.

The residential sector plays an important role in the UK economy, both as a direct (and indirect) employer and generator of output, and in providing other sectors, such as retailers and financial and business services, with a critical factor of production – the physical location from which to do business. This ESR report analyses the project using research and policies guidance to make sure this major development is built up to achieve positive economic, social and environmental impacts.

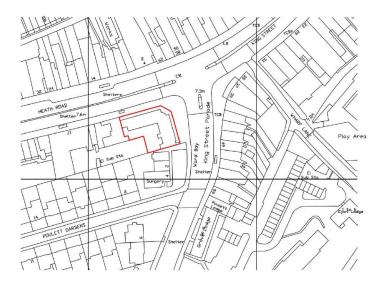


Image 2: Proposed development's site plan



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3. Planning Policy

The following planning policies and requirements have been identified as being applicable to the development and as such have informed the assessment methodology and production of the energy strategy for the proposed development.

3.1 National Planning Policy Framework (NPPF, February 2021)

The National Planning Policy Framework (NPPF) was published in 2021. The NPPF sets out the governments planning policies for England.

Section 2/Achieving Sustainable Development.

Sets out the sustainability objectives of the plan and outline the three overarching objectives which must be pursued in mutually supporting ways. The objectives are economic; social and; environmental.

Section 2, paragraph 7 of the NPPF states:

"The purpose of the planning system is to contribute to the achievement of sustainable development. At a very high level, the objective of sustainable development can be summarised as meeting the needs of the present without compromising the ability of future generations to meet their own needs4. At a similarly high level, members of the United Nations – including the United Kingdom – have agreed to pursue the 17 Global Goals for Sustainable Development in the period to 2030. These address social progress, economic well-being and environmental protection."

Section 2, Paragraph 8 of the NPPF states:

"Achieving sustainable development means that the planning system has three overarching objectives, which are interdependent and need to be pursued in mutually supportive ways (so that opportunities can be taken to secure net gains across each of the different objectives):

- a) an economic objective to help build a strong, responsive and competitive economy, by ensuring that sufficient land of the right types is available in the right places and at the right time to support growth, innovation and improved productivity; and by identifying and coordinating the provision of infrastructure;
- b) a social objective to support strong, vibrant and healthy communities, by ensuring that a sufficient number and range of homes can be provided to meet the needs of present and future generations; and by fostering well-designed, beautiful and safe places, with accessible services and open spaces that reflect current and future needs and support communities' health, social and cultural well-being; and
- c) an environmental objective to protect and enhance our natural, built and historic



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environment; including making effective use of land, improving biodiversity, using natural resources prudently, minimising waste and pollution, and mitigating and adapting to climate change, including moving to a low carbon economy.

Section 2, paragraph 10 states:

"So that sustainable development is pursued in a positive way, at the heart of the Framework is a presumption in favour of sustainable development (paragraph 11)."

3.2 The GLA Best Practice Energy Strategies for guidance only (e.g., London Plan 2021)

The London Plan 2021 prepared by The Mayor Of London came into force on 2nd March2021. Many London Boroughs have included the requirements below in their own local policies and these are considered relevant to this report:



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THE SPATIAL DEVELOPMENT STRATEGY FOR GREATER LONDON MARCH 2021

<u>Policy GG 6 – Increasing efficiency and resilience</u>; require that to help London become a more efficient and resilient city development must:

- a) Seek to improve energy efficiency towards a low carbon circular economy, contributing towards London becoming a zero carbon city by 2030;
- b) Ensure buildings and infrastructure are designed to adapt to climate change;



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- c) Create a safe and secure environment; and
- d) Take an integrated and smart approach to the delivery of strategic and local infrastructure.

Policy SI 1 – Improving air quality; Development proposals should not lead to further deterioration of existing poor air quality or create new areas that exceed air quality limits. Therefore, development must be air quality neutral and use design solutions to prevent exposure to existing air pollution. An air quality assessment should be submitted with major applications.

Policy SI 2 – Minimising Greenhouse Gas Emissions;

- (A) Major developments should be net zero-carbon and to utilise 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 efficiently and cleanly;
 - 3) Be green: maximize opportunities for renewable energy by producing, storing and using renewable energy on-site.
 - 4) Be Seen: Monitor, verify and report on energy performance.
- (B) Major development proposals should include a detailed energy strategy to demonstrate how the zero-carbon target will be met within the framework of the energy hierarchy.
- (C) A minimum on-site reduction of at least 35% beyond Building Regulations Part L 2013 is required for major development. Residential development should achieve 10% 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, and/or
 - 2) Off-site provided that an alternative proposal is identified, and delivery is certain.
- (D) Boroughs must establish and administer a carbon offset fund.

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- (E) Major development proposals should calculate and minimize unregulated emissions.
- (F) Development proposals referrable to the Mayor should calculate emissions through a nationally recognized Whole Life-Cycle Carbon Assessment and demonstrate actions taken to reduce life cycle carbon emissions.

<u>Policy SI 4 – Managing Heat Risk</u>; Development proposals should minimize impacts on the urban heat island through design, layout, orientation, materials, and the incorporation of green infrastructure.

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(A) 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 cooling hierarchy.

Policy SI 5 – Water infrastructure; Development proposals should:

- 1) Achieve a mains water consumption of 105 litres per person, per day.
- 2) Achieve BREEAM excellent standard for WAT 01 water category or equivalent (commercial development)
- 3) Incorporate measures such as smart metering, water saving and recycling measures to achieve a lower water consumption.

<u>Policy SI 7 – Reducing waste and supporting the circular economy</u>; referrable applications should aim to be net-zero waste and promote a circular economy during the construction and usage of the building. A circular economy statement should be prepared to support applications.

<u>Policy SI 12 – Flood Risk Management</u>; Strategic flood risk assessments should be used by developments to identify areas where flood risks exist and develop approaches to reduce these risks. Drainage should be designed to promote increased water efficiency, improve water quality, improve biodiversity, provide urban greening, amenity and recreation.

<u>Policy G4 – Open Space</u> – Developments should, where possible, create areas of publicly available open space, particularly in areas of deficiency, and resist the loss of protected open space in areas of deficiency.

<u>Policy G5 – Urban Greening</u>; Major development proposals should contribute to the greening of London by including urban greening.

- (A) Boroughs should develop an urban greening factor (UGF) to identify the appropriate amount of urban greening required in new developments. In the interim, the mayor recommends a target score of 0.4 for developments that are predominantly residential.
- (B) Existing green cover retained on site should count towards developments meeting the interim target scores set out in (A).

<u>Policy G6 – Biodiversity And Access to Nature</u> – Proposals should aim to establish a net biodiversity gain, and developments that reduce deficiencies in access to wildlife sites should be considered positively.

Policy G7 – Trees and Woodland – Wherever possible, existing trees of quality should be retained.

<u>Policy T2 – Healthy Streets</u> – Development proposals should show how the reduce the dominance of vehicles on London's streets, connect to local walking and cycling networks as well as public transport, and deliver improvements that support the ten healthy street indicators in line with TFL guidance:

1) Clean air





- 2) People feel relaxed
- 3) Things to do and see
- 4) People feel safe
- 5) People choose to walk, cycle, and use public transport
- 6) Not too noisy
- 7) Places to stop and rest
- 8) Shade and shelter
- 9) Easy to cross
- 10) Pedestrians from all walks of life

3.3 London Borough of Richmond Upon Thames

In July 2019, Richmond Council declared a Climate Emergency, committing to working towards becoming carbon neutral by 2030. Richmond published the Climate Emergency Strategy and the associated Action Plan. Reducing the borough's carbon emissions will require changes to the way we live and work, and changes from government and business. But change doesn't have to be a difficult, individual task; this is a unique opportunity to work together as a community to improve our quality of life and create a borough that's healthier, better to live in and fairer for everyone.



CLIMATE EMERGENCY STRATEGY GOAL: Become carbon neutral by 2030. This Climate Emergency Strategy sets out six main areas of focus around climate change and sustainability, ensuring that we comply with current legislation, have a framework to set robust targets, have identified key actions we need deliver and have the resources in place to achieve these actions.

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<u>Richmond Council - Becoming carbon neutral as an organisation by 2030</u> – To reduce the energy demands from our estate, generate our own renewable energy, minimise waste and eliminate single use plastics from our operations. Key target is to become carbon neutral as an organisation by 2030.

<u>Richmond legacy - Climate Change Mitigation and Energy Efficiency</u> – to work with residents, communities, businesses and partners to engage, involve and support them in tackling the climate emergency. This will ensure Richmond is able to plan, measure and respond proactively to the effects of climate change and the implications of resource scarcity. Main goal is to create an environment where Richmond is able to be sustainable and low carbon by default.

<u>Waste: Waste and Plastics and the Circular Economy</u> –To reduce, reuse, recycle into everything Richmond does around waste by working with the residents, businesses and schools to reduce the overall amount of waste generated in the borough and will aim to be one of the top performing boroughs in London for recycling. Key target is to reduce the amount of waste generated in the borough.

<u>Air: Improving Air Quality</u> – To develop and deliver an ambitious air quality plan that will make a meaningful change to air quality in the borough with an emphasis on reducing air pollution particularly around schools and town centres. By 2024, the target is to have less polluting traffic on our roads, contributing to an improvement in air quality across the borough. Key target is to improve the air quality in the borough.

<u>Nature: Green Infrastructure and Biodiversity</u> – To improve and protect the biodiversity and ecology of the green spaces and protect them against the negative impacts of climate change. Key target is to plant more trees.

<u>Water: Water Management and Flood Abatement</u> – To ensure that development across Richmond addresses flood risks and promotes sustainable drainage. Key target is to be fully prepared for flooding.

Legislation and Policy

While there is no legislation that directly obliges local authorities to decrease their emissions or set a target for being carbon neutral, local authorities are plugged into a dense network of overlapping policy requirements and frameworks that require us to have due regard to and take action on preventing and adapting to climate change in areas around.

In the Clean Growth Strategy (2017), the government introduced a voluntary target for the wider public and higher education sectors in England. This target aims to reduce greenhouse gas emissions across these sectors by 30% by 2020 to 2021, compared to a 2009 to 2010 baseline.

This target is voluntary and there is no requirement to report on it. The Home Energy Conservation Act 1995 ('HECA') requires all local authorities in England to submit reports to the Secretary of State demonstrating what energy conservation measures they have adopted to improve the energy efficiency of residential accommodation within that area.

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3.4 Meeting the challenge of climate change

One of the main challenges in any development is the ability to mitigate and adapt to the impact of climate change. In 2019 the government set out their ambition to reduce carbon emissions within the UK by 100%. As part of their declaration and response to the climate emergency both The Greater London Authority and The London Borough Of Richmond have set the more ambitious target to achieve this by 2030. Climate change will have an impact on the weather in the UK with winters becoming warmer and wetter with summers becoming warmer and drier. Designing buildings to mitigate and adapt to the impact of climate change will impact the design, construction and operation of all new buildings in the future. One of the NPPF's core planning principles is to include measures to mitigate and adapt to the effects of climate change in all new buildings as part of the planning process.

Reducing Embodied Carbon

Embodied carbon is the carbon used in the construction of a building. This includes carbon used during the extraction of raw materials, manufacture of goods, transportation of materials to site, installation and associated activities on site, maintenance and repair as well as the decommissioning and removal at the end of life of the building.

Embodied carbon is a significant part of the carbon associated with the construction of a building. The requirements of the Building Regulations and Planning authorities for highly energy efficient buildings may increase material usage and increase the level of embodied carbon for a building. As part of the planning submission a Whole Life Carbon Assessment (WLC) has not been undertaken. The assessment measures the carbon emissions associated with the proposed development over a period of 60 years from construction to end of life. In completing a whole life carbon assessment at this stage the building can be shaped to include sustainability and circular economy principles within the design.

Reducing Operational Carbon

National, regional and local planning policy focuses on the need to establish planning policies which create building having low operational carbon.

Recent updates to the Building Regulations support the reduction of energy demand through low carbon buildings.

The London plan requires new building to be net-zero operational. Developments are required to take all measures required to reduce the carbon emissions as much as possible with a minimum onsite reduction of 35% using measure such as fabric improvements, energy efficient systems and low carbon or renewable technologies.

Any shortfall in net-zero operational carbon are offset by a payment to the London Borough Of Richmond Carbon Offset Fund.

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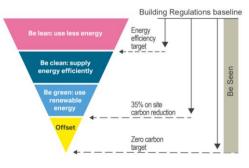
4. Assessment Methodology

4.1 The Energy Hierarchy

The energy hierarchy is a classification of different methods to improve energy performance in a parallel sequence. This includes primarily a focus on reducing energy use by avoiding unnecessary consumption, to then improving the efficiency of energy systems to minimise loss. This is followed by exploiting renewable energy sources and low carbon energy solutions for energy needs. Finally, any remaining demand can be catered for by conventional fuel sources and carbon offsetting solutions.

The Energy Strategy adopts a set of principles to guide design development and decisions regarding energy, balanced with the need to optimise environmental and economic benefits. The following hierarchy should be used to assess applications:

- **BE LEAN** By using less energy and considering the further energy efficiency measure in comparison to the baseline building.
 - Improved U values beyond those required for the Building Regulations Part L 2021.
 - Improved thermal bridging details.
 - 100% energy efficient lighting throughout the development.
- **BE CLEAN** By supplying energy efficiently. Clean energy use looks at further carbon dioxide emission savings over the lean building by taking into consideration the use of decentralise energy (e.g. CHP, District Heat Networks).
- **BE GREEN** By integrating renewable energy into the scheme which can further reduce the carbon dioxide emission rate.
- **BE SEEN** By monitoring, verifying, and reporting on energy performance to use energy mode effectively.



Source: Greater London Authority

Image 3: GLA Energy Hierarchy





4.2 Modelling Strategy

The Government approved software **StromaSAP10**, has been utilised to carry out the project compliance simulations (i.e., SAP) according to the National Calculation Methodology (NCM). Simulated Models are built to assess the actual building BER against the notional building TER. The notional building used to determine carbon dioxide targets (TER) is the same size and shape as the actual buildings, constructed to concurrent regulated specifications (i.e. **Part L1A**).

The actual building has been modelled entirely to the notional building specifications in order to meet the carbon targets and the limiting fabric and buildings services parameters. However, for differences in fabric design and glazing areas, actual buildings sometimes are expected to exceed the notional TER. Therefore, further improvements to the actual building parameters (e.g. fabric, HVAC, lightings, renewables) are made to meet the required compliance targets.

Syntegra received architectural drawings and project relevant documents. Received information is used to undertake the ultimate energy assessments and supporting the modelling assumptions. The document references are listed in the table below.

No.	Document Name	Format	Received Date
1	698-CDA-ZZ-00-DR-A-05-0002-Proposed Site Plan	PDF	February 2023
2	698-CDA-ZZ-00-DR-A-05-0101-Proposed Ground Floor Plan	PDF	February 2023
3	698-CDA-ZZ-00-DR-A-05-0103-Proposed First Floor Plan	PDF	February 2023
4	698-CDA-ZZ-XX-DR-A-00-0100-OS PLAN	PDF	February 2023
5	698-CDA-ZZ-ZZ-DR-A-05-0201-Proposed North Elevation	PDF	February 2023
6	698-CDA-ZZ-ZZ-DR-A-05-0203-Proposed East Elevation	PDF	February 2023
7	698-CDA-ZZ-ZZ-DR-A-05-0205-Proposed South Elevation	PDF	February 2023
8	698-CDA-ZZ-ZZ-DR-A-05-0207-Proposed West Elevation	PDF	February 2023

Table 3: Energy assessment document list

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5. BASELINE - Target Emission Rate (TER) & Actual Dwelling Rate (DER)

The initial stage of the energy hierarchy is to establish a baseline. The baseline details the requirements to comply with the Building Regulations Part L 2021 and serves as a benchmark for all other stages.

The baseline regulated CO₂ emissions for the development are presented in the table below:

Model Name		missions ′m².annum)
	<u>TER</u>	<u>DER</u>
Domestic	12.1	9.71

Table 4: Regulated Energy Use and Carbon Emissions TER at Baseline



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6. BE LEAN - Energy Efficient Design

This section outlines the project condition analysis and energy efficient measures taken in order to minimise the building's energy demand. The analysis helps reducing the energy use and CO₂ emissions further than the Baseline results and achieving TER compliance (Building Regulations 2013 **Part L 1A& 2A** compliance).

6.1 Site weather and Microclimate

The local weather microclimate usually influences buildings' energy performance. Urban design has a significant impact on microclimate and outdoor thermal comfort. Several studies in different climate regions have concluded that ventilation and shade are crucial to improve urban thermal comfort. Often the thermal conditions are improved as a consequence of good urban design including exist of proper shade and sufficient ventilation. This in turn leads to decreased occurrence of heat stress and heat-related diseases as well as grown performance of both mental and physical tasks.

The nearest weather station is in London, and this will be used for thermal and energy simulations.

The site's landscape also affects the energy demand of a building. Vegetation, landform, and any existing buildings can provide shade to a new development. For instance, if located to the south of the building, deciduous trees can be advantageous, providing shade in the summer but allowing sunshine through in the winter when they lose their leaves. However, any tree used for energy conservation should be considered as part of a much larger landscape.

6.2 Building Orientation, layout, and form

Building layout, orientation and form can influence many key features of the development. The design should provide for an effective use of space and appealing layout, with opportunities to benefit from natural daylight balanced with achieving solar gain without overheating. In general, a higher thermal performance can be achieved by limiting the surface area to volume ratio as this minimises heat loss through the wall area.

It should be noted that where the building footprint is extremely tight, for example in a city centre location, then the building form and orientation may have to be dictated by the available space and not by implementation of best practice measures. Invariably, planning constraints and/or the functional relationships of specific areas will result in some measure of deep planning, thus reducing the opportunity for natural ventilation.

Planning the internal layout of buildings and space to maximise the benefits of solar gain and minimise the disadvantages is essential. Spaces where overheating would be critical can be placed on the north side of the building or overhangs used to protect from excessive solar gain.

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Image 4: Proposed Building site

6.3 Building Design – Energy Efficiency Design Measures

• Enhancing Building Fabric Thermal Performance

At the 'BE LEAN' stage of the energy hierarchy, energy efficient building elements have been incorporated into the model. The heat loss of different building element is dependent upon their U-value, air permeability, and thermal bridging Y-values. Therefore, better U-values and air permeability figures than the minimum values set in the **Part L1A 2021** have been suggested in this stage of simulation. Table 5 below presents the different U-values used.

Build	ling Type	Domest	ic Residential flats
	tegory cification	Part L 1A Notional	Be-lean Improved values
U-value	Wall	0.18	0.13
(W/m² K)	Window	1.20	1.2
	Floor	0.13	0.11
	Doors	1.00	1.00
Air Permeabilit	Air Permeability (<i>m³/h.m² at 50 Pa</i>)		5.00

Table 5: Residential Proposed fabric and building Elements

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The building is adopting the following measures for the fabric thermal performance:

- Enhanced envelope U-values to reduce the building's heating loses and demand.
- Providing a well-sealed envelope to minimize the infiltration of cold winter air and warm air in summer to reduce the building's heating and cooling requirement.
- Minimizing thermal bridging by using accredited construction details to reduce the building's heating and cooling requirement.
- Adopting a window to wall ratio that prioritizes daylight but controls solar gain and glare to reduce electric lighting energy consumption while mitigating overheating.
- Providing exposed thermal mass to provide passive cooling suppresses summertime overheating to acceptable levels without the need for high energy consuming and expensive to run and maintain mechanical cooling systems.

6.4 Daylighting and Solar Shading Strategy

The scheme benefits from the usage of solar performance glazing. The glazing specification is carefully selected to ensure the internal environment is pleasant on all orientations and the selected g value is 0.63.

6.5 Ventilation strategy

A natural ventilation strategy will be adopted with extract fans in wet rooms; bathrooms, kitchens and utility rooms (if there is any). Therefore, lower energy consumption and CO₂ emissions due to avoiding mechanical ventilation.

The following table demonstrates the reduction in CO_2 emissions from the energy efficiency measures mentioned above.

BE LEAN STAGE

Building Type	Notional TER (KgCO ₂ /m ² .annum)	DER at BE-LEAN (KgCO ₂ /m ² .annum)
Domestic flats	12.1	6.8

Table 6: Regulated Carbon Emissions (DER) at Be Lean Stage

At the 'BE LEAN' stage of the energy hierarchy, energy efficient building elements have been incorporated into the model. The heat loss of different building element is dependent upon their U-value, air permeability, and thermal bridging Y-values.





7. BE CLEAN – CHP & Decentralised Energy Networks

The Energy Hierarchy encourages the use of local CHP system and connection to District Heating systems to reduce CO_2 emissions further.

7.1 Decentralised Energy Network

District and community heating systems are favoured because they offer:

- Potential economies of scale in respect of efficiency and therefore reduced carbon emissions;
- Greater potential for future replacement with Low or Zero Carbon (LZC) technologies.

The feasibility of connecting into an existing heating network or providing the building with its own combined heat and power plant has been assessed alongside the **London Heat Map**, see image 5 below, as part of this assessment. The map identifies that the site is not located near to an existing or a proposed district heating network. The nearest proposed heat network is roughly 3,500 km away from the project site address. This has been demonstrated from the London Heat Map (http://www.londonheatmap.org.uk).

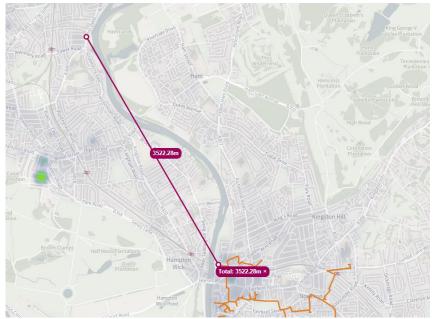


Image 5: London Heat Map near the site

It is proposed for this development to utilise air source heat pump installations to provide a low temperature heating network within the building to be used for heating and hot water within the residential units.





Cooling Hierarchy

Policy SI 4 of the London Plan outlines a hierarchy of measures which should be followed in order to reduce the demand for cooling within the development. These have been included as follows:

Multiple strategies have been considered for this development to reduce the cooling demand and the overheating risks.

- ✓ Firstly, internal heat loses shall be reduced through energy efficient design during design development. It will include minimising duct lengths and adopting pipe configurations which minimise heat loss (e.g., twin pipes).
- ✓ Minimising Internal Heat Gains DHW circulation pipe recommended to been eliminated in the communal areas of the development.
- ✓ Reducing Solar Gains As stated previously, low G-Values have been targeted.
- ✓ Thermal Mass Thermal mass is being incorporated though the floor slabs, external walls and roof however further investigation will be undertaken as to the design of these finishes to try to capitalise on the thermal massing wherever possible, so as to help regulate the internal temperature.
- ✓ Lastly, a mix of passive ventilation and mechanical extraction strategies will be adopted with extract fans in wet rooms (e.g., toilets, and food preparation) to remove the hot humid air and help free cooling.

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8. BE GREEN – Renewable Energy Appraisal

In this section the viable renewable energy technologies that could reduce the development's CO_2 emissions are examined. In determining the appropriate renewable technology for the site, the following factors are considered.

- Renewable energy resource or fuel availability of the LZC technology on the site.
- Implementation with regards the overall M&E design strategy for building type.
- Capital, operating and maintenance cost available for the project.
- Planning Permission form the local council.
- Available Grants.

The table below summarises the various low zero carbon technologies considered for the projects, and we have identified that **Air Source Heat Pumps (ASHP)** would be the most appropriate option in this development.

The Government has outlined its ambitions for residential and non-domestic developments to be delivered to a zero-carbon standard. It is anticipated that zero carbon development will be realised predominantly through energy efficiency measures and the use of on-site low or zero carbon energy and connected heat. However, it is recognised that it will be difficult to deliver all the carbon savings necessary to meet zero carbon standards on site through these measures alone.

Technology Name:	Carbon Payback	Feasibility
Photovoltaic (PV)	High	LOW
Air Source Heat Pumps (ASHP)	High	HIGH
Biomass	High	LOW
Wind Power	Low	LOW
Hydro Power	None	LOW
Solar Thermal	Low	LOW
Ground Source Heat Pumps (GSHP)	Medium	LOW

Table 8: Feasibility Study of LZC Technologies

8.1 Non-feasible Technology

• Ground Source Heat Pumps (GSHP)

Ground source heat pump would be a feasible option to meet the space heating requirements, however, it requires ground space for bore holes to extract the ground heat in order to be utilized for space heating requirements. However, this has not been discounted due to unknown ground conditions/ contamination statues and expensive CAPEX cost for investigating.



• Solar Thermal

The use of solar thermal for this development would be limited to domestic hot water only. The use of solar thermal for space heating would not be practical as it is not required when solar thermal is at its most effective during the summer months. Area coverage on the roof is an issue as well. Moreover, according to the scheme scale the expected carbon offset from the system is generally lower compared to other LZC technologies.

• Hydro power

Small-scale hydroelectric will not be studied any further because of the location and the spatial limitations of the development.

• Wind Power

Wind turbines need extensive planning requirements, and they are only feasible at consistent wind speed. Moreover, there is no available wind grid located near the project location (<u>http://www.renew-reuse-recycle.com/noabl.pl?n=503</u>). Hence this option has been discounted.

Squares surrounding the central square correspond to wind speeds for surrounding grid squares. Power generated is related to windspeed by a cubic ratio. That means if you halve the windspeed, the power goes down by a factor of 8 (which is $2 \times 2 \times 2$). A quarter of the windspeed gives you a 64^{th} of the power ($4 \times 4 \times 4$). As a rough guide, if your turbine is rated at producing 1KW at 12m/s then it will produce 125W at 6m/s and 15W at 3m/s.

Please note that bear in mind that the NOABL windspeed dataset used here is a model of windspeeds across the country, assuming completely flat terrain. It isn't a database of measured windspeeds. Other factors such as hills, houses, trees and other obstructions in your vicinity need to be considered as well as they can have a significant effect. If you're thinking about installing a wind turbine, you should perform your own windspeed measurements using an anemometer to determine what the actual figures are.

• Biomass

A biomass system designed for this development would be fueled by wood pellets which have a high energy content. However, a biomass system would not be an appropriate technology for the site for the following reasons:

- A. The burning of wood pellets releases substantially more NOx emissions when compared to similar gas boilers. As the development is situated within an urban area, the installation of a biomass boiler would further impact on the air quality in this area.
- B. Pellets would need to be transported from local pellet suppliers, which causes carbon emissions to the air.
- C. Site doesn't have an adequate storage space impacting layout and logistics arrangements.

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8.2 Proposed Technology

• Air Source Heat Pumps

An ASHP, specified **BS EN 14511-3**, can meet the space heating demands on site efficiently in comparison with gas boilers. Although this low carbon technology consumes electricity to operate, due to higher efficiency the heat output is much greater. Therefore, it has been suggested for the space heating, and hot water demand. The design stage specifications used for energy calculations are in the table below. However, the ASHP was proposed only for simulation, detailed ASHP specifications will be provided by a mechanical engineer during the design development. The system must be certified under the Microgeneration Certification Scheme (MCS).

<u>Please note that if ASHP technology is not viable then conventional boilers will be used which will not</u> <u>achieve the required CO2 reduction.</u>

Given the proposed LZC technologies on the site (i.e., **ASHP**), the overall CO2 reduction at BE GREEN stage can be calculated as shown below.

Building	TER	DER at BE-GREEN	Carbon Savings at
	(KgCO ₂ /m ² .annum)	(KgCO ₂ /m ² .annum)	Be-Green
Domestic	12.1	5.24	56.69%

Table 09: Regulated Carbon Reduction at Be-Green Stage



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9. BE SEEN

The new development will be required to monitor, verify and report on energy performance for a period of at least five years in accordance with Policy SI 2 of the London Plan.

Developments are required to review the predicted operational energy demand of a development and compare this to the actual energy consumption of the building once it is occupied.

The Be Seen Energy Monitoring Guidance (September 2021) sets out the requirements for developers to take a number of actions within four weeks of a successful planning approval:

- Upload the necessary contextual and performance data to the 'be seen' portal
- Confirm the target dates for all subsequent 'be seen' stages

• Confirm that metering plans that will enable the in-use energy performance reporting are in place In line with the Be Seen guidance document, this Energy Strategy outlines the majority of the information required at this stage of the development, with estimates provided for the entire development as a whole, as opposed to listing estimates for each home.

The Be Seen Energy Monitoring Guidance (September 2021) sets out further requirements to be undertaken by the developer at as-built stage:

- Update the contextual data and upload energy performance predictions onto the 'be seen' portal.
- Confirm that the metering installation is complete and correctly calibrated.

At in-use stage it is likely that ownership of the building will revert to a management company to operate the building on behalf of leaseholders. The client will appropriately secure these responsibilities (to be confirmed by the developer) between the Local Authority, the client and the management company.

The Be Seen Energy Monitoring Guidance (September 2021) sets out the requirements to be undertaken by the management company at in-use stage:

- Submit energy performance data annually for at least five years.
- Where actual performance differs from estimated performance, identify the causes and the potential mitigation measures.

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10. Conclusion

This report assesses the predicted energy performance and carbon dioxide emissions of the proposed development at **Cross Deep Court, Heath Road in Twickenham TW1 4AG.**

Based on the information provided by the design team, the study has been done on the **new build 6 residential dwellings**. The study results showed that efficient thermal performance building fabric and heating systems are keys to achieve building regulations compliance. Moreover, ASHP technology proved to be a major measure to achieve over **40%** reductions beyond Part L requirements. The carbon savings from each stage are shown in the chart below. Given the total cumulative carbon savings, the proposed development shall meet the planning requirements on the site and the designed excellent ratings.

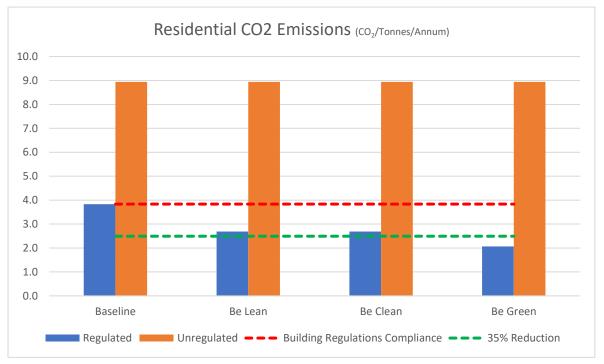


Chart 1: Carbon Emissions Reductions after each stage of the Energy Hierarchy

The table outlines the savings from the baseline to Be Green stage as being 46% meaning that a saving of 1.766 tonnes of CO_2 will be saved per year throughout the life of the building.

Development Overall Carbon Savings

Building	Baseline DER	DER at BE-GREEN	Carbon Savings at Be-
	(KgCO ₂ /m ² .annum)	(KgCO ₂ /m ² .annum)	Green
Domestic	9.71	5.24	46.03%

Table 10: Overall Regulated Carbon Reduction

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Appendix – SAP Calculations

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Dwelling Reference: Dwelling Type: EN5 5SU

Unit 02 Existing Dwelling

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Infiltration due to chimneys, flues, fans, PSVs, etc0009Additional infiltration000(1)Structural infiltration000(1)Suspended wooden ground floor000(1)No draught lobby000(1)Percentage of windows and doors draught proofed00(1)Window infiltration00(1)Infiltration rate00(1)Air permeability value, AP50, (m³/h/m²)55(1)Air permeability value, AP4, (m³/h/m²)00(1)Air permeability value)0.370.37(1)Number of sides on which dwelling is sheltered22(1)Shelter factor0.85(2)0.31(2)Infiltration rate modified for monthly wind speed00.31(2)			Air changes	per hour		
Additional infiltration00(1)Structural infiltration00(1)Suspended wooden ground floor00(1)No draught lobby00(1)Percentage of windows and doors draught proofed00(1)Window infiltration00(1)Infiltration rate00(1)Air permeability value, AP50, (m³/h/m²)55(1)Air permeability value, AP4, (m³/h/m²)00(1)Number of sides on which dwelling is sheltered22(1)Shelter factor0.85(2)Infiltration rate modified for monthly wind speed0.31(2)				0.12	0.12	(8)
Structural infiltration00(1Suspended wooden ground floor00(1No draught lobby00(1Percentage of windows and doors draught proofed00(1Window infiltration00(1Infiltration rate00(1Air permeability value, AP50, (m³/h/m²)55(1Air permeability value, AP4, (m³/h/m²)00(1Number of sides on which dwelling is sheltered22(1Shelter factor0.370.37(1Infiltration rate incorporating shelter factor0.31(2Infiltration rate modified for monthly wind speed001						(9)
Suspended wooden ground floor0001No draught lobby0001Percentage of windows and doors draught proofed0001Window infiltration0001Infiltration rate0001Air permeability value, AP50, (m³/h/m²)551Air permeability value, AP4, (m³/h/m²)001Air permeability value)0.370.371Number of sides on which dwelling is sheltered221Shelter factor0.85(2Infiltration rate incorporating shelter factor0.31(2Infiltration rate modified for monthly wind speed001						(10)
No draught lobby00(1)Percentage of windows and doors draught proofed00(1)Window infiltration00(1)Infiltration rate00(1)Air permeability value, AP50, (m³/h/m²)55(1)Air permeability value, AP4, (m³/h/m²)00(1)Air permeability value, AP4, (m³/h/m²)0.370.37(1)Number of sides on which dwelling is sheltered22(1)Shelter factor0.85(2)Infiltration rate incorporating shelter factor0.31(2)Infiltration rate modified for monthly wind speed000						(11) (12)
Percentage of windows and doors draught proofed00(1Window infiltration00(1Infiltration rate00(1Air permeability value, AP50, (m³/h/m²)55(1Air permeability value, AP4, (m³/h/m²)00(1Air permeability value)0.370.37(1Number of sides on which dwelling is sheltered22(1Shelter factor0.85(2Infiltration rate incorporating shelter factor0.31(2Infiltration rate modified for monthly wind speed11						(12)
Window infiltration00(1Infiltration rate00(1Air permeability value, AP50, (m³/h/m²)55(1Air permeability value, AP4, (m³/h/m²)00(1Air permeability value)0.370.37(1Number of sides on which dwelling is sheltered22(1Shelter factor0.85(2Infiltration rate incorporating shelter factor0.31(2Infiltration rate modified for monthly wind speed11	Percentage of windows and doors draught proofed					(14)
Air permeability value, AP50, (m³/h/m²)55(1Air permeability value, AP4, (m³/h/m²)00(1Air permeability value)0.370.37(1Number of sides on which dwelling is sheltered22(1Shelter factor0.85(2Infiltration rate incorporating shelter factor0.31(2Infiltration rate modified for monthly wind speed				0	0	(15)
Air permeability value, AP4, (m³/h/m²)00(1Air permeability value)0.370.37(1Number of sides on which dwelling is sheltered22(1Shelter factor0.85(2Infiltration rate incorporating shelter factor0.31(2Infiltration rate modified for monthly wind speed000						(16)
Air permeability value)0.370.37(1Number of sides on which dwelling is sheltered22(1Shelter factor22(1Infiltration rate incorporating shelter factor0.85(2Infiltration rate modified for monthly wind speed0.31(2						(17)
Number of sides on which dwelling is sheltered222(1Shelter factor0.85(2Infiltration rate incorporating shelter factor0.31(2Infiltration rate modified for monthly wind speed0.31(2						(17a
Shelter factor0.85(2Infiltration rate incorporating shelter factor0.31(2Infiltration rate modified for monthly wind speed(2						(18) (19)
Infiltration rate incorporating shelter factor 0.31 (2) Infiltration rate modified for monthly wind speed (2)				2		(20)
Infiltration rate modified for monthly wind speed						(20)
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Total (2					0.31	(44)
	Jan Feb Mar Apr May Jun	Jul Aug	Sep Oct N	lov Dec	Total	(22)







Monthly average wind speed from Table U2

	Wind Fac	5.1 ctor	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7	52.5	(22)
	Adjusted	1.28 I infiltrati	1.25 on rate (a	1.23 allowing f	1.1 for shelte	1.08 r and wir	0.95 nd speed)	0.95	0.93	1	1.08	1.13	1.18	13.13	(22a)
	Calculate	0.4 e effective	0.39 e air char	0.38 nge rate f	0.34 or the ap	0.34 plicable o	0.3 case:	0.3	0.29	0.31	0.34	0.35	0.37	4.11	(22b)
														0	(23a)
														0	(23b)
														0	(23c)
a) If balanced mechanical ventilation with heat recovery (MVHR)															
		0	0	0	0	0	0	0	0	0	0	0	0		(24a)
	b) If bala	nced me	chanical v	ventilatio	n withou	t heat ree	covery (N	1V)							
		0	0	0	0	0	0	0	0	0	0	0	0		(24b)
	c) If who	le house	extract v	entilatior	i or positi	ive input		on from c	outside						
	ما) الأسمعان	0	0	0 whale he	0	0	0	0	0	0	0	0	0		(24c)
	d) ir natt	ural ventil			-	-									
	Effective	0.58 air chan	0.58 ge rate	0.57	0.56	0.56	0.54	0.54	0.54	0.55	0.56	0.56	0.57		(24d)
	Tffe etites	0.58	0.58	0.57	0.56	0.56	0.54	0.54	0.54	0.55	0.56	0.56	0.57		(25)
	Effective	air chan	ge rate fr	OIN PCDB											
		0.58	0.58	0.57	0.56	0.56	0.54	0.54	0.54	0.55	0.56	0.56	0.57		(25)

3. Heat losses and heat loss parameter

Items in the table below are to be expanded as necess	ssary to allow for all different types of element	nt e.g. 4 wall types. The k -value
FLEMENT	AXU	AXk

	(W/K)	kJ/K	
Doors	2.1		(26)
Windows	17.83		(27)
Roof window	0		(27a)
Basement floor	0	0	(28)
Ground floor	0	0	(28a)
Exposed floor	10.99	6341.25	(28b)
Basement wall	0	0	(29)
External wall	12.13	12807.9	(29a)
Roof	0	0	(30)
Total area of external elements ∑A, m ²		169.63	(31)
Party Wall	0	9745.2	(32)
Party floor		0	(32a)
Party ceiling		0	(32b)



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Internal wall **												0	(33c)
Internal floor												0	(32d)
Internal ceiling f	oor											0	(32e)
Fabric heat loss,	W/K = ∑ (A x U)										43.05	(33)
Heat capacity Cn	ו = ∑(A x I	<)										28894.35	(34)
Thermal mass pa	rameter	(TMP = Cr	m ÷ TFA)	in kJ/m²k	(250	(35)
Linear Thermal bridges: Σ (L x Ψ) calculated using Appendix K											22.66	(36)	
Point Thermal bridges: $\Sigma \chi$ (W/K) if significant point thermal bridge present and values available										22.66	(36a)		
Total fabric heat	loss H = 2	<u>(</u> (A × U) +	∑(L×Ψ)	+∑χ								65.71	(37)
Ventilation heat	loss calcu	lated mo	nthly										
48.52	48.26	48.01	46.81	46.59	45.55	45.55	45.36	45.95	46.59	47.04	47.51		(38)
Heat transfer co	efficient,	W/K											
	113.97		112.53	112.31	111.27	111.27	111.08	111.67	112.31	112.76	113.23		(39)
Heat loss parame	eter (HLP)	, W/m²K											
1.35	1.35	1.35	1.33	1.33	1.32	1.32	1.31	1.32	1.33	1.33	1.34		(40)
Number of days	in month	(Table 1a)										
31	28	31	30	31	30	31	31	30	31	30	31		(41)

4. Water heating energy requirement

Assumed occupa	ancy N											2.54	(42)
Hot water usage		per day fo	r mixer s	howers \	/d showe	er (from 4	Annendiv	D D				2.54	(42)
		-				-		-			04 50		(12-)
91.94 Hot water usage	90.56 in litres r	88.55 Der dav fo	84.69 r baths. \	81.85 /d.bath (1	78.68 from App	76.88 endix J)	78.88	81.07	84.47	88.41	91.59		(42a)
30.4	29.95	29.31	28.14	27.26	26.29	25.76	26.39	27.08	28.12	29.32	30.3		(42b)
Hot water usage								27.00	20.12	23.32	50.5		(120)
42.82	41.26	39.71	38.15	36.59	35.03	35.03	36.59	38.15	39.71	41.26	42.82		(42c)
Annual average	hot water	usage in	litres per	day Vd,a	average (from App	endix J)					152.12	(43)
Hot water usage	in litres p	per day fo	r each m	onth Vd,ı	m = (42a)	+ (42b) +	+ (42c)						
		157.56			140		141.86		152.3	158.99	164.7	1823	(44)
Energy content of	of hot wat	ter used =	4.18 x V	d,m x nm	i x DTm /	3600 kW	/h/month	(from A	ppendix J)			
		242.17	206.69	196.14	172.15	166.51	175.65	180.4	206.67	226.51	257.89	2522.7	(45)
Distribution loss	(46) = 0.1	L5 x (45)											
39.24		36.33	31	29.42	25.82	24.98	26.35	27.06	31	33.98	38.68		(46)
Storage volume	-	-	y solar o	r www.hk:	S storage	within sa	ame vess	ei				0	(47)
Water storage lo	-	-	atan ia lu) / h / d a) .							_	
a) If manufactur			actor is ki	nown (kv	vn/day):							0	(48)
Temperature factor from Table 2b Energy lost from water storage, kWh/day (48) x (49) =								0	(49)				
		-										0	(50)
b) If manufactur													
Hot water storage	se ioss rac		i abie 2 (I	cvvn/ntre	e/uay)							0	(51)



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Volume factor from Table 2a Temperature factor from Table 2b	0 0	(52) (53)
Energy lost from water storage, kWh/day	0	(54)
Enter (50) or (54) in (55)	0	(55)
Water storage (or HIU) loss calculated for each month (56) = $(55) \times (41)$		
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		(56)
(57) m = (56) m $\mathbb{I}[(47) - Vs] \div (47)$, else (57) m = (56) m		
where Vs is Vww from Appendix G3 or (H12) from Appendix H (as applicable).		
0 0 0 0 0 0 0 0 0 0 0		(57)
Primary circuit loss for each month from Table 3		
modified by factor from Table H4 if there is solar water heating and a cylinder thermostat, although not for DHW-only	[,] heat netwo	
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 Combi loss for each month from Table 3a, 3b or 3c (enter 0 if not a combi boiler)		(59)
50.96 46.03 50.96 49.32 50.96 49.32 50.96 49.32 50.96 49.32 50.96		(61)
Total heat required for water heating calculated for each month $(62) = 0.85 \times (45) + (46) + (57) + (59) + (61)$		(01)
312.53 276.38 293.13 256 247.1 221.46 217.46 226.61 229.71 257.63 275.82 308.85	3122.7	(62)
CWWHRS DHW input calculated using Appendix G (negative quantity) (enter 0 if no WWHRS contribution to water hea	ating)	
0 0 0 0 0 0 0 0 0 0		(63a)
PV diverter DHW input calculated using Appendix G (negative quantity) (enter 0 if no PV diverter contribution)		(c2h)
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		(63b)
		(63c)
FGHRS DHW input calculated using Appendix G (negative quantity) (enter 0 if no FGHRS contribution to water heating	;)	()
0 0 0 0 0 0 0 0 0 0 0		(63d)
Output from water heater for each month, kWh/month (64) = (62) + (63a) + (63b) + (63c) + (63d)		
312.53 276.38 293.13 256 247.1 221.46 217.46 226.61 229.71 257.63 275.82 308.85 Output from water heater for each month, kWh/month (64) = (62) + (63a) + (63b) + (63c) + (63d)	3122.7	(64)
0 0 0 0 0 0 0 0 0 0 0		(64a)
Heat gains from water heating, kWh/month 0.25 x [0.85 × (45) + (61) + (64a)] + 0.8 x [(46) + (57) + (59)]		
99.71 88.1 93.26 81.05 77.96 69.57 68.1 71.14 72.31 81.46 87.64 98.49 include (57) m in calculation of (65) m only if hot water store is in the dwelling or hot water is from heat network		(65)

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

Metabolic gains (Table 5), watts

	152.61	152.61	152.61	152.61	152.61	152.61	152.61	152.61	152.61	152.61	152.61	152.61	(66)
Lighting gains (calculated in Appendix L, equation L12 or L12a), also see Table 5													
	35.82	31.81	25.87	19.59	14.64	12.36	13.36	17.36	23.3	29.59	34.53	36.81	(67)
Appliances gains (calculated in Appendix L, equation L16 or L16a), also see Table 5													
	341.32	344.87	335.94	316.94	292.95	270.41	255.35	251.81	260.73	279.74	303.72	326.26	(68)





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Cooking gains (calculated in Appendix L, equation L18 or L18a), also see Table 5

52.8 Pumps and fans g	52.8 ains (Tab	52.8 le 5a)	52.8	52.8	52.8	52.8	52.8	52.8	52.8	52.8	52.8	(69)
3 Losses e.g. evapo	3 ration (ne	3 egative va	3 Ilues) (Ta	-	0	0	0	0	3	3	3	(70)
-101.74 Water heating ga	-101.74 ins (Table		-101.74	-101.74	-101.74	-101.74	-101.74	-101.74	-101.74	-101.74	-101.74	(71)
134.02 Total internal gair	131.1 1s	125.35	112.57	104.78	96.62	91.54	95.62	100.43	109.49	121.73	132.38	(72)
617.84	614.46	593.84	555.77	519.05	483.07	463.92	468.47	488.14	525.48	566.66	602.13	(73)

6. Solar gains

Solar gains in watts, calculated for each month

6	7.33	130.52	220.63	343.84	449.46	474.5	445.69	362.58	262.61	155.59	83.53	55.76	(83)
Total gains – internal and solar (watts)													
6	85.17	744.98	814.47	899.62	968.51	957.57	909.61	831.05	750.76	681.07	650.19	657.89	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C)													21	(85)
Utilisation factor for gains for living area, 🗈 1, m (see Table 9a)														
	0.99	0.99	0.98	0.94	0.85	0.68	0.52	0.59	0.83	0.96	0.99	0.99		(86)
Mean internal temperature in living area T1 (follow steps 3 and 4 in Table 9c)														
	19.5	19.66	19.96	20.37	20.72	20.93	20.98	20.97	20.82	20.37	19.87	19.47		(87)
Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)														
	19.8	19.8	19.81	19.82	19.82	19.83	19.83	19.83	19.82	19.82	19.81	19.81		(88)
Roof	Roof Utilisation factor for gains for rest of dwelling, 22,m (see Table 9a)													
	0.99	0.99	0.97	0.92	0.79	0.58	0.39	0.45	0.75	0.94	0.98	0.99		(89)
Roof					Me	ean inter	nal tempe	erature ir	n the rest	ofdwell	ing T2			
	18.09	18.29	18.67	19.18	19.59	19.79	19.82	19.82	19.7	19.2	18.56	18.06		(90)
Living a	rea fractio	on											0.44	(91)
Mean ir	nternal te	mperatui	re (for the	e whole o	welling)									
	18.71	18.89	19.24	19.71	20.09	20.29	20.34	20.33	20.2	19.72	19.14	18.68		(92)
Adjuste	d mean ir	iternal te	emperatu	re:										
	18.71	18.89	19.24	19.71	20.09	20.29	20.34	20.33	20.2	19.72	19.14	18.68		(93)

8. Space heating requirement





Utilisation factor for gains,

Useful g	0.99 ains, mGr	0.98 m,W	0.96	0.92	0.81	0.62	0.45	0.51	0.78	0.94	0.98	0.99		(94)
Monthly	676.85 v average	/01/10		824.55 ure from			409.11	424.95	582.69	640.06	637.37	651.12		(95)
Heat los	4.3 s rate for	4.9 mean int	6.5 ernal ten	8.9 nperature	11.7 e	14.6	16.6	16.4	14.1	10.6	7.1	4.2		(96)
Space he	1646.41 eating rec	L 1595.01 quiremen			942.62	633.37	415.77	436.54	680.69	1023.89	1357.7	1639.9		(97)
Solar spa	721.36 ace heatii	580.49 ng calcula				0 ative qua	0 Intity)	0	0	285.57	518.64	735.66		(98a)
Space he	0 eating rec	0 quiremen	0 t for each	0 n month a	0 after sola	0 r contrib	0 ution	0	0	0	0	0		(98b)
Space he	721.36 eating rec	0001.0		282.02 ′m²/year	120.2	0	0	0	0	285.57	518.64	735.66	44.2	(98c) (99)

8c. Spa	8c. Space Cooling requirement													
Heat loss	Heat loss rate,													
Utilisatior	0 n factor	0 for loss	0	0	0	0	0	0	0	0	0	0		(100)
Useful los	0 s, mLm	0 (watts)	0	0	0	0	0	0	0	0	0	0		(101)
Gains	0	0	0	0	0	0	0	0	0	0	0	0		(102)
												(103) (104)		
Cooled fra		0 tor	0	0	0	0	0	0	0	0	0	0	0	(104) (105)
Space coo	0 oling req	0 uiremen	0 t for mon	0 ith	0	0	0	0 0	0	0	0	0	0	(106)
Space coo	0 oling req	0 uiremen	0 t in kWh/	0 ′m²/year	0	0	0	0	0	0	0	0	0	(107) (108)
8f. Spa	8f. Space heating requirement													

Fabric Energy Efficiency,

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



0

(109)

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0



Fraction of space heat from secondary/supplementary system, 0 Fraction of space heat from main system(s), Fraction of main heating from main system 2, Fraction of total space heat from main system 1, Fraction of total space heat from main system 2, Efficiency of main space heating system 1 (in %), Efficiency of main space heating system 2 (in %), Efficiency of secondary/supplementary heating system, %,	0 1 0 1 0 170 0 0	(201) (202) (203) (204) (205) (206) (207) (208)										
Cooling System Seasonal Energy Efficiency Ratio, 0	0	(209)										
Space heating requirement (calculated above),												
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0	0	(210)									
424.33 341.47 290.2 165.9 70.71 0 0 0 0 167.98 3 Space heating fuel (main heating system 2), kWh/month 0	305.08 432.74	0	(211)									
	0 0		(213)									
	0	0	(215)									
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0	170	(215)									
Efficiency of water heater		170	(210)									
170 170 170 170 170 170 170 170 170 170	170 170		(217)									
183.84 162.58 172.43 150.59 145.36 130.27 127.92 133.3 135.13 151.55 Space Cooling	162.25 181.67	1836.88	(219)									
0 0 0 0 0 0 0 0 0 0	0 0		(221)									
Annual totals kWh/year kWh/year												
Space heating fuel used, main system 1		2198.4	(211)									
Space heating fuel used, main system 2		0	(213)									
Space heating fuel used, secondary		0	(215)									
Water heating fuel used		1836.88	(219)									
Electricity for instantaneous electric shower(s)		0	(64a)									
Space cooling fuel used		0	(221)									
Electricity for pumps, fans and electric keep-hot												
Mechanical vent fans - balanced, extract or positive input from outside 0 0		0	(230a)									
warm air heating system fans		0	(230b)									
Heating circulation pump or water pump within warm air heating unit		41	(230c)									
Oil boiler auxiliary (oil pump, flue fan, etc; excludes circulation pump)		0	(230d)									
Gas boiler auxiliary (flue fan, etc; excludes circulation pump) Maintaining electric keen bot facility for gas combi boiler		45	(230e)									
Maintaining electric keep-hot facility for gas combi boiler 0 (230 During for color water bosting 0 (230												
Pump for solar water heating0(23Pump for storage WWHRS0(23												
		233.03	(232)									





Energy sa Electricit								sed in dv	velling					
Electricit	0 Sy genera	0 ated by v	0 vind turk	0 Dines (Ap	0 pendix N	0 1) (negati	0 ive quant	0 ity)	0	0	0	0	0	(233a)
Electricit	0 Sy genera	0 ated by h	0 iydro-ele	0 ectric ger	0 nerators	0	0	0	0	0	0	0	0	(234a)
Electricit	0 cy used c	0 or net ele	0 ectricity g	0 generate	0 d by micr	0 ro-CHP	0	0	0	0	0	0	0	(235a)
Energy sa Electricit								0 xported	0	0	0	0	0	(235c)
Electricit	0 Sy genera	0 ated by v	0 vind turk	0 Dines (Ap	0 pendix N	0 1) (negati	0 ive quant	0 ity)	0	0	0	0	0	(233b)
Electricit	0 Sy genera	0 ated by h	0 iydro-ele	0 ectric ger	0 nerators	0	0	0	0	0	0	0	0	(234b)
Electricit	0 zy used c	0 or net ele	0 ectricity §	0 generate	0 d by micr	0 ro-CHP	0	0	0	0	0	0	0	(235b)
Appendi: Appendi:			• • •		0	0	0	0	0	0	0	0	0	(235d)
energy s energy u Total del	aved ised		·					Fue	21	kWh/yea	-		0 0 4374.32	(236a) (237a)

10a. Fuel costs – Individual heating systems including micro-CHP

Fuel required	kWh/year	Fuel price	Fuel cost £/ye	ar
Space heating - main system 1 (electric off-peak tariff				
High-rate fraction (Table 12a, or Appendix F for electric CPSU)	0		80.02	(240a)
Low-rate fraction	0		80.02	(240b)
High-rate cost	0		0	(240c)
Low-rate cost	0		0	(240d)
Space heating - main system 1 cost (other fuel)	0		0	(240e)
Space heating - main system 2 (electric off-peak tariff				
High-rate fraction (Table 12a, or Appendix F for electric CPSU)	0		80.02	(241a)
Low-rate fraction	0		80.02	(241b)
High-rate cost	0		0	(241c)
Low-rate cost	0		0	(241d)
Space heating - main system 2 cost (other fuel)	0		0	(241e)
Space heating - secondary (electric off-peak tariff)				
High-rate fraction (Table 12a, or Appendix F for electric CPSU)	0		80.02	(242a)





Low-rate fraction	0		80.02	(242b)
High-rate cost	0		0	(242c)
Low-rate cost	0		0	(242d)
Space heating - secondary cost (other fuel)	0		0	(242e)
Water heating (electric off-peak tariff)				
High-rate fraction (Table 12a, or Appendix F for electric CPSU)	0		0	(243)
Low-rate fraction	0		0	(242b)
High-rate cost	0		0	(242c)
Low-rate cost	0		0	(242d)
Water heating cost (other fuel)	0		66.86	(247)
(for a DHW-only heat network use (342a) or (342b) instead of (247)				
Energy For instantaneous electric shower(s)	0		0	(247a)
Space cooling	0		0	(248)
Pumps, fans And electric keep-hot	0		14.18	(249)
Energy For lighting	0		41.73	(250)
Additional standing charges	0		92	(251)
Energy saving/generation technologies	0		0	(252)
Appendix Q, <item 1="" description=""></item>	Fuel	kWh/year		
energy saved Or generated	0		0	(253)
energy used	0		0	(254)
Total energy cost	0		294.79	(255)
11a. SAP rating – Individual heating systems including micro-CHP				
Energy cost deflator	0		0	(256)
Energy cost factor (ECF)	0		0	(257)
SAP rating	0		0	(258)

11a. SAP rating – Individual heating systems including micro-CHP		
Energy cost deflator	0.36	(256)
Energy cost factor (ECF)	0.82	(257)
SAP rating	86.72	(258)
12a, CO2 emissions – Individual heating systems including micro-CHP		

	Energy	ergy Emission factor		Emissions	
	KWh/year	r	kg	kg CO2/year	
Space heating - main system 1				461.66	(261)
Space heating - main system 2				0	(262)
Space heating - secondary				0	(263)
Energy for water heating				259.05	(264)
Energy for instantaneous electric shower(s)				0	(264a)





Space and water heating		0	(265)
Space cooling		0	(266)
Electricity for pumps, fans and electric keep		11.93	(267)
Electricity for lighting		36.52	(268)
energy saved or generated	0	0	(269b)
Appendix Q items			
energy saved	0	0	
energy used	0	0	
energy saved	0	0	(270b)
energy used		0	(271b)
Total CO2, kg/year		769.17	(272)
Dwelling CO2 Emission Rate		9.1	(273)
El rating		92	(274)

13a. Primary Energy – Individual heating systems including micro-CHP

	Energy Emission factor	Emissionsr
	KWh/year kg	kg CO2/year
Space heating - main system 1		2484.2 (275)
Space heating - main system 2		0 (276)
Space heating - secondary		0 (277)
Energy for water heating		2794.77 (278)
Energy for instantaneous electric shower(s)		0 (278a)
Space and water heating		0 (279)
Space cooling		0 (280)
Electricity for pumps, fans and electric keep		130.1 (281)
Electricity for lighting		388.11 (282)
energy saved or generated	0	0
Appendix Q items		
energy saved	0	0
energy used	0	0
energy saved	0	0 (284b)
energy used		0 (285b)
Total PE, kWh/year		5797.17 (286)
Dwelling PE Rate		68.57 (287)







Dwelling Reference: Dwelling Type: EN5 5SU

Unit 02 Existing Dwelling

1. Overall dwelling dimensions					
	Area(m²)	Av. Height(r	n)	Volume(m³)	
Ground Floor Total floor area TFA Dwelling volume	61.3	(1a) x 3	(2a) =	183.9 61.3 183.9	(3a) (4) (5)
2. Ventilation Rate					
Chimneys/Flues	0	x 80 =		0	(6a)
Open chimneys	0	x 20 =		0	(6b)
Chimneys / flues attached to closed fire	0	x 10 =		0	(6c)
Flues attached to solid fuel boiler	0	x 20 =		0	(6d)
Flues attached to other heater	0	x 35 =		0	(6e)
Number of blocked chimneys	0	x 20 =		0	(6f)
Number of intermittent extract fans	3	x 10 =		30	(7a)
Number of passive vents	0	x 10 =		0	(7b)
Number of flueless gas fires	0	x 40 = Air changes	per hour	0	(7c)
		All changes	per nour		
Number of storeys in the dwelling (ns)			0.16	0.16	(8)
Infiltration due to chimneys, flues, fans, PSVs, etc			0	0	(9)
Additional infiltration			0	0	(10)
Structural infiltration Suspended wooden ground floor			0	0	(11)
No draught lobby			0 0	0 0	(12) (13)
Percentage of windows and doors draught proofed			0	0	(13)
Window infiltration			0	0	(15)
Infiltration rate			0	0	(16)
Air permeability value, AP50, $(m^3/h/m^2)$			5	5	(17)
Air permeability value, AP4, (m³/h/m²)			0	0	(17a)
Air permeability value) Number of sides on which dwelling is sheltered			0.41	0.41	(18)
Shelter factor			2	2 0.85	(19) (20)
Infiltration rate incorporating shelter factor				0.35	(20)
Infiltration rate modified for monthly wind speed				0.55	(41)
Jan Feb Mar Apr May Jun	Jul Aug	Sep Oct M	Nov Dec	Total	(22)







Monthly average wind speed from Table U2

Wind Fa	5.1 ctor	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7	52.5	(22)
Adjustec	1.28 d infiltrati	1.25 ion rate (1.23 allowing	1.1 for shelte	1.08 er and wi	0.95 nd speed	0.95)	0.93	1	1.08	1.13	1.18	13.13	(22a)
Calculate	0.45 e effectiv	0.44 e air chai	0.43 nge rate f	0.39 for the ap	0.38 oplicable	0.33 case:	0.33	0.32	0.35	0.38	0.4	0.41	4.61	(22b)
													0	(23a)
													0	(23b)
													0	(23c)
a) If bala	inced me	chanical	ventilatio	on with he	eat recov	ery (MVI	HR)							
	0	0	0	0	0	0	0	0	0	0	0	0		(24a)
b) If bala	anced me	chanical	ventilatio	on withou	it heat re	covery (I	∕IV)							
	0	0	0	0	0	0	0	0	0	0	0	0		(24b)
c) If who	ole house	extract v	entilatio	n or posit	ive input	ventilati	on from	outside						
	0	0	0	0.	.0	0	0	0	0	0	0	0		(24c)
d) if nati	ural venti			-	-									
	0.6	0.6	0.59	0.57	0.57	0.56	0.56	0.55	0.56	0.57	0.58	0.59		(24d)
Effective	e air chan	-												()
Effoctive	0.6	0.6	0.59	0.57	0.57	0.56	0.56	0.55	0.56	0.57	0.58	0.59		(25)
enective	e air chan	-												()
	0.6	0.6	0.59	0.57	0.57	0.56	0.56	0.55	0.56	0.57	0.58	0.59		(25)

3. Heat losses and heat loss parameter

Items in the table below are to be expanded as necessary to allow f	or all different types of element e.g. 4 wall types.	The k -value
ELEMENT	AXU	AXk

	(W/K)	kJ/K	
Doors	2.1		(26)
Windows	7.89		(27)
Roof window	0		(27a)
Basement floor	0	0	(28)
Ground floor	0	0	(28a)
Exposed floor	7.97	4597.5	(28b)
Basement wall	0	0	(29)
External wall	10.18	10742.6	(29a)
Roof	0	0	(30)
Total area of external elements ∑A, m ²		126.83	(31)
Party Wall	0	9250.2	(32)
Party floor		0	(32a)
Party ceiling		0	(32b)





Internal wall **	0	(33c)
Internal floor	0	(32d)
Internal ceiling floor	0	(32e)
Fabric heat loss, W/K = \sum (A x U)	28.14	(33)
Heat capacity $Cm = \sum (A \times k)$	24590.3	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m ² K	250	(35)
Linear Thermal bridges: Σ (L x Ψ) calculated using Appendix K	16.29	(36)
Point Thermal bridges: $\Sigma \chi$ (W/K) if significant point thermal bridge present and values available	16.29	(36a)
Total fabric heat loss $H = \sum (A \times U) + \sum (L \times \Psi) + \sum \chi$	44.43	(37)
Ventilation heat loss calculated monthly		
36.43 36.19 35.96 34.87 34.67 33.72 33.72 33.55 34.09 34.67 35.08 35.51 Heat transfer coefficient, W/K		(38)
80.85 80.62 80.39 79.3 79.09 78.15 78.15 77.97 78.51 79.09 79.51 79.94 Heat loss parameter (HLP), W/m ² K		(39)
1.32 1.32 1.31 1.29 1.29 1.27 1.27 1.27 1.28 1.29 1.3 1.3 Number of days in month (Table 1a)		(40)
31 28 31 30 31 31 30 31 30 31		(41)

4. Water heating energy requirement

Assumed occupancy, N	2.02	(42)							
Hot water usage in litres per day for mixer showers, Vd, shower (from Appendix J)									
79.83 78.63 76.88 73.54 71.07 68.31 66.75 68.49 70.39 73.34 76.76 79.52		(42a)							
Hot water usage in litres per day for baths, Vd,bath (from Appendix J)									
26.41 26.02 25.47 24.45 23.68 22.84 22.38 22.93 23.53 24.43 25.47 26.32		(42b)							
Hot water usage in litres per day for other uses, Vd,other (from Appendix J)									
37.16 35.8 34.45 33.1 31.75 30.4 30.4 31.75 33.1 34.45 35.8 37.16		(42c)							
Annual average hot water usage in litres per day Vd, average (from Appendix J)	132.07	(43)							
Hot water usage in litres per day for each month Vd,m = (42a) + (42b) + (42c)									
143.39 140.45 136.8 131.09 126.5 121.55 119.53 123.17 127.02 132.23 138.04 143	1582.77	(44)							
Energy content of hot water used = 4.18 x Vd,m x nm x DTm / 3600 kWh/month (from Appendix J)									
227.1 200 210.26 179.45 170.3 149.46 144.56 152.51 156.63 179.43 196.66 223.9	2190.26	6 (45)							
Distribution loss (46) = 0.15 x (45)									
34.07 30 31.54 26.92 25.54 22.42 21.68 22.88 23.49 26.91 29.5 33.59		(46)							
Storage volume (litres) including any solar or WWHRS storage within same vessel	0	(47)							
Water storage loss (or HIU loss)	0	(48)							
a) If manufacturer's declared loss factor is known (kWh/day):									
Temperature factor from Table 2b Energy lost from water storage, kWh/day (48) x (49) =	0 0	(49) (50)							
b) If manufacturer's declared loss factor is not known :									
Hot water storage loss factor from Table 2 (kWh/litre/day)	0	(54)							
The water storage loss racion from rable 2 (NWII) intervaly	0	(51)							





Volume factor from Table 2a	0 (52)
Temperature factor from Table 2b	0 (53)
Energy lost from water storage, kWh/day	0 (54)
Enter (50) or (54) in (55)	0 (55)
Water storage (or HIU) loss calculated for each month (56) = (55) × (41)	
0 0 0 0 0 0 0 0 0 0 0 0	(56)
If the vessel contains dedicated solar storage or dedicated WWHRS storage,	
(57)m = (56)m 🛛 [(47) – Vs] ÷ (47), else (57)m = (56)m	
where Vs is Vww from Appendix G3 or (H12) from Appendix H (as applicable).	
0 0 0 0 0 0 0 0 0 0	(57)
Primary circuit loss for each month from Table 3	
modified by factor from Table H4 if there is solar water heating and a cylinder thermostat, although not for DHW	/-only heat networks)
0 0 0 0 0 0 0 0 0 0 0	(59)
Combi loss for each month from Table 3a, 3b or 3c (enter 0 if not a combi boiler)	
50.96 46.03 50.96 49.32 50.96 49.32 50.96 50.96 49.32 50.96 49.32 50.96	6 (61)
Total heat required for water heating calculated for each month (62) = $0.85 \times (45) + (46) + (57) + (59) + (61)$	
278.06 246.03 261.22 228.76 221.26 198.78 195.52 203.47 205.94 230.39 245.97 274.8	86 2790.26 (62)
CWWHRS DHW input calculated using Appendix G (negative quantity) (enter 0 if no WWHRS contribution to wat	
0 0 0 0 0 0 0 0 0 0 0	(63a)
PV diverter DHW input calculated using Appendix G (negative quantity) (enter 0 if no PV diverter contribution)	
0 0 0 0 0 0 0 0 0 0 0	(63b)
Solar DHW input calculated using Appendix H (negative quantity) (enter 0 if no solar contribution to water heatir	ng)
0 0 0 0 0 0 0 0 0 0	(63c)
FGHRS DHW input calculated using Appendix G (negative quantity) (enter 0 if no FGHRS contribution to water he	
0 0 0 0 0 0 0 0 0 0 0	(63d)
Output from water heater for each month, kWh/month (64) = (62) + (63a) + (63b) + (63c) + (63d)	
278.06 246.03 261.22 228.76 221.26 198.78 195.52 203.47 205.94 230.39 245.97 274.8	86 2790.26 (64)
Output from water heater for each month, kWh/month $(64) = (62) + (63a) + (63b) + (63c) + (63d)$	2730120 (01)
	(64a)
Heat gains from water heating, kWh/month 0.25 x [0.85 × (45) + (61) + (64a)] + 0.8 x [(46) + (57) + (59)]	(0.0)
88.25 78.01 82.65 72 69.36 62.03 60.81 63.45 64.41 72.4 77.72 87.19	9 (65)
include (57) m in calculation of (65) m only if hot water store is in the dwelling or hot water is from heat network	,

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

Metabolic gains (Table 5), watts

	121.09	121.09	121.09	121.09	121.09	121.09	121.09	121.09	121.09	121.09	121.09	121.09	(66)
Lighting	gains (cal	culated i	n Appeno	lix L, equ	ation L12	or L12a)	, also see	e Table 5					
	29.19	25.93	21.08	15.96	11.93	10.07	10.88	14.15	18.99	24.11	28.14	30	(67)
Applianc	es gains (calculate	ed in App	endix L, e	quation I	16 or L1	6a), also	see Table	25				
	263	265.73	258.86	244.22	225.73	208.36	196.76	194.03	200.91	215.55	234.03	251.4	(68)





Cooking gains (calculated in Appendix L, equation L18 or L18a), also see Table 5

Pump	49.13 s and fans g	49.13 gains (Tab	49.13 le 5a)	49.13	49.13	49.13	49.13	49.13	49.13	49.13	49.13	49.13	(69)
Losse	3 s e.g. evapo	3 oration (ne	3 egative va	3 alues) (Ta	3 able 5	0	0	0	0	3	3	3	(70)
Wate	-80.73 r heating ga	-80.73 ins (Table	-80.73 e 5)	-80.73	-80.73	-80.73	-80.73	-80.73	-80.73	-80.73	-80.73	-80.73	(71)
Total	118.62 internal gai	110.00	111.09	99.99	93.23	86.15	81.73	85.28	89.45	97.31	107.94	117.19	(72)
	503.3	500.23	483.52	452.66	423.39	394.07	378.86	382.95	398.84	429.46	462.6	491.08	(73)

6. Solar gains

Solar gains in watts, calculated for each month													
Total gai	-		180.57 solar (wat		250.6	248.79	239.86	219.81	195.52	145.85	92.8	66.3	(83)
		632.2			673.98	642.86	618.72	602.76	594.36	575.32	555.4	557.38	(84)

7. Mean internal temperature (heating season)

Temper	ature dur	ing heati	ng perioc	ls in the l	iving are	a from Ta	able 9, Th	1 (°C)					21	(85)
Utilisati	on factor	for gains	for living	g area, 🛙 1	,m (see T	able 9a)								
	0.99	0.98	0.96	0.93	0.85	0.71	0.54	0.57	0.78	0.93	0.98	0.99		(86)
Mean internal temperature in living area T1 (follow steps 3 and 4 in Table 9c)														
	19.68	19.85	20.11	20.44	20.73	20.92	20.98	20.98	20.87	20.51	20.04	19.65		(87)
Temper	ature dur	ing heati	ng perioc	ls in rest	of dwelli	ng from 1	Table 9, T	'h2 (°C)						
	19.83	19.83	19.83	19.85	19.85	19.86	19.86	19.86	19.86	19.85	19.84	19.84		(88)
Roof Utilisation factor for gains for rest of dwelling, 2,m (see Table 9a)														
	0.98	0.97	0.95	0.91	0.8	0.61	0.41	0.44	0.69	0.9	0.97	0.99		(89)
Roof					Me	ean interi	nal tempe	erature ir	n the rest	of dwell	ing T2			
	18.34	18.55	18.88	19.29	19.62	19.82	19.86	19.85	19.77	19.39	18.81	18.31		(90)
Living a	rea fractio	on											0.58	(91)
Mean in	iternal te	mperatui	re (for the	e whole d	welling)									
	19.12	19.31	19.6	19.96	20.27	20.46	20.51	20.51	20.41	20.04	19.53	19.09		(92)
Adjuste	d mean ir	nternal te	mperatu	re:										
	19.12	19.31	19.6	19.96	20.27	20.46	20.51	20.51	20.41	20.04	19.53	19.09		(93)

8. Space heating requirement







Utilisation factor for gains,

Useful g	0.98 ains, mGr	0.97 n,W	0.95	0.91	0.82	0.66	0.48	0.52	0.74	0.91	0.97	0.98		(94)
Monthly	569.15 average	613.11 external	631.1 temperat		554.88 Table U		299.8	312.23	439.9	523.33	537.18	547.86		(95)
Heat los	4.3 s rate for	4.9 mean int	6.5 ernal ter	8.9 nperatur	11.7 e	14.6	16.6	16.4	14.1	10.6	7.1	4.2		(96)
Space he	1198.44 eating rec		3 1052.71 t for each		677.68	458.09	305.83	320.47	495.56	746.96	988.16	1190.6		(97)
Solar spa	468.19 ace heatir			188.76 g Append		0 ative qua	0 Intity)	0	0	166.38	324.71	478.19		(98a)
Space he	0 eating rec	0 Juiremen	0 t for each	0 n month a	0 after sola	0 r contrib	0 ution	0	0	0	0	0		(98b)
Space he	468.19 eating rec			188.76 /m²/year	91.36	0	0	0	0	166.38	324.71	478.19	39.15	(98c) (99)

8c. Space (Cooling re	quirem	ent										
Heat loss rate	,												
0 Utilisation fac	0 tor for loss	0	0	0	0	0	0	0	0	0	0		(100)
0 Useful loss, m	0 Lm (watts)	0	0	0	0	0	0	0	0	0	0		(101)
0 Gains	0	0	0	0	0	0	0	0	0	0	0		(102)
0 Space cooling	0 requireme	0 ent for m	0 nonth, wh	0 ole dwel	0 ling, cont	0 inuous (l	0 ‹Wh)	0	0	0	0		(103) (104)
0 Cooled fractio Intermittency		0	0	0	0	0	0	0	0	0	0	0	(104) (105)
0 Space cooling	0 requireme	0 ent for m	0 nonth	0	0	0	0	0	0	0	0	0	(106)
0 Space cooling	0 requireme	0 ent in kV	0 Vh/m²/yea	0 ar	0	0	0	0	0	0	0	0	(107) (108)
8f. Space h	8f. Space heating requirement												

Fabric Energy Efficiency,	0	0 (109)

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





Fraction of space heat from secondary/supplementary system,0Fraction of space heat from main system(s),1Fraction of main heating from main system 2,1Fraction of total space heat from main system 1,1Fraction of total space heat from main system 2,1Efficiency of main space heating system 1 (in %),1Efficiency of main space heating system 2 (in %),1								0 1 0 1 0 170 0	(201) (202) (203) (204) (205) (206) (207)	
Efficiency of secondary/supplementary heating system, Cooling System Seasonal Energy Efficiency Ratio,	1, %,			0					0 0	(208) (209)
Space heating requirement (calculated above),										()
0 0 0 0 0 0 0 0 0 0 0 Space heating fuel (main heating system 1), kWh/mont	0 th	0	0	0	0	0	0	0	0	(210)
275.4 216.77 184.52 111.04 53.74 C Space heating fuel (main heating system 2), kWh/mont		0	0	0	0	97.87	191	281.29	0	(211)
0 0 0 0 0 0 Space heating fuel (secondary), kWh/month	0	0	0	0	0	0	0	0	0	(213)
	0	0	0		0	0	0	0		(215)
Efficiency of water heater				0					170	(216)
170 170 170 170 170 170 1 Fuel for water heating	170	170	17	0	170	170	170	170		(217)
163.57 144.72 153.66 134.57 130.15 1 Space Cooling	116.93	115.01	11	9.69	121.14	135.52	144.69	161.68	1641.33	(219)
0 0 0 0 0 C Annual totals	0	0	0 kW	h/yea	0 ar kM	0 /h/year	0	0		(221)
Space heating fuel used, main system 1				, , , cc		in, year			1411.63	(211)
Space heating fuel used, main system 2									0	(213)
Space heating fuel used, secondary									0	(215)
Water heating fuel used									1641.33	(219)
Electricity for instantaneous electric shower(s)									0	(64a)
Space cooling fuel used									0	(221)
Electricity for pumps, fans and electric keep-hot										
Mechanical vent fans - balanced, extract or positive inp	put from	outside		0		0			0	(230a)
warm air heating system fans							0	(230b)		
Heating circulation pump or water pump within warm air heating unit							41	(230c)		
Oil boiler auxiliary (oil pump, flue fan, etc; excludes circ		pump)							0	(230d)
Gas boiler auxiliary (flue fan, etc; excludes circulation pump) Maintaining electric keep het facility for gas sombi beiler							45	(230e)		
Maintaining electric keep-hot facility for gas combi boil	IEI								0	(230f)
Pump for solar water heating							0	(230g)		
Pump for storage WWHRS Total electricity for the above									0	(230h)
Electricity for lighting									86 206 2	(231)
									206.2	(232)





	nergy saving/							ised in dv	velling					
E	lectricity gene	rated by	PVs (App	endix M)	(negativ	e quantil	ty)							
г	0	0	0 wind turk	0	0 nondiv N	0	0	0	0	0	0	0	0	(233a)
E	lectricity gene	rated by	wind ture	Jines (Ap	pendix	vi) (negat	ive quant	lity)						
F	0 lectricity gene	0 vrated by	0 bydro-ole	0 octric ger	0 Nerators	0	0	0	0	0	0	0	0	(234a)
L	lectricity gene	i aleu by	ilyul0-ele	ettile gei										
E	0 lectricity used	0 or not ol	0 loctricity (0 Toporato	0 d by mic		0	0	0	0	0	0	0	(235a)
L	lectricity used	or net er	ectricity g	generate	u by fine									
E	0 Dorgy coving //	0 Tonoratio	0 n tachna	0 Logios (Au	0 nnondic		0 Enorgy o	0 whortod	0	0	0	0	0	(235c)
	nergy saving/	-						exported						
E	lectricity gene	rated by	PVs (App	endix M)	(negativ	e quantit	ty)							
_	0	0	0	0	0	0	0	0	0	0	0	0	0	(233b)
E	lectricity gene	rated by	wind turk	oines (Ap	pendix N	𝔄) (negat	ive quant	tity)						
	0	0	0	0	0	0	0	0	0	0	0	0	0	(234b)
E	lectricity gene	rated by	hydro-ele	ectric ger	nerators									
	0	0	0	0	0	0	0	0	0	0	0	0	0	(235b)
E	lectricity used	or net el	lectricity g	generate	d by mic	ro-CHP								
	0	0	0	0	0	0	0	0	0	0	0	0	0	(235d)
A	ppendix Q ite	ms: annu	al energy											
A	ppendix Q, <it< td=""><td>tem 1 des</td><td>scription></td><td></td><td></td><td></td><td></td><td>Fue</td><td>el</td><td>kWh/yea</td><td>r</td><td></td><td></td><td></td></it<>	tem 1 des	scription>					Fue	el	kWh/yea	r			
e	nergy saved												0	(236a)
e	nergy used												0	(237a)
Т	otal delivered	energy f	or all uses	5									3345.16	

10a. Fuel costs – Individual heating systems including micro-CHP

Fuel required	kWh/year	Fuel price	Fuel cost £/yea	ar
Space heating - main system 1 (electric off-peak tariff				
High-rate fraction (Table 12a, or Appendix F for electric CPSU)	0		51.38	(240a)
Low-rate fraction	0		51.38	(240b)
High-rate cost	0		0	(240c)
Low-rate cost	0		0	(240d)
Space heating - main system 1 cost (other fuel)	0		0	(240e)
Space heating - main system 2 (electric off-peak tariff				
High-rate fraction (Table 12a, or Appendix F for electric CPSU)	0		51.38	(241a)
Low-rate fraction	0		51.38	(241b)
High-rate cost	0		0	(241c)
Low-rate cost	0		0	(241d)
Space heating - main system 2 cost (other fuel)	0		0	(241e)
Space heating - secondary (electric off-peak tariff)				
High-rate fraction (Table 12a, or Appendix F for electric CPSU)	0		51.38	(242a)





Low-rate fraction	0		51.38	(242b)
High-rate cost	0		0	(242c)
Low-rate cost	0		0	(242d)
Space heating - secondary cost (other fuel)	0		0	(242e)
Water heating (electric off-peak tariff)				
High-rate fraction (Table 12a, or Appendix F for electric CPSU)	0		0	(243)
Low-rate fraction	0		0	(242b)
High-rate cost	0		0	(242c)
Low-rate cost	0		0	(242d)
Water heating cost (other fuel)	0		59.74	(247)
(for a DHW-only heat network use (342a) or (342b) instead of (247)				
Energy For instantaneous electric shower(s)	0		0	(247a)
Space cooling	0		0	(248)
Pumps, fans And electric keep-hot	0		14.18	(249)
Energy For lighting	0		34	(250)
Additional standing charges	0		92	(251)
Energy saving/generation technologies	0		0	(252)
Appendix Q, <item 1="" description=""></item>	Fuel	kWh/year		
energy saved Or generated	0		0	(253)
energy used	0		0	(254)
Total energy cost	0		251.31	(255)
11a. SAP rating – Individual heating systems including micro-CHP				
Energy cost deflator	0		0	(256)
Energy cost factor (ECF)	0		0	(257)
SAP rating	0		0	(258)

11a. SAP rating – Individual heating systems including micro-CHP		
Energy cost deflator	0.36	(256)
Energy cost factor (ECF)	0.85	(257)
SAP rating	86.2	(258)
12a, CO2 emissions – Individual heating systems including micro-CHP		

Emission factor Emissions Energy KWh/year kg kg CO2/year Space heating - main system 1 296.44 (261) Space heating - main system 2 0 (262) Space heating - secondary 0 (263) Energy for water heating 231.37 (264) Energy for instantaneous electric shower(s) 0 (264a)





Space and water heating		0	(265)
Space cooling		0	(266)
Electricity for pumps, fans and electric keep		11.93	(267)
Electricity for lighting		29.76	(268)
energy saved or generated	0	0	(269b)
Appendix Q items			
energy saved	0	0	
energy used	0	0	
energy saved	0	0	(270b)
energy used		0	(271b)
Total CO2, kg/year		569.5	(272)
Dwelling CO2 Emission Rate		9.29	(273)
El rating		93	(274)

13a. Primary Energy – Individual heating systems including micro-CHP

	Energy Emission factor	Emissionsr
	KWh/year kg	kg CO2/year
Space heating - main system 1		1595.14 (275)
Space heating - main system 2		0 (276)
Space heating - secondary		0 (277)
Energy for water heating		2496.84 (278)
Energy for instantaneous electric shower(s)		0 (278a)
Space and water heating		0 (279)
Space cooling		0 (280)
Electricity for pumps, fans and electric keep		130.1 (281)
Electricity for lighting		316.27 (282)
energy saved or generated	0	0
Appendix Q items		
energy saved	0	0
energy used	0	0
energy saved	0	0 (284b)
energy used		0 (285b)
Total PE, kWh/year		4538.35 (286)
Dwelling PE Rate		74.04 (287)







Dwelling Reference: Dwelling Type: EN5 5SU Unit 03 Existing Dwelling

	Area(m²)		Av. Heig	ht(m)	Volume(m³)	
			- 0			
Ground Floor	84	.71(1a) ×	< 3	(2a) =	254.13	(3a
Total floor area TFA					84.71	(4)
Dwelling volume					254.13	(5)
2. Ventilation Rate						
Chimneys/Flues		0 >	x 80 =		0	(6a)
Open chimneys		-	x 20 =		0	(6b)
Chimneys / flues attached to closed fire		0 >	x 10 =		0	(6c)
Flues attached to solid fuel boiler		0 >	x 20 =		0	(6d)
Flues attached to other heater		0 >	x 35 =		0	(6e
Number of blocked chimneys		0 >	x 20 =		0	(6f)
Number of intermittent extract fans		2 >	x 10 =		20	(7a
Number of passive vents		0 >	x 10 =		0	(7b
Number of flueless gas fires		0 >	x 40 =		0	(7c)
			Air chan	ges per hour		
Number of storeys in the dwelling (ns)				0.08	0.08	(8)
Infiltration due to chimneys, flues, fans, PSVs, etc				0	0	(9)
Additional infiltration Structural infiltration				0	0	(10
Suspended wooden ground floor				0 0	0 0	(11 (12
No draught lobby				0	0	(12
Percentage of windows and doors draught proofed				0	0	(14
Window infiltration				0	0	(15
Infiltration rate				0	0	(16
Air permeability value, AP50, (m³/h/m²)				5	5	(17
Air permeability value, AP4, (m³/h/m²) Air permeability value)				0	0	(17
Number of sides on which dwelling is sheltered				0.33 3	0.33 3	(18 (19
Shelter factor				Э	0.78	(19
Infiltration rate incorporating shelter factor					0.25	(20
Infiltration rate modified for monthly wind speed					0.20	(21
Jan Feb Mar Apr May Ju	n Jul Aug	Sep	Oct	Nov Dec	Total	(22)



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Monthly average wind speed from Table U2

Wind Fa	5.1 actor	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7	52.5	(22)
Adjuste	1.28 d infiltrat	1.25 ion rate	1.23 (allowing	1.1 for shelt	1.08 er and wi	0.95 ind speed	0.95 J)	0.93	1	1.08	1.13	1.18	13.13	(22a)
Calcula	0.32 te effectiv	0.32 ve air cha	0.31 nge rate	0.28 for the a	0.27 pplicable	0.24 case:	0.24	0.24	0.25	0.27	0.29	0.3	3.34	(22b)
													0	(23a)
													0	(23b)
													0	(23c)
a) If bal	a) If balanced mechanical ventilation with heat recovery (MVHR)													
	0	0	0	0	0	0	0	0	0	0	0	0		(24a)
b) If bal	lanced me	echanical	ventilati	on witho	ut heat re	ecovery (MV)							
	0	0	0	0	0	0	0	0	0	0	0	0		(24b)
c) If wh	ole house	extract	ventilatio	on or posi	tive inpu	t ventilat	ion from	outside						
	0	0	0	0	0	0	0	0	0	0	0	0		(24c)
d) If nat	tural vent	ilation or	whole h	ouse posi	itive inpu	t ventilat	ion from	loft						
	0.55	0.55	0.55	0.54	0.54	0.53	0.53	0.53	0.53	0.54	0.54	0.54		(24d)
Effectiv	e air char	ige rate												
F ff,	0.55	0.55	0.55	0.54	0.54	0.53	0.53	0.53	0.53	0.54	0.54	0.54		(25)
Effectiv	e air char	ige rate f	rom PCD	В:										
	0.55	0.55	0.55	0.54	0.54	0.53	0.53	0.53	0.53	0.54	0.54	0.54		(25)

3. Heat losses and heat loss parameter

Items in the table below are to be expanded as nec	cessary to allow for all different types of element	e.g. 4 wall types. The k -value
FLEMENT	ΑΧυ	AXk

	(W/K)	kJ/K	
Doors	2.1	(26)
Windows	12.97	(27)
Roof window	0	(27a)
Basement floor	0	0 (1	28)
Ground floor	0	0 (28a)
Exposed floor	7.97	4597.5 (28b)
Basement wall	0	0 (1	29)
External wall	14.54	15352 (29a)
Roof	0	0 (30)
Total area of external elements ∑A, m ²		155.53 (31)
Party Wall	0	6274.8 (32)
Party floor		0 (32a)
Party ceiling		0 (1	32b)





Internal wall **	0	(33c)				
Internal floor	0	(32d)				
Internal ceiling floor	0	(32e)				
Fabric heat loss, W/K = \sum (A x U)	37.59	(33)				
Heat capacity $Cm = \sum (A \times k)$	26224.3	(34)				
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m ² K	250	(35)				
Linear Thermal bridges: Σ (L x Ψ) calculated using Appendix K	21.94	(36)				
Point Thermal bridges: $\Sigma \chi$ (W/K) if significant point thermal bridge present and values available						
Total fabric heat loss H = $\Sigma(A \times U) + \Sigma(L \times \Psi) + \Sigma\chi$	59.52	(37)				
Ventilation heat loss calculated monthly						
46.35 46.18 46.01 45.22 45.08 44.39 44.39 44.26 44.65 45.08 45.38 45.69 Heat transfer coefficient, W/K		(38)				
105.88 105.71 105.54 104.75 104.6 103.91 103.91 103.78 104.18 104.6 104.9 105.21 Heat loss parameter (HLP), W/m ² K		(39)				
1.25 1.25 1.25 1.24 1.23 1.23 1.23 1.23 1.23 1.23 1.23 1.24 1.24 Number of days in month (Table 1a)		(40)				
31 28 31 30 31 30 31 31 30 31 30 31		(41)				

4. Water heating energy requirement

Assumed occupa	ncy, N											2.55	(42)
Hot water usage	in litres p	oer day fo	r mixer s	howers, \	/d,showe	er (from A	Appendix	J)					、 -/
92 Hot water usage	90.62 in litres p	88.61 Der day fo	84.75 r baths <i>,</i> \	81.91 /d,bath (1	78.73 from App	76.93 endix J)	78.93	81.12	84.53	88.46	91.65		(42a)
30.42 Hot water usage	29.97 in litres p	29.33 Der day fo	28.16 r other u	27.28 ses, Vd,o	26.3 ther (froi	25.78 m Append	26.41 dix J)	27.1	28.14	29.34	30.32		(42b)
42.85 Annual average h Hot water usage		-	-	-				38.17	39.73	41.29	42.85	152.22	(42c) (43)
165.27 Energy content o		157.67 ter used =			140.1 x DTm /		141.96 /h/month				164.81	1824.2	(44)
261.74 Distribution loss		242.33 L5 x (45)	206.82	196.27	172.26	166.62	175.77	180.52	206.8	226.66	258.06	2524.36	(45)
39.26 Storage volume (Water storage lo	ss (or HIL	J loss)	-			24.99 within sa	26.37 ame vess	27.08 el	31.02	34	38.71	0	(46) (47)
a) If manufacture			actor is ki	nown (kV	Vh/day):							0	(48)
Temperature fac			(h. / h / A)	0)(40)								0	(49)
Energy lost from b) If manufacture	er's decla	red loss fa	actor is n	ot knowr	n :							0	(50)
Hot water storag	e loss fac	tor from	Table 2 (l	<wh litre<="" td=""><td>e/day)</td><td></td><td></td><td></td><td></td><td></td><td></td><td>0</td><td>(51)</td></wh>	e/day)							0	(51)





Volume factor from Table 2a Temperature factor from Table 2b Energy lost from water storage, kWh/day Enter (50) or (54) in (55)	0 0 0 0	(52) (53) (54) (55)
Water storage (or HIU) loss calculated for each month (56) = (55) × (41)		
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		(56)
where Vs is Vww from Appendix G3 or (H12) from Appendix H (as applicable).		
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		(57)
modified by factor from Table H4 if there is solar water heating and a cylinder thermostat, although not for DHW-on	ly heat netw	(orks)
	iy near nerw	-
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 Combi loss for each month from Table 3a, 3b or 3c (enter 0 if not a combi boiler)		(59)
		(61)
50.96		(01)
312.7 276.54 293.29 256.14 247.23 221.58 217.57 226.73 229.83 257.76 275.97 309.02 CWWHRS DHW input calculated using Appendix G (negative quantity) (enter 0 if no WWHRS contribution to water h		36 (62)
		(63a)
PV diverter DHW input calculated using Appendix G (negative quantity) (enter 0 if no PV diverter contribution)		ζ, γ
0 0 0 0 0 0 0 0 0 0		(63b)
Solar DHW input calculated using Appendix H (negative quantity) (enter 0 if no solar contribution to water heating)		()
0 0 0 0 0 0 0 0 0 0		(63c)
FGHRS DHW input calculated using Appendix G (negative quantity) (enter 0 if no FGHRS contribution to water heatin	ıg)	
0 0 0 0 0 0 0 0 0 0 0		(63d)
Output from water heater for each month, kWh/month (64) = (62) + (63a) + (63b) + (63c) + (63d)		
312.7 276.54 293.29 256.14 247.23 221.58 217.57 226.73 229.83 257.76 275.97 309.02 Output from water heater for each month, kWh/month (64) = (62) + (63a) + (63b) + (63c) + (63d)	3124.3	36 (64)
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		(64a)
99.77 88.15 93.31 81.1 78 69.61 68.14 71.18 72.35 81.5 87.69 98.54 include (57) m in calculation of (65) m only if hot water store is in the dwelling or hot water is from heat network		(65)

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

Metabolic gains (Table 5), watts

					152.77				152.77	152.77	152.77	152.77	(66)
Lighting	gains (cal	culated in	n Appeno	lix L, equ	ation L12	or L12a)	, also see	e Table 5					
	38.2	33.93	27.59	20.89	15.61	13.18	14.24	18.51	24.85	31.55	36.83	39.26	(67)
Applianc	es gains (calculate	d in App	endix L, e	quation I	L16 or L1	6a), also	see Table	25				
	341.79	345.34	336.4	317.38	293.36	270.78	255.7	252.16	261.09	280.12	304.14	326.71	(68)





Cooking gains (calculated in Appendix L, equation L18 or L18a), also see Table 5

52.82 Pumps and fans ۽	52.82 gains (Tab	52.82 le 5a)	52.82	52.82	52.82	52.82	52.82	52.82	52.82	52.82	52.82	(69)
3 Losses e.g. evapo	3 oration (ne	3 egative va			0	0	0	0	3	3	3	(70)
-101.85 Water heating ga	5 -101.85 iins (Table		-101.85	-101.85	-101.85	-101.85	-101.85	-101.85	-101.85	-101.85	-101.85	(71)
134.1 Total internal gai	101110	125.42	112.63	104.84	96.68	91.59	95.68	100.49	109.55	121.79	132.45	(72)
620.84	617.19	596.16	557.65	520.56	484.39	465.28	470.09	490.18	527.97	569.51	605.17	(73)

6. Solar gains

Solar gains in wa	Solar gains in watts, calculated for each month											
38.44 Total gains – inte	76.95 rnal and s			300.13	320.29	299.48	238.47	165.93	93.42	48.11	31.57	
0	694.15	``	,	820.69	804.68	764.76	708.57	656.11	621.38	617.62	636.74	

7. Mean	internal	temperature	(heating season)
---------	----------	-------------	------------------

Temper	ature dur	ing heati	ng period	ds in the	living are	a from Ta	able 9, Th	1 (°C)					21	(85)
Utilisati	on factor	for gains	for living	g area, 🛙 1	l,m (see 1	Table 9a)								
	0.99	0.99	0.98	0.96	0.89	0.74	0.58	0.64	0.86	0.97	0.99	0.99		(86)
Mean ir	nternal te	mperatu	re in livin	g area 11	. (follow s	steps 3 ai	nd 4 in Ta	ible 9c)						
_	19.62	19.74	19.99	20.35	20.7	20.91	20.98	20.97	20.81	20.39	19.95	19.59		(87)
Temper	ature dur	ing heati	ng period	ds in rest	of dwelli	ng from ⁻	Table 9, T	ĥ2 (°C)						
	19.88	19.88	19.88	19.89	19.89	19.9	19.9	19.9	19.9	19.89	19.89	19.89		(88)
Roof				I	Utilisatio	n factor f	or gains f	for rest o	fdwelling	g, ⊡2,m (s	ee Table	9a)		
	0.99	0.99	0.98	0.94	0.84	0.64	0.44	0.5	0.79	0.95	0.99	0.99		(89)
Roof					M	ean inter	nal temp	erature ii	n the rest	of dwell	ing T2			
	18.29	18.45	18.77	19.23	19.63	19.85	19.89	19.89	19.76	19.29	18.72	18.26		(90)
Living a	rea fractio	on											0.36	(91)
Mean ir	nternal te	mperatu	re (for the	e whole o	dwelling)									
	18.77	18.91	19.21	19.63	20.01	20.23	20.28	20.27	20.13	19.68	19.16	18.74		(92)
Adjuste	d mean ir	nternal te	emperatu	re:										
	18.77	18.91	19.21	19.63	20.01	20.23	20.28	20.27	20.13	19.68	19.16	18.74		(93)

8. Space heating requirement



Page 5

(83)

(84)



Utilisation factor for gains,

Useful g	0.99 ains, mGr	0.98 n , W	0.97	0.94	0.85	0.68	0.49	0.55	0.81	0.95	0.98	0.99		(94)
Monthly	652.1 v average	683.62 external	712.95 temperat	732.51 ure from	000072	543.47 1	375.34	389.98	530.41	590.02	606.86	630.79		(95)
Heat los	4.3 s rate for	4.9 mean int	6.5 ernal ten	8.9 nperature	11.7 e	14.6	16.6	16.4	14.1	10.6	7.1	4.2		(96)
Space he	1531.61 eating rec	1481.03 Juiremen			869.25	584.85	382.46	402.03	628.68	949.94	1264.79	1529.28		(97)
Solar spa	654.36 ace heatii	535.86 ng calcula				-	0 Intity)	0	0	267.78	473.71	668.47		(98a)
Space he	0 eating rec	0 Juiremen	0 t for each	0 1 month a	0 after sola	0 r contrib	0 ution	0	0	0	0	0		(98b)
Space he	654.36 eating rec	535.86 Juiremen			128.37	0	0	0	0	267.78	473.71	668.47	41.06	(98c) (99)

8c. Sp	ace Coo	oling req	Juiremer	ıt										
Heat loss	s rate,													
Utilisatio	0 on factor	0 for loss	0	0	0	0	0	0	0	0	0	0		(100)
Useful lo	0 oss, mLm	0 (watts)	0	0	0	0	0	0	0	0	0	0		(101)
Gains	0	0	0	0	0	0	0	0	0	0	0	0		(102)
Space co	0 ooling rec	0 quiremer	0 nt for mor	0 nth, whol	0 e dwellin	0 g, contin	0 uous (kW	0 ′h)	0	0	0	0		(103) (104)
Cooled fi Intermitt		0 ctor	0	0	0	0	0	0	0	0	0	0	0	(104) (105)
Space co	0 ooling rec	0 quiremer	0 nt for mor	0 nth	0	0	0	0 0	0	0	0	0	0	(106)
Space co	0 ooling red	0 quiremer	0 nt in kWh,	0 /m²/year	0	0	0	0	0	0	0	0	0	(107) (108)
06 6	b	+:	uiromon											

8f. Space heating requirement

Fabric Energy Efficiency,

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



0

(109)

SAP WORKSHEET

0



Fraction of space heat from secondary/supp Fraction of space heat from main system(s), Fraction of main heating from main system 2 Fraction of total space heat from main system Fraction of total space heat from main system Efficiency of main space heating system 1 (in Efficiency of main space heating system 2 (in Efficiency of secondary/supplementary heat Cooling System Seasonal Energy Efficiency Ra	2, m 1, m 2, 1 %), 1 %), ing syste		Ι,		0					0 1 0 1 0 170 0 0 0	 (201) (202) (203) (204) (205) (206) (207) (208) (209)
Space heating requirement (calculated above	e) <i>,</i>										. ,
0 0 0 0 0 Space heating fuel (main heating system 1),	0 kWh/mo	0 nth	0	0	0	0	0	0	0	0	(210)
384.92 315.21 274.98 165.78 Space heating fuel (main heating system 2)		0 nth	0	0	0	0	157.52	278.65	393.22	0	(211)
0 0 0 0 Space heating fuel (secondary), kWh/month	0	0	0	0	0	0	0	0	0	0	(213)
0 0 0 0	0	0	0	0	0	0	0	0	0	0	(215)
Output from water heater),	0	0	0	0	0	0	0	0	0	170	(216)
Efficiency of water heater											(-)
170 170 170 170 170 Fuel for water heating	170	170	170	17	0	170	170	170	170		(217)
183.94 162.67 172.52 150.67 Space Cooling	145.43	130.34	127.99	13	3.37	135.2	151.63	162.34	181.77	1837.86	(219)
0 0 0 0 Annual totals	0	0	0	0 kW	h/yea	0 ar kW	0 /h/year	0	0		(221)
Space heating fuel used, main system 1					, , c.		, , ca.			2045.8	(211)
Space heating fuel used, main system 2										0	(213)
Space heating fuel used, secondary										0	(215)
Water heating fuel used										1837.86	(219)
Electricity for instantaneous electric shower	(s)									0	(64a)
Space cooling fuel used										0	(221)
Electricity for pumps, fans and electric keep-											
Mechanical vent fans - balanced, extract or p	positive ii	nput fron	n outside	•	0		0			0	(230a)
warm air heating system fans										0	(230b)
Heating circulation pump or water pump wit			-							41	(230c)
Oil boiler auxiliary (oil pump, flue fan, etc; ex			i pump)							0	(230d)
Gas boiler auxiliary (flue fan, etc; excludes ci Maintaining electric keep-hot facility for gas										45	(230e)
Pump for solar water heating		51161								0	(230f)
Pump for storage WWHRS										0 0	(230g) (230b)
Total electricity for the above										86	(230h) (231)
Electricity for lighting										269.83	(231)
										200.00	(





Energy sa Electricity								ed in dwe	lling					
Electricity	0 generat	0 ted by w	0 ind turbi	0 nes (App	0 endix M)	0 (negative	0 e quantit	0 y)	0	0	0	0	0	(233a)
Electricity	0 generat	0 ted by hy	0 ydro-eleo	0 tric gene	0 rators	0	0	0	0	0	0	0	0	(234a)
Electricity	0 used or	0 net elec	0 ctricity ge	0 enerated	0 by micro	0 -CHP	0	0	0	0	0	0	0	(235a)
Energy sa Electricity								0 ported	0	0	0	0	0	(235c)
Electricity	0 generat	0 ted by w	0 ind turbi	0 nes (App	0 endix M)	0 (negativ	0 e quantit	0 y)	0	0	0	0	0	(233b)
Electricity	0 generat	0 ted by hy	0 ydro-eleo	0 tric gene	0 rators	0	0	0	0	0	0	0	0	(234b)
Electricity	0 used or	0 net elec	0 ctricity ge	0 enerated	0 by micro	0 -CHP	0	0	0	0	0	0	0	(235b)
Appendix			•.	0	0	0	0	0	0	0	0	0	0	(235d)
Appendix energy sa energy us Total deliv	ved ed							Fuel		kWh/year			0 0 4239.49	(236a) (237a)

10a. Fuel costs – Individual heating systems including micro-CHP

Fuel required	kWh/year	Fuel price	Fuel cost £/ye	ar
Space heating - main system 1 (electric off-peak tariff				
High-rate fraction (Table 12a, or Appendix F for electric CPSU)	0		74.47	(240a)
Low-rate fraction	0		74.47	(240b)
High-rate cost	0		0	(240c)
Low-rate cost	0		0	(240d)
Space heating - main system 1 cost (other fuel)	0		0	(240e)
Space heating - main system 2 (electric off-peak tariff				
High-rate fraction (Table 12a, or Appendix F for electric CPSU)	0		74.47	(241a)
Low-rate fraction	0		74.47	(241b)
High-rate cost	0		0	(241c)
Low-rate cost	0		0	(241d)
Space heating - main system 2 cost (other fuel)	0		0	(241e)
Space heating - secondary (electric off-peak tariff)				
High-rate fraction (Table 12a, or Appendix F for electric CPSU)	0		74.47	(242a)





Low-rate fraction	0		74.47	(242b)
High-rate cost	0		0	(242c)
Low-rate cost	0		0	(242d)
Space heating - secondary cost (other fuel)	0		0	(242e)
Water heating (electric off-peak tariff)				
High-rate fraction (Table 12a, or Appendix F for electric CPSU)	0		0	(243)
Low-rate fraction	0		0	(242b)
High-rate cost	0		0	(242c)
Low-rate cost	0		0	(242d)
Water heating cost (other fuel)	0		66.9	(247)
(for a DHW-only heat network use (342a) or (342b) instead of (247)				
Energy For instantaneous electric shower(s)	0		0	(247a)
Space cooling	0		0	(248)
Pumps, fans And electric keep-hot	0		14.18	(249)
Energy For lighting	0		44.5	(250)
Additional standing charges	0		92	(251)
Energy saving/generation technologies	0		0	(252)
Appendix Q, <item 1="" description=""></item>	Fuel	kWh/year		
energy saved Or generated	0		0	(253)
energy used	0		0	(254)
Total energy cost	0		292.04	(255)
11a. SAP rating – Individual heating systems including micro-CHP				
Energy cost deflator	0		0	(256)
Energy cost factor (ECF)	0		0	(257)
SAP rating	0		0	(258)

11a. SAP rating – Individual heating systems including micro-CHP		
Energy cost deflator	0.36	(256)
Energy cost factor (ECF)	0.81	(257)
SAP rating	86.86	(258)
12a CO2 emissions – Individual heating systems including micro-CHP		

	Energy	Emission factor	Emissions	
	KWh/year	kg	kg CO2/year	
Space heating - main system 1			429.62	(261)
Space heating - main system 2			0	(262)
Space heating - secondary			0	(263)
Energy for water heating			259.19	(264)
Energy for instantaneous electric shower(s)			0	(264a)





Space and water heating		0	(265)
Space cooling		0	(266)
Electricity for pumps, fans and electric keep		11.93	(267)
Electricity for lighting		38.95	(268)
energy saved or generated	0	0	(269b)
Appendix Q items			
energy saved	0	0	
energy used	0	0	
energy saved	0	0	(270b)
energy used		0	(271b)
Total CO2, kg/year		739.68	(272)
Dwelling CO2 Emission Rate		8.73	(273)
El rating		92	(274)

13a. Primary Energy – Individual heating systems including micro-CHP

	Energy Emission factor	Emissionsr
	KWh/year kg	kg CO2/year
Space heating - main system 1		2311.75 (275)
Space heating - main system 2		0 (276)
Space heating - secondary		0 (277)
Energy for water heating		2796.26 (278)
Energy for instantaneous electric shower(s)		0 (278a)
Space and water heating		0 (279)
Space cooling		0 (280)
Electricity for pumps, fans and electric keep		130.1 (281)
Electricity for lighting		413.88 (282)
energy saved or generated	0	0
Appendix Q items		
energy saved	0	0
energy used	0	0
energy saved	0	0 (284b)
energy used		0 (285b)
Total PE, kWh/year		5651.99 (286)
Dwelling PE Rate		66.72 (287)







Dwelling Reference: Dwelling Type: EN5 5SU

Unit 02 Existing Dwelling

1. Overall dwelling dimensions					
	Area(m²)	Av. Height(m	1)	Volume(m³)	
Ground Floor Total floor area TFA	51.52 (1a) x 3	(2a) =	154.56 51.52	(3a)
Dwelling volume				154.56	(4) (5)
2. Ventilation Rate					
Chimneys/Flues	0	x 80 =		0	(6a)
Open chimneys	0	x 20 =		0	(6b)
Chimneys / flues attached to closed fire	0	x 10 =		0	(6c)
Flues attached to solid fuel boiler	0	x 20 =		0	(6d)
Flues attached to other heater	0	x 35 =		0	(6e)
Number of blocked chimneys	0	x 20 =		0	(6f)
Number of intermittent extract fans	2	x 10 =		20	(7a)
Number of passive vents	0	x 10 =		0	(7b)
Number of flueless gas fires	0	x 40 =		0	(7c)
		Air changes p	per hour		
Number of storeys in the dwelling (ns)			0.13	0.13	(8)
Infiltration due to chimneys, flues, fans, PSVs, etc			0	0	(9)
Additional infiltration Structural infiltration			0	0	(10)
Suspended wooden ground floor			0 0	0 0	(11) (12)
No draught lobby			0	0	(12)
Percentage of windows and doors draught proofed			0	0	(14)
Window infiltration			0	0	(15)
Infiltration rate			0	0	(16)
Air permeability value, AP50, $(m^3/h/m^2)$			5	5	(17)
Air permeability value, AP4, (m³/h/m²) Air permeability value)			0	0	(17a)
Number of sides on which dwelling is sheltered			0.38 3	0.38 3	(18) (19)
Shelter factor			5	0.78	(20)
Infiltration rate incorporating shelter factor				0.29	(21)
Infiltration rate modified for monthly wind speed					(/
Jan Feb Mar Apr May Jun	Jul Aug	Sep Oct N	ov Dec	Total	(22)







Monthly average wind speed from Table U2

Wind F	5.1 actor	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7	52.5	(22)
Adjust	1.28 ed infiltrat	1.25 tion rate	1.23 (allowing	1.1 for shelt	1.08 er and w	0.95 ind speed	0.95 d)	0.93	1	1.08	1.13	1.18	13.13	(22a)
Calcula	0.37 ate effectiv	0.37 ve air cha	0.36 ange rate	0.32 for the a	0.32 pplicable	0.28 case:	0.28	0.27	0.29	0.32	0.33	0.35	3.86	(22b)
													0	(23a)
													0	(23b)
													0	(23c)
a) If ba	lanced me	echanical	ventilati	on with h	leat recov	very (MV	HR)							
	0	0	0	0	0	0	0	0	0	0	0	0		(24a)
b) If ba	lanced m	echanica	ventilati	on witho	ut heat re	ecovery (MV)							
	0	0	0	0	0	0	0	0	0	0	0	0		(24b)
c) If wi	nole house	e extract	ventilatio	on or posi	tive inpu	t ventilat	ion from	outside						
1.1.6	0	0	0	0	. 0	0	0	0	0	0	0	0		(24c)
d) If na	itural vent	ilation of	r whole h	ouse pos	itive inpu	it ventilat	tion from	loft						
	0.57	0.57	0.56	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.55	0.56		(24d)
Effecti	ve air chai	nge rate												
	0.57	0.57	0.56	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.55	0.56		(25)
Effecti	ve air chai	•												()
	0.57	0.57	0.56	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.55	0.56		(25)

3. Heat losses and heat loss parameter

Items in the table below are to be expanded as necessary to	o allow for all different types	s of element e.g. 4 wall types. The k -value
ELEMENT	AXU	A X k

(W/K)	kJ/K
2.1	(26)
10.29	(27)
0	(27a)
0	0 (28)
0	0 (28a)
6.7	3864 (28b)
0	0 (29)
9.89	10442.4 (29a)
0	0 (30)
	117.57 (31)
0	8044.2 (32)
	0 (32a)
	0 (32b)
	2.1 10.29 0 0 0 6.7 0 9.89 0





Internal	wall **												0	(33c)
Internal	floor												0	(32d)
Internal	ceiling fl	oor											0	(32e)
Fabric h	eat loss,	W/K = ∑ ((A x U)										28.98	(33)
Heat cap	pacity Cm	n = ∑(A x I	k)										22350.6	(34)
Therma	mass pa	rameter	(TMP = C	m ÷ TFA)	in kJ/m²ł	<							250	(35)
Linear Thermal bridges: Σ (L x Ψ) calculated using Appendix K								16.72	(36)					
Point Th	ermal br	idges: ∑χ	(W/K) if s	significan	t point th	nermal br	idge pres	sent and	values av	ailable			16.72	(36a)
Total fal	oric heat	loss H = 2	5(A × U) +	-∑(L×Ψ)	+∑χ								45.71	(37)
Ventilat	ion heat	loss calcu	lated mo	onthly										
	29.09	28.95	28.81	28.17	28.05	27.49	27.49	27.39	27.71	28.05	28.29	28.55		(38)
Heat tra	nsfer coe	efficient,	W/K											
	74.8	74.66	74.52	73.88	73.76	73.2	73.2	73.1	73.42	73.76	74	74.26		(39)
Heat los	s parame	eter (HLP)), W/m²K											
	1.45	1.45	1.45	1.43	1.43	1.42	1.42	1.42	1.42	1.43	1.44	1.44		(40)
Number	of days i	in month	(Table 1a	a)										
	31	28	31	30	31	30	31	31	30	31	30	31		(41)

4. Water heating energy requirement

Hot water usage in litres per day for mixer showers, Vd,shower (from Appendix J)73.372.270.5967.5265.2562.7361.2962.8864.6367.3470.4873.02	.73	(42)
Hot water usage in litres per day for baths, Vd,bath (from Appendix J)		(42a)
24.26 23.9 23.39 22.46 21.76 20.98 20.56 21.06 21.61 22.44 23.4 24.18 Hot water usage in litres per day for other uses, Vd,other (from Appendix J)		(42b)
34.1 32.86 31.62 30.38 29.14 27.9 29.14 30.38 31.62 32.86 34.1 Annual average hot water usage in litres per day Vd, average (from Appendix J) 12 12 Hot water usage in litres per day for each month Vd, m = (42a) + (42b) + (42c) 12	1.27	(42c) (43)
131.66 128.96 125.61 120.36 116.15 111.61 109.75 113.09 116.62 121.41 126.74 131.3 Energy content of hot water used = 4.18 x Vd,m x nm x DTm / 3600 kWh/month (from Appendix J)	1453.27	(44)
208.52 183.64 193.05 164.77 156.36 137.24 132.74 140.03 143.81 164.75 180.57 205.58 Distribution loss (46) = 0.15 x (45)	2011.05	(45)
Water storage loss (or HIU loss) a) If manufacturer's declared loss factor is known (kWh/day):	0	(46) (47) (48)
Energy lost from water storage, kWh/day (48) x (49) = b) If manufacturer's declared loss factor is not known :	0 0	(49) (50) (51)





Volume factor from Table 2a	0 (52)
Temperature factor from Table 2b	0 (53)
Energy lost from water storage, kWh/day	0 (54)
Enter (50) or (54) in (55)	0 (55)
Water storage (or HIU) loss calculated for each month (56) = (55) × (41)	()
0 0 0 0 0 0 0 0 0 0	(56)
If the vessel contains dedicated solar storage or dedicated WWHRS storage,	
(57)m = (56)m ᠌ [(47) − Vs] ÷ (47), else (57)m = (56)m	
where Vs is Vww from Appendix G3 or (H12) from Appendix H (as applicable).	
0 0 0 0 0 0 0 0 0 0	(57)
Primary circuit loss for each month from Table 3	
modified by factor from Table H4 if there is solar water heating and a cylinder thermostat, although not for DHW-only	y heat networks)
0 0 0 0 0 0 0 0 0 0	(59)
Combi loss for each month from Table 3a, 3b or 3c (enter 0 if not a combi boiler)	
50.96 46.03 50.96 49.32 50.96 49.32 50.96 50.96 49.32 50.96 49.32 50.96	(61)
Total heat required for water heating calculated for each month (62) = $0.85 \times (45) + (46) + (57) + (59) + (61)$	
259.48 229.66 244.01 214.08 207.32 186.55 183.7 190.99 193.12 215.71 229.88 256.54	2611.05 (62)
CWWHRS DHW input calculated using Appendix G (negative quantity) (enter 0 if no WWHRS contribution to water he	ating)
0 0 0 0 0 0 0 0 0 0 0	(63a)
PV diverter DHW input calculated using Appendix G (negative quantity) (enter 0 if no PV diverter contribution)	
0 0 0 0 0 0 0 0 0 0 0	(63b)
Solar DHW input calculated using Appendix H (negative quantity) (enter 0 if no solar contribution to water heating)	
0 0 0 0 0 0 0 0 0 0 0	
FGHRS DHW input calculated using Appendix G (negative quantity) (enter 0 if no FGHRS contribution to water heating	(63c)
· · · · · · · · · · · · · · · · · · ·	. ,
	. ,
	g)
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	g)
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	g) (63d) 2611.05 (64)
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	g) (63d)
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	g) (63d) 2611.05 (64) (64a)
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	g) (63d) 2611.05 (64)

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

Metabolic gains (Table 5), watts

	104.09	104.09	104.09	104.09	104.09	104.09	104.09	104.09	104.09	104.09	104.09	104.09	(66)
Lighting	gains (cal	culated in	n Append	lix L, equ	ation L12	or L12a)	, also see	e Table 5					
	22.1	19.63	15.97	12.09	9.04	7.63	8.24	10.71	14.38	18.26	21.31	22.72	(67)
Applianc	es gains (calculate	d in Appe	endix L, e	quation I	16 or L1	6a), also	see Table	25				
	225.64	227.98	222.08	209.52	193.67	178.76	168.81	166.47	172.37	184.93	200.78	215.69	(68)





Cooking gains (calculated in Appendix L, equation L18 or L18a), also see Table 5

Pumps a	47.14 and fans g	47.14 gains (Tab	47.14 le 5a)	47.14	47.14	47.14	47.14	47.14	47.14	47.14	47.14	47.14	(69)
Losses e	3 e.g. evapo	3 ration (ne	3 egative va	3 alues) (Ta	3 able 5	0	0	0	0	3	3	3	(70)
Water h	-69.4 eating ga	-69.4 ins (Table	-69.4 e 5)	-69.4	-69.4	-69.4	-69.4	-69.4	-69.4	-69.4	-69.4	-69.4	(71)
Total int	110.31 ernal gai	107.99 ns	103.4	93.21	87	80.5	76.44	79.7	83.54	90.75	100.51	109	(72)
	442.9	440.44	426.29	399.67	374.55	348.73	335.34	338.73	352.12	378.78	407.45	432.25	(73)

6. Solar gains

Solar gains in watts, calculated for each month													
Total gain	31 Is – inter				250.97	267.56	250.3	199.54	138.53	77.11	39.01	25.32	(83)
•	473.9				625.52	616.29	585.63	538.26	490.65	455.89	446.45	457.56	(84)

7. Mean internal temperature (heating season)

Temper	ature dur	ing heati	ng perioc	ls in the l	iving are	a from Ta	able 9, Th	1 (°C)					21	(85)
Utilisati	on factor	for gains	for living	g area, ⊡1	,m (see T	able 9a)								
	0.99	0.98	0.97	0.93	0.84	0.69	0.53	0.59	0.82	0.95	0.98	0.99		(86)
Mean in	iternal te	mperatur	e in livin	g area T1	(tollow s	steps 3 ar	nd 4 in Ta	ble 9c)						
-	19.46	19.61	19.9	20.32	20.69	20.91	20.98	20.96	20.8	20.34	19.83	19.43		(87)
Temper	ature dur	ing heati	ng period	is in rest	of dwelli	ng from	lable 9, I	h2 (°C)						
	19.72	19.73	19.73	19.74	19.74	19.75	19.75	19.75	19.74	19.74	19.74	19.73		(88)
Roof				ι	Jtilisatio	n factor f	or gains f	or rest of	fdwelling	g, ⊇2,m (s	ee Table	9a)		
	0.99	0.98	0.96	0.91	0.79	0.58	0.39	0.45	0.74	0.93	0.98	0.99		(89)
Roof					Me	ean interi	nal tempe	erature ir	n the rest	of dwell	ing T2			
	17.99	18.17	18.55	19.06	19.48	19.7	19.74	19.74	19.61	19.1	18.47	17.95		(90)
Living a	rea fractio	on											0.42	(91)
Mean in	nternal ter	mperatur	e (for the	e whole c	welling)									
	18.61	18.78	19.12	19.59	19.99	20.21	20.26	20.26	20.11	19.63	19.05	18.58		(92)
Adjuste	d mean ir	iternal te	mperatu	re:										. ,
	18.61	18.78	19.12	19.59	19.99	20.21	20.26	20.26	20.11	19.63	19.05	18.58		(93)

8. Space heating requirement





Utilisation factor for gains,

Useful ga	0.98 ains, mGr	0.97 n,W	0.96	0.91	0.8	0.62	0.45	0.51	0.76	0.93	0.97	0.98		(94)
Monthly	465.07 average	490.7 external	516.31 temperat	001.00	500.3 Table U	383.16 1	262.95	273.12	375.04	422.37	433.76	450.11		(95)
Heat loss	4.3 s rate for	4.9 mean int	6.5 ernal ter	8.9 nperatur	11.7 e	14.6	16.6	16.4	14.1	10.6	7.1	4.2		(96)
Space he		5 1036.28 Juiremen		789.99 n month	611.75	410.77	268.26	281.94	441.37	665.89	884.16	1067.79		(97)
Solar spa	450.4 ace heatir			185.69 g Append		0 ative qua	0 Intity)	0	0	181.18	324.29	459.56		(98a)
Space he	0 ating rec	0 Juiremen	0 t for each	0 n month a	0 after sola	0 r contrib	0 ution	0	0	0	0	0		(98b)
Space he	450.4 ating rec			185.69 /m²/year		0	0	0	0	181.18	324.29	459.56	45.93	(98c) (99)

8c. Space Cooling requirement														
Heat loss r	rate,													
Utilisation	0 factor	0 for loss	0	0	0	0	0	0	0	0	0	0		(100)
Useful loss	0 s, mLm	0 (watts)	0	0	0	0	0	0	0	0	0	0		(101)
Gains	0	0	0	0	0	0	0	0	0	0	0	0		(102)
Space coo	0 ling rec	0 Juiremen	0 It for mo	0 nth, whol	0 e dwellin	0 g, contin	0 uous (kW	0 'h)	0	0	0	0		(103) (104)
Cooled fra Intermitte		0 tor	0	0	0	0	0	0	0	0	0	0	0	(104) (105)
Space coo	0 ling rec	0 Juiremen	0 It for mo	0 nth	0	0	0	0 0	0	0	0	0	0	(106)
Space coo	0 ling rec	0 Juiremen	0 it in kWh	0 /m²/year	0	0	0	0	0	0	0	0	0	(107) (108)
8f. Spa	ce hea	ting req	uiremer	t		_		_		_				

Fabric Energy Efficiency,	0

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



0

(109)



Fraction of space heat from secondary/supplementary system,0Fraction of space heat from main system(s),-Fraction of main heating from main system 2,-Fraction of total space heat from main system 1,-Fraction of total space heat from main system 2,-Efficiency of main space heating system 1 (in %),-Efficiency of main space heating system 2 (in %),-Efficiency of secondary/supplementary heating system, %,0	0 (201) 1 (202) 0 (203) 1 (204) 0 (205) 170 (206) 0 (207) 0 (208) 0 (209)
Space heating requirement (calculated above),	
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	(210) 0
264.94 215.66 185.69 109.23 48.77 0 0 0 0 106.58 190.76 270.33	
Space heating fuel (main heating system 2), kWh/month 0	0
0 0 0 0 0 0 0 0 0 0 0	(213)
Space heating fuel (secondary), kWh/month 0	0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	(215)
Output from water heater), 0 Efficiency of water heater	170 (216)
	(217)
170 170 170 170 170 170 170 170 170 170	(217)
152.63 135.1 143.54 125.93 121.96 109.74 108.06 112.35 113.6 126.89 135.22 150.93	1 1535.91 (219)
Space Cooling	
0 0 0 0 0 0 0 0 0 0 0	(221)
Annual totals kWh/year kWh/year	
Space heating fuel used, main system 1	1391.96 (211)
Space heating fuel used, main system 2	0 (213)
Space heating fuel used, secondary Water heating fuel used	0 (215)
Electricity for instantaneous electric shower(s)	1535.91 (219)
Space cooling fuel used	0 (64a)
Electricity for pumps, fans and electric keep-hot	0 (221)
Mechanical vent fans - balanced, extract or positive input from outside 0 0	0 (230a)
warm air heating system fans	0 (230a)
Heating circulation pump or water pump within warm air heating unit	41 (230c)
Oil boiler auxiliary (oil pump, flue fan, etc; excludes circulation pump)	0 (230d)
Gas boiler auxiliary (flue fan, etc; excludes circulation pump)	45 (230e)
Maintaining electric keep-hot facility for gas combi boiler	0 (230f)
Pump for solar water heating	0 (230g)
Pump for storage WWHRS	
· · · · · · · · · · · · · · · · · · ·	0 (230h)
Total electricity for the above	
	0 (230h)





Energy sav Electricity								ed in dwe	lling					
Electricity	0 generat	0 ed by wi	0 ind turbii	0 nes (Appe	0 endix M)	0 (negative	0 e quantity	0 y)	0	0	0	0	0	(233a)
Electricity	0 generat	0 ed by hy	0 vdro-elec	0 tric genei	0 rators	0	0	0	0	0	0	0	0	(234a)
Electricity	0 used or	0 net elec	0 tricity ge	0 nerated l	0 by micro	0 -CHP	0	0	0	0	0	0	0	(235a)
Energy sav Electricity								0 ported	0	0	0	0	0	(235c)
Electricity	0 generat	0 ed by wi	0 ind turbii	0 nes (Appe	0 endix M)	0 (negative	0 e quantit	0 y)	0	0	0	0	0	(233b)
Electricity	0 generat	0 ed by hy	0 /dro-elec	0 tric genei	0 rators	0	0	0	0	0	0	0	0	(234b)
Electricity	0 used or	0 net elec	0 tricity ge	0 nerated l	0 by micro	0 -CHP	0	0	0	0	0	0	0	(235b)
Appendix			•.	0	0	0	0	0	0	0	0	0	0	(235d)
Appendix energy sav energy uso Total deliv	ved ed							Fuel		kWh/year			0 0 3170.01	(236a) (237a)

10a. Fuel costs – Individual heating systems including micro-CHP

Fuel required	kWh/year	Fuel price	Fuel cost £/yea	ar
Space heating - main system 1 (electric off-peak tariff				
High-rate fraction (Table 12a, or Appendix F for electric CPSU)	0		50.67	(240a)
Low-rate fraction	0		50.67	(240b)
High-rate cost	0		0	(240c)
Low-rate cost	0		0	(240d)
Space heating - main system 1 cost (other fuel)	0		0	(240e)
Space heating - main system 2 (electric off-peak tariff				
High-rate fraction (Table 12a, or Appendix F for electric CPSU)	0		50.67	(241a)
Low-rate fraction	0		50.67	(241b)
High-rate cost	0		0	(241c)
Low-rate cost	0		0	(241d)
Space heating - main system 2 cost (other fuel)	0		0	(241e)
Space heating - secondary (electric off-peak tariff)				
High-rate fraction (Table 12a, or Appendix F for electric CPSU)	0		50.67	(242a)





Low-rate fraction	0		50.67	(242b)
High-rate cost	0		0	(242c)
Low-rate cost	0		0	(242d)
Space heating - secondary cost (other fuel)	0		0	(242e)
Water heating (electric off-peak tariff)				
High-rate fraction (Table 12a, or Appendix F for electric CPSU)	0		0	(243)
Low-rate fraction	0		0	(242b)
High-rate cost	0		0	(242c)
Low-rate cost	0		0	(242d)
Water heating cost (other fuel)	0		55.91	(247)
(for a DHW-only heat network use (342a) or (342b) instead of (247)				
Energy For instantaneous electric shower(s)	0		0	(247a)
Space cooling	0		0	(248)
Pumps, fans And electric keep-hot	0		14.18	(249)
Energy For lighting	0		25.75	(250)
Additional standing charges	0		92	(251)
Energy saving/generation technologies	0		0	(252)
Appendix Q, <item 1="" description=""></item>	Fuel	kWh/year		
energy saved Or generated	0		0	(253)
energy used	0		0	(254)
Total energy cost	0		238.5	(255)
11a. SAP rating – Individual heating systems including micro-CHP				
Energy cost deflator	0		0	(256)
Energy cost factor (ECF)	0		0	(257)
SAP rating	0		0	(258)

11a. SAP rating – Individual heating systems including micro-CHP		
Energy cost deflator	0.36	(256)
Energy cost factor (ECF)	0.89	(257)
SAP rating	85.58	(258)
12a, CO2 emissions – Individual heating systems including micro-CHP		

E	nergy	Emission factor	Emissions	
KV	/h/year	kg	kg CO2/year	
Space heating - main system 1			292.31	(261)
Space heating - main system 2			0	(262)
Space heating - secondary			0	(263)
Energy for water heating			216.44	(264)
Energy for instantaneous electric shower(s)			0	(264a)





Space and water heating		0	(265)
Space cooling		0	(266)
Electricity for pumps, fans and electric keep		11.93	(267)
Electricity for lighting		22.54	(268)
energy saved or generated	0	0	(269b)
Appendix Q items			
energy saved	0	0	
energy used	0	0	
energy saved	0	0	(270b)
energy used		0	(271b)
Total CO2, kg/year		543.22	(272)
Dwelling CO2 Emission Rate		10.54	(273)
El rating		92	(274)

13a. Primary Energy – Individual heating systems including micro-CHP

	Energy Emission factor	Emissionsr
	KWh/year kg	kg CO2/year
Space heating - main system 1		1572.91 (275)
Space heating - main system 2		0 (276)
Space heating - secondary		0 (277)
Energy for water heating		2336.23 (278)
Energy for instantaneous electric shower(s)		0 (278a)
Space and water heating		0 (279)
Space cooling		0 (280)
Electricity for pumps, fans and electric keep		130.1 (281)
Electricity for lighting		239.49 (282)
energy saved or generated	0	0
Appendix Q items		
energy saved	0	0
energy used	0	0
energy saved	0	0 (284b)
energy used		0 (285b)
Total PE, kWh/year		4278.73 (286)
Dwelling PE Rate		83.05 (287)







Dwelling Reference: Dwelling Type: EN5 5SU

Unit 02 Existing Dwelling

1. Overall dwelling dimensions			
	Area(m²)	Av. Height(m)	Volume(m³)
Ground Floor	60.99 (1	a) x 3 (2a)	= 182.97 (3a)
Total floor area TFA Dwelling volume			60.99(4)182.97(5)
2. Ventilation Rate			
Chimneys/Flues	0	x 80 =	0 (6a)
Open chimneys	0	x 20 =	0 (6b)
Chimneys / flues attached to closed fire	0	x 10 =	0 (6c)
Flues attached to solid fuel boiler	0	x 20 =	0 (6d)
Flues attached to other heater	0	x 35 =	0 (6e)
Number of blocked chimneys	0	x 20 =	0 (6f)
Number of intermittent extract fans	2	x 10 =	20 (7a)
Number of passive vents	0	x 10 =	0 (7b)
Number of flueless gas fires	0	x 40 =	0 (7c)
		Air changes per hour	
Number of storeys in the dwelling (ns)		0.11	0.11 (8)
Infiltration due to chimneys, flues, fans, PSVs, etc Additional infiltration		0	0 (9)
Structural infiltration		0 0	0 (10) 0 (11)
Suspended wooden ground floor		0	0 (11)
No draught lobby		0	0 (13)
Percentage of windows and doors draught proofed		0	0 (14)
Window infiltration		0	0 (15)
Infiltration rate Air pormoability value, ABEO, $(m^3/h/m^2)$		0	0 (16)
Air permeability value, AP50, (m³/h/m²) Air permeability value, AP4, (m³/h/m²)		5	5 (17)
Air permeability value)		0 0.36	0 (17a 0.36 (18)
Number of sides on which dwelling is sheltered		3	3 (19)
Shelter factor			0.78 (20)
Infiltration rate incorporating shelter factor			0.28 (21)
Infiltration rate modified for monthly wind speed			
Jan Feb Mar Apr May Jun	Jul Aug Se	ep Oct Nov D	ec Total (22)







Monthly average wind speed from Table U2

Wind Fac	5.1 ctor	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7	52.5	(22)
Adjusted	1.28 d infiltrati	1.25 on rate (a	1.23 allowing f	1.1 for shelte	1.08 r and wir	0.95 nd speed	0.95)	0.93	1	1.08	1.13	1.18	13.13	(22a)
Calculate	0.36 e effective	0.35 e air char	0.34 nge rate f	0.31 or the ap	0.3 plicable (0.26 case:	0.26	0.26	0.28	0.3	0.31	0.33	3.65	(22b)
														(23a)
													0	(23b)
													0	(23c)
a) If bala	inced me	chanical v	ventilatio	n with he	eat recov	ery (MVF	IR)							
	0	0	0	0	0	0	0	0	0	0	0	0		(24a)
b) If bala	anced me	chanical	ventilatio	n withou	t heat re	covery (N	Л∨)							
	0	0	0	0	0	0	0	0	0	0	0	0		(24b)
c) If who	le house	extract v	entilatior	n or posit	ive input	ventilatio	on from o	outside						
N 16 1	0	0	0	0	.0	0	0	0	0	0	0	0		(24c)
d) if hatt	ural venti	lation or	whole no	use posit	live input	ventilati	on from	ΙΟΤΤ						
Effective	0.56 e air chan	0.56 ge rate	0.56	0.55	0.54	0.53	0.53	0.53	0.54	0.54	0.55	0.55		(24d)
	0.56	0.56	0.56	0.55	0.54	0.53	0.53	0.53	0.54	0.54	0.55	0.55		(25)
Effective	e air chan	ge rate fr	om PCDB	3:										
	0.56	0.56	0.56	0.55	0.54	0.53	0.53	0.53	0.54	0.54	0.55	0.55		(25)

3. Heat losses and heat loss parameter

Items in the table below are to be expanded as nec	cessary to allow for all different types of element	e.g. 4 wall types. The k -value
FLEMENT	AXU	AXk

ELEIVIENI	(W/K)	kJ/K	
Doors	2.1		(26)
Windows	11.39		(27)
Roof window	0		(27a)
Basement floor	0	0	(28)
Ground floor	0	0	(28a)
Exposed floor	7.93	4574.25	(28b)
Basement wall	0	0	(29)
External wall	11.73	12380.4	(29a)
Roof	0	0	(30)
Total area of external elements ∑A, m ²		138.2	(31)
Party Wall	0	7650	(32)
Party floor		0	(32a)
Party ceiling		0	(32b)





Internal	Internal wall **													(33c)
Internal	floor												0	(32d)
Internal	ceiling fl	oor											0	(32e)
Fabric h	eat loss, '	W/K = ∑ (A x U)										33.15	(33)
Heat ca	pacity Cm	ı = ∑(A x I	<)										24604.65	(34)
Therma	Thermal mass parameter (TMP = Cm \div TFA) in kJ/m ² K												250	(35)
Linear T	Linear Thermal bridges: $\sum (L \times \Psi)$ calculated using Appendix K												16.54	(36)
	Point Thermal bridges: $\sum \chi$ (W/K) if significant point thermal bridge present and values available												16.54	(36a)
Total fa	Total fabric heat loss H = $\Sigma(A \times U) + \Sigma(L \times \Psi) + \Sigma\chi$												49.69	(37)
Ventilat	Ventilation heat loss calculated monthly													
	34	33.85	33.7	33.02	32.9	32.3	32.3	32.19	32.53	32.9	33.15	33.42		(38)
Heat tra	insfer coe	efficient,	W/K											
	83.68	83.54	83.39	82.71	82.58	81.99	81.99	81.88	82.22	82.58	82.84	83.11		(39)
Heat los	s parame	eter (HLP)	, W/m²K											
	1.37 1.37 1.37 1.36 1.35 1.34 1.34 1.34 1.35 1.35 1.36 1.36													(40)
Numbe	Number of days in month (Table 1a)													
	31	28	31	30	31	30	31	31	30	31	30	31		(41)

4. Water heating energy requirement

Assumed occupancy, N	2.01	(42)										
Hot water usage in litres per day for mixer showers, Vd,shower (from Appendix J)												
79.63 78.43 76.69 73.35 70.89 68.14 66.58 68.31 70.21 73.16 76.57 79.32 Hot water usage in litres per day for baths, Vd,bath (from Appendix J)		(42a)										
26.34 25.95 25.4 24.39 23.63 22.78 22.33 22.87 23.47 24.37 25.41 26.26 Hot water usage in litres per day for other uses, Vd,other (from Appendix J)												
37.06 35.71 34.37 33.02 31.67 30.32 31.67 33.02 34.37 35.71 37.06 Annual average hot water usage in litres per day Vd, average (from Appendix J) 131.74 Hot water usage in litres per day for each month Vd, m = (42a) + (42b) + (42c)												
143.04 140.1 136.46 130.76 126.19 121.25 119.23 122.86 126.7 131.9 137.69 142.64 1578.81 (4 Energy content of hot water used = 4.18 x Vd,m x nm x DTm / 3600 kWh/month (from Appendix J)												
226.53 199.5 209.73 179 169.87 149.09 144.2 152.13 156.23 178.98 196.17 223.34 Distribution loss (46) = 0.15 x (45)	2184.78	8 (45)										
33.98 29.93 31.46 26.85 25.48 22.36 21.63 22.82 23.43 26.85 29.42 33.5 Storage volume (litres) including any solar or WWHRS storage within same vessel Water storage loss (or HIU loss)	0	(46) (47)										
a) If manufacturer's declared loss factor is known (kWh/day):	0	(48)										
Temperature factor from Table 2b0(49Energy lost from water storage, kWh/day (48) x (49) =0(50												
b) If manufacturer's declared loss factor is not known :												
Hot water storage loss factor from Table 2 (kWh/litre/day)	0	(51)										





Volume factor from Table 2a Temperature factor from Table 2b Energy lost from water storage, kWh/day														
Enter (50) or (54) in (55)	0 0	(54) (55)												
Water storage (or HIU) loss calculated for each month (56) = (55) × (41)														
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0														
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0														
modified by factor from Table H4 if there is solar water heating and a cylinder thermostat, although not for DHW-only	heat netwo	orks)												
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		(59)												
50.96 46.03 50.96 49.32 50.96 49.32 50.96 50.96 49.32 50.96 49.32 50.96 49.32 50.96 Total heat required for water heating calculated for each month (62) = 0.85 × (45) + (46) + (57) + (59) + (61)		(61)												
277.49 245.53 260.69 228.32 220.83 198.41 195.16 203.08 205.55 229.94 245.48 274.3 CWWHRS DHW input calculated using Appendix G (negative quantity) (enter 0 if no WWHRS contribution to water hea	2784.7 ating)	8 (62)												
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0 (63a													
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		(63b)												
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0)	(63c)												
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 Output from water heater for each month, kWh/month (64) = (62) + (63a) + (63b) + (63c) + (63d)		(63d)												
277.49 245.53 260.69 228.32 220.83 198.41 195.16 203.08 205.55 229.94 245.48 274.3 Output from water heater for each month, kWh/month (64) = (62) + (63a) + (63b) + (63c) + (63d)	2784.7	8 (64)												
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		(64a)												
88.06 77.84 82.48 71.85 69.22 61.9 60.69 63.32 64.28 72.25 77.55 87 include (57) m in calculation of (65) m only if hot water store is in the dwelling or hot water is from heat network		(65)												

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

Metabolic gains (Table 5), watts

		120.57							120.57	120.57	120.57	120.57	(66)	
Lighting	Lighting gains (calculated in Appendix L, equation L12 or L12a), also see Table 5													
Applianc	26.8 ces gains (10.95 quation l					22.14	25.84	27.54	(67)	
	261.85	264.56	257.72	243.14	224.74	207.44	195.89	193.17	200.02	214.6	233	250.29	(68)	





Cooking gains (calculated in Appendix L, equation L18 or L18a), also see Table 5

P	49.07 umps and fan		49.07 ble 5a)	49.07	49.07	49.07	49.07	49.07	49.07	49.07	49.07	49.07	(69)
L	3 osses e.g. eva	3 poration (r	3 Negative v	3 alues) (Ta	3 able 5	0	0	0	0	3	3	3	(70)
٧	-80.3 Vater heating			-80.38	-80.38	-80.38	-80.38	-80.38	-80.38	-80.38	-80.38	-80.38	(71)
Т	118.3 otal internal g	86 115.83 ains	110.85	99.79	93.04	85.97	81.57	85.11	89.27	97.11	107.71	116.94	(72)
	499.2	496.46	480.18	449.84	420.99	391.92	376.71	380.53	395.98	426.1	458.81	487.03	(73)

6. Solar gains

Solar gains in watts, calculated for each month 34.31 69.84 125.83 206.64 277.77 296.13 277.03 220.85 153.32 85.35 43.17 28.02 Total gains – internal and solar (watts) 533.57 566.29 606.01 656.48 698.76 688.06 653.73 601.38 549.31 511.45 501.98 515.05

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (8														(85)
Utilisati	on factor	for gains	for living	; area, ⊡1	,m (see T	able 9a)								
0.99 0.99 0.98 0.94 0.85 0.69 0.53 0.59 0.83 0.96 0.99 0.99 (Mean internal temperature in living area T1 (follow steps 3 and 4 in Table 9c)														(86)
Mean internal temperature in living area 11 (follow steps 3 and 4 in Table 9c)														
_	19.53	19.67	19.95	20.35	20.71	20.92	20.98	20.97	20.81	20.37	19.89	19.5		(87)
Temper	ature dur	ing heati	ng perioc	ls in rest	of dwelli	ng from 1	Table 9, T	h2 (°C)						
	19.78	19.79	19.79	19.8	19.8	19.81	19.81	19.81	19.8	19.8	19.8	19.79		(88)
Roof Utilisation factor for gains for rest of dwelling, 22,m (see Table 9a)														
	0.99	0.98	0.97	0.92	0.8	0.59	0.4	0.46	0.75	0.94	0.98	0.99		(89)
Roof					Me	ean inter	nal tempe	erature ir	hthe rest	of dwell	ing T2			
	18.12	18.3	18.66	19.15	19.56	19.76	19.8	19.8	19.67	19.19	18.58	18.08		(90)
Living a	rea fractio	on											0.33	(91)
Mean in	iternal te	mperatur	re (for the	e whole c	welling)									
	18.58	18.75	19.08	19.55	19.94	20.14	20.19	20.18	20.05	19.58	19.01	18.55		(92)
Adjuste	d mean ir	nternal te	mperatu	re:										
	18.58	18.75	19.08	19.55	19.94	20.14	20.19	20.18	20.05	19.58	19.01	18.55		(93)

8. Space heating requirement



(83)

(84)



Utilisation factor for gains,

Useful g	0.98 ains, mGr	0.98 n,W	0.96	0.91	0.8	0.62	0.44	0.5	0.77	0.93	0.97	0.99		(94)
Monthly	524.79 v average	553.37 external		599.05 ture from	562 n Table U	427.16 1	289.58	301.71	420.66	475.97	489.11	507.68		(95)
Heat los	4.3 s rate for	4.9 mean int	6.5 ernal ter	8.9 nperatur	11.7 e	14.6	16.6	16.4	14.1	10.6	7.1	4.2		(96)
Space he	1195.43 eating rec	, 110,		2 880.47 n month	680.14	454.44	294.31	309.78	489.17	741.51	986.7	1192.86		(97)
Solar spa	498.96 ace heatir	405.64 ng calcula				0 ative qua	0 Intity)	0	0	197.56	358.27	509.77		(98a)
Space he	0 eating rec	0 Juiremen	0 t for each	0 n month a	0 after sola	0 r contrib	0 ution	0	0	0	0	0		(98b)
Space he	498.96 eating rec			202.62 /m²/year		0	0	0	0	197.56	358.27	509.77	42.77	(98c) (99)

8c. Spac	8c. Space Cooling requirement														
Heat loss r	Heat loss rate,														
	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0														
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 (101) Useful loss, mLm (watts)															
(Gains	0 0 0 0 0 0 0 0 0 0 0 0 0 (102)														
-	0 0 0 0 0 0 0 0 0 (103) Space cooling requirement for month, whole dwelling, continuous (kWh) (104)														
C Cooled frac) ction	0	0	0	0	0	0	0	0	0	0	0	0	(104) (105)	
Intermitter C Space cool)	0	0 t for mo	0 Inth	0	0	0	0	0	0	0	0	0	(106)	
ں Space cool		0 iremen	0 it in kWh	0 n/m²/yea	0 r	0	0	0	0	0	0	0	0	(107) (108)	
8f. Spac	8f. Space heating requirement														

Fabric Energy Efficiency,

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



Page 6

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(109)

SAP WORKSHEET

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Fraction of space heat from secondary/supplementary system, Fraction of space heat from main system(s), Fraction of main heating from main system 2, Fraction of total space heat from main system 1, Fraction of total space heat from main system 2, Efficiency of main space heating system 1 (in %), Efficiency of main space heating system 2 (in %), Efficiency of secondary/supplementary heating system, %,													
Cooling System Seasonal Energy Efficiency R	0	(209)											
Space heating requirement (calculated above), 0 (210)													
Space heating fuel (main heating system 1), kWh/month 0													
293.51 238.61 204.69 119.19 Space heating fuel (main heating system 2),	0	(211)											
0 0 0 0 Snace heating fuel (secondary) kWh/month	0	(213)											
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0													
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0													
Output from water heater), 0 170 170 (216) Efficiency of water heater 170 170 170 170 170 (217) 170 170 170 170 170 170 170 170 (217) Fuel for water heating 170 170 170 170 170 170 170 170													
Fuel for water heating 163.23 144.43 153.35 134.3 129.9 116.71 114.8 119.46 120.91 135.26 144.4 161.35 1638.11 (2 Space Cooling													
0 0 0 0 Annual totals	0	0	0	0	I. <i>I</i>	0	0	0	0		(221)		
Space heating fuel used, main system 1				KVV	h/yea	ar kv	/h/year			1534.52	(211)		
Space heating fuel used, main system 2										0	(213)		
Space heating fuel used, secondary										0	(215)		
Water heating fuel used										1638.11	(219)		
Electricity for instantaneous electric shower	(s)									0	(64a)		
Space cooling fuel used										0	(221)		
Electricity for pumps, fans and electric keep-													
Mechanical vent fans - balanced, extract or p	positive i	nput fron	n outside	ġ	0		0			0	(230a)		
warm air heating system fans										0	(230b)		
Heating circulation pump or water pump with			-							41	(230c)		
Oil boiler auxiliary (oil pump, flue fan, etc; ex			i pump)							0	(230d)		
Gas boiler auxiliary (flue fan, etc; excludes ci										45	(230e)		
Maintaining electric keep-hot facility for gas combi boiler0(230f)Pump for solar water heating0(230g)													
Pump for storage WWHRS										0	(230g)		
Total electricity for the above										0	(230h)		
Electricity for lighting										86 189.31	(231) (232)		
										103.31	(232)		





Energy sa Electricity								ised in dv	velling					
Electricit	0 y genera	0 ated by v	0 vind turl	0 Dines (Ap	0 pendix N	0 1) (negati	0 ve quant	0 ity)	0	0	0	0	0	(233a)
Electricit	0 y genera	0 ated by h	0 iydro-ele	0 ectric ger	0 nerators	0	0	0	0	0	0	0	0	(234a)
Electricit	0 y used c	0 or net ele	0 ectricity {	0 generate	0 d by micr	0 ro-CHP	0	0	0	0	0	0	0	(235a)
	000000000(235c)Energy saving/generation technologies (Appendices M, N) - Energy exportedElectricity generated by PVs (Appendix M) (negative quantity)													
Electricit	0 y genera	0 ated by v	0 vind turl	0 Dines (Ap	0 pendix N	0 1) (negati	0 ve quant	0 ity)	0	0	0	0	0	(233b)
Electricit	0 y genera	0 ated by h	0 iydro-ele	0 ectric ger	0 nerators	0	0	0	0	0	0	0	0	(234b)
Electricit	0 y used c	0 or net ele	0 ectricity {	0 generate	0 d by micr	0 ro-CHP	0	0	0	0	0	0	0	(235b)
Appendix			•.		0	0	0	0	0	0	0	0	0	(235d)
Appendix energy sa energy u Total deli	aved sed		·					Fue	51	kWh/yea	r		0 0 3447.94	(236a) (237a)

10a. Fuel costs – Individual heating systems including micro-CHP

Fuel required	kWh/year	Fuel price	Fuel cost £/yea	ar
Space heating - main system 1 (electric off-peak tariff				
High-rate fraction (Table 12a, or Appendix F for electric CPSU)	0		55.86	(240a)
Low-rate fraction	0		55.86	(240b)
High-rate cost	0		0	(240c)
Low-rate cost	0		0	(240d)
Space heating - main system 1 cost (other fuel)	0		0	(240e)
Space heating - main system 2 (electric off-peak tariff				
High-rate fraction (Table 12a, or Appendix F for electric CPSU)	0		55.86	(241a)
Low-rate fraction	0		55.86	(241b)
High-rate cost	0		0	(241c)
Low-rate cost	0		0	(241d)
Space heating - main system 2 cost (other fuel)	0		0	(241e)
Space heating - secondary (electric off-peak tariff)				
High-rate fraction (Table 12a, or Appendix F for electric CPSU)	0		55.86	(242a)





Low-rate fraction	0		55.86	(242b)
High-rate cost	0		0	(242c)
Low-rate cost	0		0	(242d)
Space heating - secondary cost (other fuel)	0		0	(242e)
Water heating (electric off-peak tariff)				
High-rate fraction (Table 12a, or Appendix F for electric CPSU)	0		0	(243)
Low-rate fraction	0		0	(242b)
High-rate cost	0		0	(242c)
Low-rate cost	0		0	(242d)
Water heating cost (other fuel)	0		59.63	(247)
(for a DHW-only heat network use (342a) or (342b) instead of (247)				
Energy For instantaneous electric shower(s)	0		0	(247a)
Space cooling	0		0	(248)
Pumps, fans And electric keep-hot	0		14.18	(249)
Energy For lighting	0		31.22	(250)
Additional standing charges	0		92	(251)
Energy saving/generation technologies	0		0	(252)
Appendix Q, <item 1="" description=""></item>	Fuel	kWh/year		
energy saved Or generated	0		0	(253)
energy used	0		0	(254)
Total energy cost	0		252.88	(255)
11a. SAP rating – Individual heating systems including micro-CHP				
Energy cost deflator	0		0	(256)
Energy cost factor (ECF)	0		0	(257)
SAP rating	0		0	(258)

11a. SAP rating – Individual heating systems including micro-CHP		
Energy cost deflator	0.36	(256)
Energy cost factor (ECF)	0.86	(257)
SAP rating	86.08	(258)
12a. CO2 emissions – Individual heating systems including micro-CHP		

Energy	Emission factor	Emissions	
KWh/year	kg	kg CO2/year	
Space heating - main system 1		322.25	(261)
Space heating - main system 2		0	(262)
Space heating - secondary		0	(263)
Energy for water heating		230.91	(264)
Energy for instantaneous electric shower(s)		0	(264a)





Space and water heating		0	(265)
Space cooling		0	(266)
Electricity for pumps, fans and electric keep		11.93	(267)
Electricity for lighting		27.32	(268)
energy saved or generated	0	0	(269b)
Appendix Q items			
energy saved	0	0	
energy used	0	0	
energy saved	0	0	(270b)
energy used		0	(271b)
Total CO2, kg/year		592.41	(272)
Dwelling CO2 Emission Rate		9.71	(273)
El rating		93	(274)

13a. Primary Energy – Individual heating systems including micro-CHP

	Energy Emission factor	Emissionsr
	KWh/year kg	kg CO2/year
Space heating - main system 1		1734.01 (275)
Space heating - main system 2		0 (276)
Space heating - secondary		0 (277)
Energy for water heating		2491.93 (278)
Energy for instantaneous electric shower(s)		0 (278a)
Space and water heating		0 (279)
Space cooling		0 (280)
Electricity for pumps, fans and electric keep		130.1 (281)
Electricity for lighting		290.37 (282)
energy saved or generated	0	0
Appendix Q items		
energy saved	0	0
energy used	0	0
energy saved	0	0 (284b)
energy used		0 (285b)
Total PE, kWh/year		4646.41 (286)
Dwelling PE Rate		76.18 (287)







Dwelling Reference: Dwelling Type: EN5 5SU

Unit 02 Existing Dwelling

1. Overall dwelling dimensions					
	Area(m²)	Av. Height(r	m)	Volume(m³)	
Ground Floor Total floor area TFA	51.82 (1a) x 3	(2a) =	155.46	(3a)
Dwelling volume				51.82 155.46	(4) (5)
2. Ventilation Rate					
Chimneys/Flues	0	x 80 =		0	(6a)
Open chimneys	0	x 20 =		0	(6b)
Chimneys / flues attached to closed fire	0	x 10 =		0	(6c)
Flues attached to solid fuel boiler	0	x 20 =		0	(6d)
Flues attached to other heater	0	x 35 =		0	(6e)
Number of blocked chimneys	0	x 20 =		0	(6f)
Number of intermittent extract fans	2	x 10 =		20	(7a)
Number of passive vents	0	x 10 =		0	(7b)
Number of flueless gas fires	0	x 40 =		0	(7c)
		Air changes	per hour		
Number of storeys in the dwelling (ns)			0.13	0.13	(8)
Infiltration due to chimneys, flues, fans, PSVs, etc			0	0	(9)
Additional infiltration Structural infiltration			0	0	(10)
Suspended wooden ground floor			0 0	0 0	(11) (12)
No draught lobby			0	0	(12)
Percentage of windows and doors draught proofed			0	0	(14)
Window infiltration			0	0	(15)
Infiltration rate			0	0	(16)
Air permeability value, AP50, (m³/h/m²) Air permeability value, AP4, (m³/h/m²)			5	5	(17)
Air permeability value)			0 0.38	0 0.38	(17a) (18)
Number of sides on which dwelling is sheltered			3	3	(18)
Shelter factor			0	0.78	(20)
Infiltration rate incorporating shelter factor				0.29	(21)
Infiltration rate modified for monthly wind speed					. /
Jan Feb Mar Apr May Jun	Jul Aug	Sep Oct I	Nov Dec	Total	(22)







Monthly average wind speed from Table U2

Wind	5.1 Factor	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7	52.5	(22)
Adjust	1.28 ed infiltrat	1.25 tion rate	1.23 (allowing	1.1 for shelt	1.08 er and w	0.95 ind speed	0.95 d)	0.93	1	1.08	1.13	1.18	13.13	(22a)
Calcul	0.37 ate effecti [,]	0.37 ve air cha	0.36 ange rate	0.32 for the a	0.32 pplicable	0.28 case:	0.28	0.27	0.29	0.32	0.33	0.34	3.85	(22b)
													0	(23a)
													0	(23b)
													0	(23c)
a) If balanced mechanical ventilation with heat recovery (MVHR)														
	0	0	0	0	0	0	0	0	0	0	0	0		(24a)
b) If ba	alanced m	echanica	l ventilati	on witho	ut heat re	ecovery (MV)							
	0	0	0	0	0	0	0	0	0	0	0	0		(24b)
c) If w	hole house	extract	ventilatio	on or posi	tive inpu	t ventilat	ion from	outside						
1.16	0	0	0	0	0	0	0	0	0	0	0	0		(24c)
d) If na	atural vent	liation o	r whole h	ouse pos	-	it ventila	tion from	loft						
	0.57	0.57	0.56	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.55	0.56		(24d)
Effecti	ve air chai	nge rate												
Fff a t	0.57	0.57	0.56	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.55	0.56		(25)
Effecti	ve air chai	nge rate i	rom PCD	в:										
	0.57	0.57	0.56	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.55	0.56		(25)

3. Heat losses and heat loss parameter

Items in the table below are to be expanded as necessary to allow for all different types of element e.g. 4 wall types. The k -value										
ELEMENT	A X U (W/K)	A X k kJ/K								
Doors	2.1	(26								
Windows	5.89	(27								
Roof window	0	(27								
Basement floor	0	0 (28								
Ground floor	0	0 (28								
Exposed floor	6.74	3886.5 (28								
Basement wall	0	0 (29								
External wall	10.49	11075.1 (29								
Roof	0	0 (30								
Total area of external elements ∑A, m ²		117.35 (31								
Party Wall	0	5482.8 (32								
Party floor		0 (32								
Party ceiling		0 (32								





Internal	wall **												0	(33c)
Internal	floor												0	(32d)
Internal	ceiling fl	oor											0	(32e)
Fabric h	eat loss, '	W/K = ∑ (A x U)										25.21	(33)
Heat ca	pacity Cm	ı = ∑(A x ŀ	<)										20444.4	(34)
Therma	l mass pa	rameter	(TMP = C	m ÷ TFA)	in kJ/m²ł	<							250	(35)
Linear Thermal bridges: $\sum (L \times \Psi)$ calculated using Appendix K												12.8	(36)	
Point Thermal bridges: $\sum \chi$ (W/K) if significant point thermal bridge present and values available										12.8	(36a)			
Total fabric heat loss H = $\Sigma(A \times U) + \Sigma(L \times \Psi) + \Sigma\chi$										38.01	(37)			
Ventilat	ion heat l	oss calcu	lated mo	nthly										
	29.24	29.1	28.97	28.32	28.2	27.64	27.64	27.54	27.86	28.2	28.45	28.7		(38)
Heat tra	insfer coe	efficient, V	W/K											
	67.25	67.11	66.98	66.33	66.21	65.65	65.65	65.55	65.87	66.21	66.46	66.71		(39)
Heat los	s parame	eter (HLP)	, W/m²K											
	1.3	1.3	1.29	1.28	1.28	1.27	1.27	1.26	1.27	1.28	1.28	1.29		(40)
Number	r of days i	n month	(Table 1a	a)										
	31	28	31	30	31	30	31	31	30	31	30	31		(41)

4. Water heating energy requirement

Assumed occupancy, N		1.74	(42)					
Hot water usage in litres per day for mixer showers, Vd,shower (from Appendix J)								
73.5 72.4 70.79 67.71 65.44 62.9 61.46 63.06 64.81 67.53 70.68	73.22		(42a)					
Hot water usage in litres per day for baths, Vd,bath (from Appendix J)								
	24.25		(42b)					
Hot water usage in litres per day for other uses, Vd,other (from Appendix J)								
	34.2		(42c)					
Annual average hot water usage in litres per day Vd, average (from Appendix J)	1	21.61	(43)					
Hot water usage in litres per day for each month Vd,m = (42a) + (42b) + (42c)								
132.03 129.32 125.96 120.7 116.48 111.92 110.06 113.4 116.95 121.75 127.09	131.66	1457.31	(44)					
Energy content of hot water used = 4.18 x Vd,m x nm x DTm / 3600 kWh/month (from Appendix J)								
	206.15	2016.65	(45)					
Distribution loss (46) = 0.15 x (45)								
	30.92		(46)					
Storage volume (litres) including any solar or WWHRS storage within same vessel		0	(47)					
Water storage loss (or HIU loss)								
a) If manufacturer's declared loss factor is known (kWh/day):		0	(48)					
Temperature factor from Table 2b								
Energy lost from water storage, kWh/day (48) x (49) =		0	(50)					
b) If manufacturer's declared loss factor is not known :								
Hot water storage loss factor from Table 2 (kWh/litre/day)		0	(51)					





Volume factor from Table 2a Temperature factor from Table 2b	0 0	(52) (53)
Energy lost from water storage, kWh/day	0	(53)
Enter (50) or (54) in (55)	0	(55)
Water storage (or HIU) loss calculated for each month (56) = $(55) \times (41)$		
		(56)
If the vessel contains dedicated solar storage or dedicated WWHRS storage, (57)m = (56)m 🖻 [(47) – Vs] ÷ (47), else (57)m = (56)m		
where Vs is Vww from Appendix G3 or (H12) from Appendix H (as applicable).		
		(57)
Primary circuit loss for each month from Table 3		
modified by factor from Table H4 if there is solar water heating and a cylinder thermostat, although not for DHW-on	ly heat netw	
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 Combi loss for each month from Table 3a, 3b or 3c (enter 0 if not a combi boiler)		(59)
		(61)
50.96 46.03 50.96 49.32 50.96 49.32 50.96 50.96 49.32 50.96 49.32 50.96 Total heat required for water heating calculated for each month (62) = 0.85 × (45) + (46) + (57) + (59) + (61)		(01)
260.06 230.18 244.55 214.54 207.76 186.93 184.06 191.38 193.53 216.17 230.38 257.11	2616.6	65 (62)
CWWHRS DHW input calculated using Appendix G (negative quantity) (enter 0 if no WWHRS contribution to water h	eating)	
		(63a)
PV diverter DHW input calculated using Appendix G (negative quantity) (enter 0 if no PV diverter contribution)		(624)
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		(63b)
		(63c)
FGHRS DHW input calculated using Appendix G (negative quantity) (enter 0 if no FGHRS contribution to water heating	ıg)	()
0 0 0 0 0 0 0 0 0 0 0		(63d)
Output from water heater for each month, kWh/month (64) = (62) + (63a) + (63b) + (63c) + (63d)		
260.06 230.18 244.55 214.54 207.76 186.93 184.06 191.38 193.53 216.17 230.38 257.11 Output from water heater for each month, kWh/month (64) = (62) + (63a) + (63b) + (63c) + (63d)	2616.6	55 (64)
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		(64a)
82.27 72.74 77.11 67.27 64.88 58.09 57 59.43 60.28 67.67 72.53 81.29 include (57) m in calculation of (65) m only if hot water store is in the dwelling or hot water is from heat network		(65)

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

Metabolic gains (Table 5), watts

Liebtin e i						104.63			104.63	104.63	104.63	104.63	(66)
Lighting gains (calculated in Appendix L, equation L12 or L12a), also see Table 5													
Appliance						8.65 16 or L1				20.7	24.16	25.76	(67)
	226.8	229.16	223.23	210.6	194.66	179.68	169.68	167.32	173.25	185.88	201.82	216.8	(68)





Cooking gains (calculated in Appendix L, equation L18 or L18a), also see Table 5

Pumps	47.21 and fans g	47.21 gains (Tab	47.21 ole 5a)	47.21	47.21	47.21	47.21	47.21	47.21	47.21	47.21	47.21	(69)
Losses	3 e.g. evapo	3 oration (no	3 egative va	3 alues) (Ta	3 able 5	0	0	0	0	3	3	3	(70)
Water	-69.75 heating ga	00170	-69.75 e 5)	-69.75	-69.75	-69.75	-69.75	-69.75	-69.75	-69.75	-69.75	-69.75	(71)
Total ir	110.57 nternal gai	108.24 ns	103.64	93.43	87.2	80.68	76.61	79.88	83.72	90.96	100.74	109.26	(72)
	447.52	444.74	430.05	402.81	377.19	351.09	337.71	341.43	355.36	382.62	411.8	436.89	(73)

6. Solar gains

Solar gains in watts, calculated for each month 57.8 98.45 134.7 166.91 186.95 185.6 178.93 163.98 145.86 108.81 69.23 49.46 Total gains – internal and solar (watts) 505.32 543.19 564.76 569.72 564.14 536.69 516.65 505.41 501.22 491.43 481.03 486.35

7. Mean internal temperature (heating season)

Temper	ature dur	ing heati	ng perioc	ls in the l	iving are	a from Ta	able 9, Th	1 (°C)					21	(85)
Utilisati	on factor	for gains	for living	; area, 🛙 1	.,m (see 1	able 9a)								
Mean in	0.99 Iternal ter	0.98 mperatur	0.96 re in living	0.93 area T1	0.86 (follow s	0.71 tens 3 ar	0.54 od 4 in Ta	0.57 ble 9c)	0.78	0.93	0.98	0.99		(86)
Mean internal temperature in living area T1 (follow steps 3 and 4 in Table 9c)												(0-)		
-	19.74	. 19.89	20.14	20.45	20.73	20.92	20.98	20.98	20.87	20.53	20.08	19.71		(87)
Temper	ature dur	ing heati	ng perioc	is in rest	of dwelli	ng from	lable 9, I	h2 (°C)						
	19.84	19.84	19.85	19.86	19.86	19.87	19.87	19.87	19.86	19.86	19.85	19.85		(88)
Roof Utilisation factor for gains for rest of dwelling, 22,m (see Table 9a)														
	0.98	0.97	0.95	0.91	0.8	0.61	0.41	0.44	0.69	0.9	0.97	0.98		(89)
Roof					Me	ean inter	nal temp	erature ir	n the rest	of dwell	ing T2			
	18.42	18.62	18.92	19.31	19.63	19.82	19.86	19.86	19.78	19.42	18.86	18.39		(90)
Living ar	rea fractio	on											0.45	(91)
Mean in	iternal tei	mperatur	re (for the	e whole d	dwelling)									
	19.02	19.19	19.47	19.82	20.13	20.32	20.37	20.36	20.27	19.92	19.41	18.98		(92)
Adjuste	d mean ir		20117		20.10	20.02	_0.07	20.00		20.02		20.00		. /
	19.02	19.19	19.47	19.82	20.13	20.32	20.37	20.36	20.27	19.92	19.41	18.98		(93)

8. Space heating requirement



(83)

(84)



Utilisation factor for gains,

Useful g	0.98 ains, mGr	0.97 n,W	0.95	0.9	0.82	0.65	0.47	0.5	0.73	0.9	0.96	0.98		(94)
Monthly	493.56 v average	0		515.56 ture from			243.02	253.97	364.62	443.03	462.99	476.6		(95)
Heat los	4.3 s rate for	4.9 mean int	6.5 ernal ter	8.9 nperatur	11.7 e	14.6	16.6	16.4	14.1	10.6	7.1	4.2		(96)
Space he	989.67 eating rec	959.09 Juiremen	868.75 t for eacl	/ =	558.05	375.34	247.26	259.78	406.54	616.95	818.22	986.06		(97)
Solar spa	369.11 ace heatir	291.75 ng calcula				0 ative qua	0 antity)	0	0	129.4	255.77	379.04		(98a)
Space he	0 eating rec	0 Juiremen	0 t for eacl	0 n month a	0 after sola	0 r contrib	0 ution	0	0	0	0	0		(98b)
Space he	369.11 eating rec	291.75 Juiremen				0	0	0	0	129.4	255.77	379.04	36.59	(98c) (99)

8c. Sp	8c. Space Cooling requirement													
Heat loss	rate,													
Utilisatio	0 n factor	0 for loss	0	0	0	0	0	0	0	0	0	0		(100)
Useful lo	0 ss, mLm	0 (watts)	0	0	0	0	0	0	0	0	0	0		(101)
Gains	0	0	0	0	0	0	0	0	0	0	0	0		(102)
Space co	0 oling rec	0 Juiremen	0 t for mor	0 nth, whol	0 e dwellin	0 g, contin	0 uous (kW	0 /h)	0	0	0	0		(103) (104)
Cooled fr Intermitt		0 tor	0	0	0	0	0	0	0	0	0	0	0	(104) (105)
Space co	0	0	0 It for mor	0 nth	0	0	0	0	0	0	0	0	0	(106)
Space co	0 oling rec	0 Juiremen	0 it in kWh,	0 /m²/year	0	0	0	0	0	0	0	0	0	(107) (108)
8f. Spa	ace hea	ting req	uiremen	t										

Fabric Energy Efficiency,

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



0

(109)

SAP WORKSHEET

0



Fraction of space heat from secondary/supplementary system, 0 Fraction of space heat from main system(s), Fraction of main heating from main system 2, Fraction of total space heat from main system 1, Fraction of total space heat from main system 2, Efficiency of main space heating system 1 (in %), Efficiency of main space heating system 2 (in %), Efficiency of secondary/supplementary heating system, %,	0 1 0 1 0 170 0 0	(201) (202) (203) (204) (205) (206) (207) (208)
Cooling System Seasonal Energy Efficiency Ratio, 0	0	(209)
Space heating requirement (calculated above),		
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0	(210)
217.12 171.62 146.26 88.52 42.35 0 0 0 76.12 150.45 222.97 Space heating fuel (main heating system 2), kWh/month 0	0	(211)
	0	(213)
Space heating fuel (secondary), kWh/month 0	0	()
0 0 0 0 0 0 0 0 0 0 0 0		(215)
Output from water heater), 0	170	(216)
Efficiency of water heater		(217)
170 170 170 170 170 170 170 170 170 170		(217)
152.98 135.4 143.85 126.2 122.21 109.96 108.27 112.57 113.84 127.16 135.52 151.24 Space Cooling	1539.21	(219)
		(221)
Annual totals kWh/year kWh/year		、 ,
Space heating fuel used, main system 1	1115.39	(211)
Space heating fuel used, main system 2	0	(213)
Space heating fuel used, secondary	0	(215)
Water heating fuel used	1539.21	(219)
Electricity for instantaneous electric shower(s)	0	(64a)
Space cooling fuel used	0	(221)
Electricity for pumps, fans and electric keep-hot		
Mechanical vent fans - balanced, extract or positive input from outside 0 0	0	(230a)
warm air heating system fans Heating circulation pump or water pump within warm air heating unit	0	(230b)
Oil boiler auxiliary (oil pump, flue fan, etc; excludes circulation pump)	41	(230c)
Gas boiler auxiliary (flue fan, etc; excludes circulation pump)	0	(230d)
Maintaining electric keep-hot facility for gas combi boiler	45	(230e)
Pump for solar water heating	0	(230f)
Pump for storage WWHRS	0 0	(230g) (230b)
Total electricity for the above	86	(230h) (231)
Electricity for lighting	177.03	(231)
	177.00	(232)





						es M, N) - re quantit		sed in dv	velling					
Electricit	0 ty genera	0 ated by v	0 vind turl	0 bines (Ap	0 pendix N	0 A) (negati	0 ive quant	0 ity)	0	0	0	0	0	(233a)
Electricit	0 ty genera	0 ated by h	0 iydro-ele	0 ectric ger	0 nerators	0	0	0	0	0	0	0	0	(234a)
Electricit	0 ty used c	0 or net ele	0 ectricity (0 generate	0 d by mici	0 ro-CHP	0	0	0	0	0	0	0	(235a)
						0 es M, N) - re quantit		0 xported	0	0	0	0	0	(235c)
Electricit	0 ty genera	0 ated by v	0 vind turl	0 bines (Ap	0 pendix N	0 A) (negati	0 ive quant	0 ity)	0	0	0	0	0	(233b)
Electricit	0 ty genera	0 ated by h	0 iydro-ele	0 ectric ger	0 nerators	0	0	0	0	0	0	0	0	(234b)
Electricit	0 ty used c	0 or net ele	0 ectricity (0 generate	0 d by micı	0 ro-CHP	0	0	0	0	0	0	0	(235b)
Appendi			•.		0	0	0	0	0	0	0	0	0	(235d)
Appendi energy s energy u Total del	aved ised		·					Fue	51	kWh/yea	r		0 0 2917.64	(236a) (237a)

10a. Fuel costs – Individual heating systems including micro-CHP

Fuel required	kWh/year	Fuel price	Fuel cost £/ye	ar
Space heating - main system 1 (electric off-peak tariff				
High-rate fraction (Table 12a, or Appendix F for electric CPSU)	0		40.6	(240a)
Low-rate fraction	0		40.6	(240b)
High-rate cost	0		0	(240c)
Low-rate cost	0		0	(240d)
Space heating - main system 1 cost (other fuel)	0		0	(240e)
Space heating - main system 2 (electric off-peak tariff				
High-rate fraction (Table 12a, or Appendix F for electric CPSU)	0		40.6	(241a)
Low-rate fraction	0		40.6	(241b)
High-rate cost	0		0	(241c)
Low-rate cost	0		0	(241d)
Space heating - main system 2 cost (other fuel)	0		0	(241e)
Space heating - secondary (electric off-peak tariff)				
High-rate fraction (Table 12a, or Appendix F for electric CPSU)	0		40.6	(242a)





Low-rate fraction	0		40.6	(242b)
High-rate cost	0		0	(242c)
Low-rate cost	0		0	(242d)
Space heating - secondary cost (other fuel)	0		0	(242e)
Water heating (electric off-peak tariff)				
High-rate fraction (Table 12a, or Appendix F for electric CPSU)	0		0	(243)
Low-rate fraction	0		0	(242b)
High-rate cost	0		0	(242c)
Low-rate cost	0		0	(242d)
Water heating cost (other fuel)	0		56.03	(247)
(for a DHW-only heat network use (342a) or (342b) instead of (247)				
Energy For instantaneous electric shower(s)	0		0	(247a)
Space cooling	0		0	(248)
Pumps, fans And electric keep-hot	0		14.18	(249)
Energy For lighting	0		29.19	(250)
Additional standing charges	0		92	(251)
Energy saving/generation technologies	0		0	(252)
Appendix Q, <item 1="" description=""></item>	Fuel	kWh/year		
energy saved Or generated	0		0	(253)
energy used	0		0	(254)
Total energy cost	0		232	(255)
11a. SAP rating – Individual heating systems including micro-CHP				
Energy cost deflator	0		0	(256)
Energy cost factor (ECF)	0		0	(257)
SAP rating	0		0	(258)

11a. SAP rating – Individual heating systems including micro-CHP		
Energy cost deflator	0.36	(256)
Energy cost factor (ECF)	0.86	(257)
SAP rating	86.02	(258)
12a. CO2 emissions – Individual heating systems including micro-CHP		

E	Energy Emission factor		Emissions	
KW	/h/year	kg	kg CO2/year	
Space heating - main system 1			234.23	(261)
Space heating - main system 2			0	(262)
Space heating - secondary			0	(263)
Energy for water heating			216.91	(264)
Energy for instantaneous electric shower(s)			0	(264a)





Space and water heating		0	(265)
Space cooling		0	(266)
Electricity for pumps, fans and electric keep		11.93	(267)
Electricity for lighting		25.55	(268)
energy saved or generated	0	0	(269b)
Appendix Q items			
energy saved	0	0	
energy used	0	0	
energy saved	0	0	(270b)
energy used		0	(271b)
Total CO2, kg/year		488.62	(272)
Dwelling CO2 Emission Rate		9.43	(273)
El rating		93	(274)

13a. Primary Energy – Individual heating systems including micro-CHP

	Energy Emission factor	Emissionsr
	KWh/year kg	kg CO2/year
Space heating - main system 1		1260.4 (275)
Space heating - main system 2		0 (276)
Space heating - secondary		0 (277)
Energy for water heating		2341.25 (278)
Energy for instantaneous electric shower(s)		0 (278a)
Space and water heating		0 (279)
Space cooling		0 (280)
Electricity for pumps, fans and electric keep		130.1 (281)
Electricity for lighting		271.54 (282)
energy saved or generated	0	0
Appendix Q items		
energy saved	0	0
energy used	0	0
energy saved	0	0 (284b)
energy used		0 (285b)
Total PE, kWh/year		4003.29 (286)
Dwelling PE Rate		77.25 (287)







Dwelling Reference: Dwelling Type: EN5 5SU

Unit 02 Existing Dwelling

Total floor area TFA 84.55 (4 Dwelling volume 253.65 (5 2. Ventilation Rate 2 2 Chimneys/Flues 0 x 80 = 0 (6 Open chimneys 0 x 20 = 0 (6 Chimneys / flues attached to closed fire 0 x 10 = 0 (6 Flues attached to solid fuel boiler 0 x 35 = 0 (6 Number of blocked chimneys 0 x 20 = 0 (6 Number of blocked chimneys 0 x 20 = 0 (6 Number of passive vents 0 x 10 = 30 (7 Number of storeys in the dwelling (ns) 0 x 40 = 0 (7 Number of storeys in the dwelling (ns) 0 0 0 (1 Supended wooden ground floor 0 0 0 (1 Number of storeys in the dwelling (ns) 0 0 (1 Supended wooden ground floor 0 0 (1 Number of storeys in the dwelling (ns) 0 0 (1 Supended wooden	1. Overall dwelling dimensions					
Total floor area TFA Bits (14) Bits (14)		Area(m²)	Av. Height(n	n)	Volume(m³)	
Dwelling volume 253,65 (5) 2. Ventilation Rate 2 2 0 (6) Chimneys/Flues 0 x 80 = 0 (6) Open chimneys 0 x 20 = 0 (6) Chimneys / flues attached to closed fire 0 x 10 = 0 (6) Flues attached to other heater 0 x 35 = 0 (6) Number of locked chimneys 0 x 20 = 0 (6) Number of locked chimneys 0 x 20 = 0 (6) Number of locked chimneys 0 x 20 = 0 (6) Number of passive vents 0 x 10 = 0 (7) Number of storeys in the dwelling (ns) 0 x 10 = 0 (7) Number of storeys in the dwelling (ns) 0 0 11 20 12 0.12 0.12 0.12 0.12 0.12 0 0 11 30 </td <td></td> <td>84.55</td> <td>(1a) x 3</td> <td>(2a) =</td> <td></td> <td>(3a)</td>		84.55	(1a) x 3	(2a) =		(3a)
Chimneys/Flues0x80 =0(6Open chimneys0x20 =0(6Chimneys / flues attached to closed fire0x10 =0(6Flues attached to solid fuel boiler0x20 =0(6Flues attached to other heater0x35 =0(6Number of blocked chimneys0x20 =0(6Number of blocked chimneys0x20 =0(7Number of passive vents0x10 =0(7Number of flueless gas fires0x40 =0(7Number of storeys in the dwelling (ns)0x40 =0(7Number of storeys in the dwelling (ns)0.120.120.12(8Infiltration due to chimneys, flues, fans, PSVs, etc00(1Structural infiltration00(1Nu dditional infiltration00(1No draught lobby00(1Percentage of windows and doors draught proofed00(1Vindow infiltration00(1Air permeability value, AP50, (m³/h/m²)55(1Air permeability value, AP50, (m³/h/m²)00(1Number of sides on which dwelling is sheltered22(1Number of sides on which dwelling is sheltered0.370.37(1Number of sides on which dwelling is sheltered0.31(2 <t< td=""><td></td><td></td><td></td><td></td><td></td><td>(4) (5)</td></t<>						(4) (5)
Open chimneys0x20 =066Chimneys / flues attached to closed fire0x10 =066Flues attached to solid fuel boiler0x20 =066Flues attached to other heater0x35 =066Number of blocked chimneys0x20 =066Number of blocked chimneys0x20 =066Number of blocked chimneys0x20 =066Number of passive vents3x10 =077Number of flueless gas fires0x40 =077Number of storeys in the dwelling (ns)0x40 =066Infiltration00011 <td>2. Ventilation Rate</td> <td></td> <td></td> <td></td> <td></td> <td></td>	2. Ventilation Rate					
Chimneys / flues attached to closed fire0x10 =0(6)Flues attached to solid fuel boiler0x20 =0(6)Flues attached to other heater0x35 =0(6)Number of blocked chimneys0x20 =0(6)Number of intermittent extract fans3x10 =30(7)Number of passive vents0x10 =0(7)Number of flueless gas fires0x40 =0(7)Number of storeys in the dwelling (ns)0x40 =0(7)Number of storeys, flues, fans, PSVs, etc000(1)Additional infiltration00(1)(1)(1)Suspended wooden ground floor00(1)(1)(1)No draught lobby00(1)(1)(1)(1)(1)(1)Percentage of windows and doors draught proofed00(1)(1	Chimneys/Flues	0	x 80 =		0	(6a)
Flues attached to solid fuel boiler0x20 =0(6)Flues attached to other heater0x35 =0(6)Number of blocked chimneys0x20 =0(6)Number of intermittent extract fans3x10 =30(7)Number of passive vents0x10 =0(7)Number of flueless gas fires0x40 =0(7)Number of storeys in the dwelling (ns)0x40 =0(7)Number of storeys in the dwelling (ns)00(1)(1)Structural infiltration00(1)(1)Structural infiltration00(1)(1)Suspended wooden ground floor00(1)(1)Nunder of storeys and doors draught proofed00(1)Vindow infiltration00(1)(1)Number of sides on which dwelling is sheltered22(1)Air permeability value, AP50, (m³/h/m²)55(1)Air permeability value)0.370.37(1)Number of sides on which dwelling is sheltered22(1)Shelter factor0.31(2)(2)(1)Infiltration rate modified for monthly wind speed0.31(2)(3)	Open chimneys	0	x 20 =		0	(6b)
Flues attached to other heater 0 x 10 0 x 10 0 0 Number of blocked chimneys 0 x 20 = 0 66 Number of intermittent extract fans 3 x 10 = 0 (7 Number of passive vents 0 x 10 = 0 (7 Number of flueless gas fires 0 x 40 = 0 (7 Number of storeys in the dwelling (ns) 0 x 40 = 0 (7 Number of storeys in the dwelling (ns) 0 x 40 = 0 (7 Number of storeys in the dwelling (ns) 0 0.12 0.12 (8 Infiltration 0 0 11 11 10 0 0 11 Suppended wooden ground floor 0 0 0 11 <td< td=""><td>Chimneys / flues attached to closed fire</td><td>0</td><td>x 10 =</td><td></td><td>0</td><td>(6c)</td></td<>	Chimneys / flues attached to closed fire	0	x 10 =		0	(6c)
Number of blocked chimneys 0 x 30 0 (6) Number of blocked chimneys 0 x 20 = 0 (6) Number of intermittent extract fans 3 x 10 = 30 (7) Number of passive vents 0 x 10 = 0 (7) Number of flueless gas fires 0 x 40 = 0 (7) Number of storeys in the dwelling (ns) 0 x 40 = 0 (7) Number of storeys in the dwelling (ns) 0 0.12 0.12 (8) Infiltration 0 0 0 (1) Structural infiltration 0 0 (1) Suppended wooden ground floor 0 0 (1) No draught lobby 0 0 (1) Percentage of windows and doors draught proofed 0 0 (1) Window infiltration 0 0 (1) Air permeability value, AP4, (m³/h/m²) 0 0 (1) Air permeability value, AP4, (m³/h/m²) 0 (2) <t< td=""><td>Flues attached to solid fuel boiler</td><td>0</td><td>x 20 =</td><td></td><td>0</td><td>(6d)</td></t<>	Flues attached to solid fuel boiler	0	x 20 =		0	(6d)
Number of intermittent extract fans3x10 =30(7)Number of passive vents0x10 =0(7)Number of flueless gas fires0x40 =0(7)Number of storeys in the dwelling (ns)0.120.12(8)(8)(8)Infiltration due to chimneys, flues, fans, PSVs, etc00(9)(9)(1)Additional infiltration00(1)(1)(1)(1)Structural infiltration00(1)(1)(1)(1)(1)(1)Suspended wooden ground floor00(1)	Flues attached to other heater	0	x 35 =		0	(6e)
Number of passive vents0x1000(7)Number of flueless gas fires0x40 =0(7)Air changes per hourNumber of storeys in the dwelling (ns)0.120.12(8)Infiltration due to chimneys, flues, fans, PSVs, etc00(9)Additional infiltration00(1)Suspended wooden ground floor00(1)No draught lobby00(1)Percentage of windows and doors draught proofed00(1)Infiltration rate00(1)Air permeability value, AP50, (m³/h/m²)55(1)Air permeability value, AP4, (m³/h/m²)00(1)Number of sides on which dwelling is sheltered22(1)Shelter factor0.31(2)(3)(2)Infiltration rate modified for monthly wind speed0(3)(2)	Number of blocked chimneys	0	x 20 =		0	(6f)
Number of flueless gas fires0x40 =0(7)Number of storeys in the dwelling (ns)0.120.120.12(8)Infiltration due to chimneys, flues, fans, PSVs, etc00(9)Additional infiltration00(1)Structural infiltration00(1)Suspended wooden ground floor00(1)No draught lobby00(1)Percentage of windows and doors draught proofed00(1)Window infiltration00(1)Air permeability value, AP50, (m³/h/m²)55(1)Air permeability value, AP4, (m³/h/m²)0.370.37(1)Number of sides on which dwelling is sheltered22(1)Shelter factor0.85(2)(2)(1)Infiltration rate modified for monthly wind speed0.31(2)	Number of intermittent extract fans	3	x 10 =		30	(7a)
Air changes per hourNumber of storeys in the dwelling (ns)0.120.12(8)Infiltration due to chimneys, flues, fans, PSVs, etc00(9)Additional infiltration00(1)Structural infiltration00(1)Suspended wooden ground floor00(1)No draught lobby00(1)Percentage of windows and doors draught proofed00(1)Window infiltration00(1)Infiltration rate00(1)Air permeability value, AP50, (m³/h/m²)55(1)Air permeability value, AP4, (m³/h/m²)0.370.37(1)Number of sides on which dwelling is sheltered22(1)Shelter factor0.85(2)0.31(2)Infiltration rate modified for monthly wind speed0.31(2)(2)	Number of passive vents	0	x 10 =		0	(7b)
Number of storeys in the dwelling (ns)0.120.120.120Infiltration due to chimneys, flues, fans, PSVs, etc000(1)Additional infiltration000(1)Structural infiltration000(1)Suspended wooden ground floor000(1)No draught lobby000(1)Percentage of windows and doors draught proofed00(1)Window infiltration00(1)Infiltration rate00(1)Air permeability value, AP50, (m³/h/m²)55(1)Air permeability value, AP4, (m³/h/m²)0.370.37(1)Number of sides on which dwelling is sheltered22(1)Shelter factor0.85(2)0.31(2)Infiltration rate modified for monthly wind speed031(2)	Number of flueless gas fires	0	x 40 =		0	(7c)
Infiltration due to chimneys, flues, fans, PSVs, etc0009Additional infiltration000(1)Structural infiltration000(1)Suspended wooden ground floor000(1)No draught lobby000(1)Percentage of windows and doors draught proofed00(1)Window infiltration00(1)Infiltration rate00(1)Air permeability value, AP50, (m³/h/m²)55(1)Air permeability value, AP4, (m³/h/m²)00(1)Air permeability value)0.370.37(1)Number of sides on which dwelling is sheltered22(1)Shelter factor0.85(2)0.31(2)Infiltration rate modified for monthly wind speed00.31(2)			Air changes	per hour		
Additional infiltration00(1)Structural infiltration00(1)Suspended wooden ground floor00(1)No draught lobby00(1)Percentage of windows and doors draught proofed00(1)Window infiltration00(1)Infiltration rate00(1)Air permeability value, AP50, (m³/h/m²)55(1)Air permeability value, AP4, (m³/h/m²)00(1)Number of sides on which dwelling is sheltered22(1)Shelter factor0.85(2)Infiltration rate modified for monthly wind speed0.31(2)				0.12	0.12	(8)
Structural infiltration00(1Suspended wooden ground floor00(1No draught lobby00(1Percentage of windows and doors draught proofed00(1Window infiltration00(1Infiltration rate00(1Air permeability value, AP50, (m³/h/m²)55(1Air permeability value, AP4, (m³/h/m²)00(1Number of sides on which dwelling is sheltered22(1Shelter factor0.370.37(1Infiltration rate incorporating shelter factor0.31(2Infiltration rate modified for monthly wind speed001						(9)
Suspended wooden ground floor0001No draught lobby0001Percentage of windows and doors draught proofed0001Window infiltration0001Infiltration rate0001Air permeability value, AP50, (m³/h/m²)551Air permeability value, AP4, (m³/h/m²)001Air permeability value)0.370.371Number of sides on which dwelling is sheltered221Shelter factor0.85(2Infiltration rate incorporating shelter factor0.31(2Infiltration rate modified for monthly wind speed001						(10)
No draught lobby00(1)Percentage of windows and doors draught proofed00(1)Window infiltration00(1)Infiltration rate00(1)Air permeability value, AP50, (m³/h/m²)55(1)Air permeability value, AP4, (m³/h/m²)00(1)Air permeability value, AP4, (m³/h/m²)0.370.37(1)Number of sides on which dwelling is sheltered22(1)Shelter factor0.85(2)Infiltration rate incorporating shelter factor0.31(2)Infiltration rate modified for monthly wind speed000						(11) (12)
Percentage of windows and doors draught proofed00(1Window infiltration00(1Infiltration rate00(1Air permeability value, AP50, (m³/h/m²)55(1Air permeability value, AP4, (m³/h/m²)00(1Air permeability value)0.370.37(1Number of sides on which dwelling is sheltered22(1Shelter factor0.85(2Infiltration rate incorporating shelter factor0.31(2Infiltration rate modified for monthly wind speed11						(12)
Window infiltration00(1Infiltration rate00(1Air permeability value, AP50, (m³/h/m²)55(1Air permeability value, AP4, (m³/h/m²)00(1Air permeability value)0.370.37(1Number of sides on which dwelling is sheltered22(1Shelter factor0.85(2Infiltration rate incorporating shelter factor0.31(2Infiltration rate modified for monthly wind speed11	Percentage of windows and doors draught proofed					(14)
Air permeability value, AP50, (m³/h/m²)55(1Air permeability value, AP4, (m³/h/m²)00(1Air permeability value)0.370.37(1Number of sides on which dwelling is sheltered22(1Shelter factor0.85(2Infiltration rate incorporating shelter factor0.31(2Infiltration rate modified for monthly wind speed				0	0	(15)
Air permeability value, AP4, (m³/h/m²)00(1Air permeability value)0.370.37(1Number of sides on which dwelling is sheltered22(1Shelter factor0.85(2Infiltration rate incorporating shelter factor0.31(2Infiltration rate modified for monthly wind speed000						(16)
Air permeability value)0.370.37(1Number of sides on which dwelling is sheltered22(1Shelter factor22(1Infiltration rate incorporating shelter factor0.85(2Infiltration rate modified for monthly wind speed0.31(2						(17)
Number of sides on which dwelling is sheltered222(1Shelter factor0.85(2Infiltration rate incorporating shelter factor0.31(2Infiltration rate modified for monthly wind speed0.31(2						(17a
Shelter factor0.85(2Infiltration rate incorporating shelter factor0.31(2Infiltration rate modified for monthly wind speed(2						(18) (19)
Infiltration rate incorporating shelter factor 0.31 (2) Infiltration rate modified for monthly wind speed (2)				2		(20)
Infiltration rate modified for monthly wind speed						(20)
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Total (2					0.31	(44)
	Jan Feb Mar Apr May Jun	Jul Aug	Sep Oct N	lov Dec	Total	(22)







Monthly average wind speed from Table U2

Wind Fac	5.1 ctor	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7	52.5	(22)
Adjusted	1.28 I infiltrati	1.25 on rate (a	1.23 allowing f	1.1 for shelte	1.08 r and wir	0.95 nd speed)	0.95	0.93	1	1.08	1.13	1.18	13.13	(22a)
Calculate	0.4 e effective	0.39 e air char	0.38 nge rate f	0.34 or the ap	0.34 plicable o	0.3 case:	0.3	0.29	0.31	0.34	0.35	0.37	4.11	(22b)
													0	(23a)
													0	(23b)
													0	(23c)
a) If bala	nced mee	chanical v	entilatio/	n with he	eat recove	ery (MVH	IR)							
	0	0	0	0	0	0	0	0	0	0	0	0		(24a)
b) If bala	nced me	chanical v	ventilatio	n withou	t heat ree	covery (N	1V)							
	0	0	0	0	0	0	0	0	0	0	0	0		(24b)
c) If who	le house	extract v	entilatior	i or positi	ive input		on from c	outside						
ما) الأسمعان	0	0	0 whale he	0	0	0	0	0	0	0	0	0		(24c)
d) ir natt	ural ventil			-	-									
Effective	0.58 air chan	0.58 ge rate	0.57	0.56	0.56	0.54	0.54	0.54	0.55	0.56	0.56	0.57		(24d)
Tffe etites	0.58	0.58	0.57	0.56	0.56	0.54	0.54	0.54	0.55	0.56	0.56	0.57		(25)
Effective	air chan	ge rate fr	OIN PCDB											
	0.58	0.58	0.57	0.56	0.56	0.54	0.54	0.54	0.55	0.56	0.56	0.57		(25)

3. Heat losses and heat loss parameter

Items in the table below are to be expanded as necessary to allow	for all different types of element e.g. 4 wall types.	The k -value
ELEMENT	AXU	AXk

	(W/K)	kJ/K
Doors	2.1	(26)
Windows	17.83	(27)
Roof window	0	(27a)
Basement floor	0	0 (28)
Ground floor	0	0 (28a)
Exposed floor	9.3	6341.25 (28b)
Basement wall	0	0 (29)
External wall	8.76	12807.9 (29a)
Roof	0	0 (30)
Total area of external elements ∑A, m ²		169.63 (31)
Party Wall	0	9745.2 (32)
Party floor		0 (32a)
Party ceiling		0 (32b)





Internal wall **	0	(33c)
Internal floor	0	(32d)
Internal ceiling floor	0	(32e)
Fabric heat loss, W/K = \sum (A x U)	37.99	(33)
Heat capacity $Cm = \sum (A \times k)$	28894.35	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m ² K	250	(35)
Linear Thermal bridges: Σ (L x Ψ) calculated using Appendix K	22.66	(36)
Point Thermal bridges: $\Sigma \chi$ (W/K) if significant point thermal bridge present and values available	22.66	(36a)
Total fabric heat loss H = $\Sigma(A \times U) + \Sigma(L \times \Psi) + \Sigma\chi$	60.65	(37)
Ventilation heat loss calculated monthly		
48.52 48.26 48.01 46.81 46.59 45.55 45.55 45.36 45.95 46.59 47.04 47.51 Heat transfer coefficient, W/K		(38)
109.17 108.91 108.66 107.47 107.24 106.21 106.21 106.01 106.61 107.24 107.7 108.17 Heat loss parameter (HLP), W/m ² K		(39)
1.29 1.29 1.29 1.27 1.27 1.26 1.26 1.25 1.26 1.27 1.27 1.28 Number of days in month (Table 1a)		(40)
31 28 31 30 31 31 30 31 30 31		(41)

4. Water heating energy requirement

Assume	d occupar	ncy, N											2.54	(42)
Hot wate	er usage i	n litres p	er day fo	r mixer sl	howers, \	/d,showe	er (from A	Appendix	l)					
	91.94	90.56	88.55	84.69	81.85	78.68	76.88	78.88	81.07	84.47	88.41	91.59		(42a)
Hot wate	er usage i	n litres p	er day fo	r baths, N	/d,bath (f	from App	endix J)							
	30.4	29.95	29.31	28.14	27.26	26.29	25.76	26.39	27.08	28.12	29.32	30.3		(42b)
Hot wate	er usage i	n litres p	er day fo	r other u	ses, Vd,o	ther (froi	m Appen	dix J)						
	42.82	41.26	39.71	38.15	36.59	35.03	35.03	36.59	38.15	39.71	41.26	42.82		(42c)
Annual a	average h	ot water	usage in	litres per	day Vd,a	average (from App	endix J)					152.12	(43)
Hot wate	er usage i	n litres p	er day fo	r each m	onth Vd,ı	n = (42a)	+ (42b) +	+ (42c)						
			157.56			140		141.86		152.3	158.99	164.7	1823	(44)
Energy c	content of	f hot wat	er used =	4.18 x V	d,m x nm	x DTm /	3600 kW	/h/month	(from A	ppendix J)			
			242.17	206.69	196.14	172.15	166.51	175.65	180.4	206.67	226.51	257.89	2522.7	(45)
Distribut	tion loss (46) = 0.1	5 x (45)											
	39.24		36.33	31	29.42	25.82	24.98	26.35	27.06	31	33.98	38.68		(46)
-	volume (l	-	-	y solar o	r WWHR	S storage	within sa	ame vess	el				0	(47)
	torage los	•												
	nufacture			actor is ki	nown (kV	Vh/day):							1.56	(48)
•	ature fact												0.54	(49)
Energy lost from water storage, kWh/day (48) x (49) =											0	(50)		
b) If manufacturer's declared loss factor is not known : Hot water storage loss factor from Table 2 (kWh/litre/day)														
Hot wate	er storage	e loss fac	tor from	Table 2 (ł	wh/litre	e/day)							0	(51)





Volume factor from Table 2a	0	(52)
Temperature factor from Table 2b	0	(53)
Energy lost from water storage, kWh/day	0	(54)
Enter (50) or (54) in (55)	0.84	(55)
Water storage (or HIU) loss calculated for each month (56) = (55) × (41)		
26.11 23.59 26.11 25.27 26.11 25.27 26.11 26.11 25.27 26.11 25.27 26.11 25.27 26.11 1 f the vessel contains dedicated solar storage or dedicated WWHRS storage, (57)m = (56)m ☑ [(47) - Vs] ÷ (47), else (57)m = (56)m		(56)
where Vs is Vww from Appendix G3 or (H12) from Appendix H (as applicable).		
26.11 23.59 26.11 25.27 26.11 25.27 26.11 26.11 25.27 26.11 25.27 26.11 25.27 26.11 Primary circuit loss for each month from Table 3		(57)
modified by factor from Table H4 if there is solar water heating and a cylinder thermostat, although not for DHW-only	/ heat netw	orks)
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		(59)
		(61)
Total heat required for water heating calculated for each month (62) = $0.85 \times (45) + (46) + (57) + (59) + (61)$		(01)
287.69 253.94 268.28 231.96 222.26 197.42 192.62 201.77 205.67 232.78 251.78 284 CWWHRS DHW input calculated using Appendix G (negative quantity) (enter 0 if no WWHRS contribution to water he	2830.1 ating)	7 (62)
		(63a)
PV diverter DHW input calculated using Appendix G (negative quantity) (enter 0 if no PV diverter contribution)		(054)
		(63b)
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		(050)
		$\langle C 2 \rangle$
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	<i>,</i>)	(63c)
	,/	
0 0 0 0 0 0 0 0 0 0		(63d)
287.69 253.94 268.28 231.96 222.26 197.42 192.62 201.77 205.67 232.78 251.78 284 Output from water heater for each month, kWh/month (64) = (62) + (63a) + (63b) + (63c) + (63d)	2830.1	7 (64)
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		(64a)
86.97 76.59 80.52 68.72 65.22 57.24 55.36 58.41 59.98 68.72 75.31 85.75 include (57) m in calculation of (65) m only if hot water store is in the dwelling or hot water is from heat network		(65)

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

Metabolic gains (Table 5), watts

l i slatin s									152.61	152.61	152.61	152.61	(66)
Lighting	gains (cal	culated l	n Append	lix L, equ	ation L12	or Liza)	, also see	e Table 5					
Applianc	35.82 es gains (31.81 calculate								29.59	34.53	36.81	(67)
	341.32	344.87	335.94	316.94	292.95	270.41	255.35	251.81	260.73	279.74	303.72	326.26	(68)





Cooking gains (calculated in Appendix L, equation L18 or L18a), also see Table 5

Pumps ar	52.8 nd fans ga	52.8 ains (Tabl	52.8 e 5a)	52.8	52.8	52.8	52.8	52.8	52.8	52.8	52.8	52.8	(69)
Losses e.	0 g. evapor	0 ation (ne	•	-		0	0	0	0	0	0	0	(70)
Water he		-101.74 ns (Table		-101.74	-101.74	-101.74	-101.74	-101.74	-101.74	-101.74	-101.74	-101.74	(71)
Total inte	116.9 ernal gain		108.23	95.45	87.66	79.5	74.41	78.5	83.31	92.36	104.6	115.25	(72)
	597.72	594.33	573.72	535.65	498.93	465.95	446.8	451.35	471.02	505.36	546.53	582.01	(73)

6. Solar gains

Solar gains in watts, calculated for each month

6	67.33	130.52	220.63	343.84	449.46	474.5	445.69	362.58	262.61	155.59	83.53	55.76	(83)
Total gains – internal and solar (watts)													
6	665.05	724.86	794.34	879.49	948.39	940.45	892.49	813.92	733.64	660.95	630.06	637.76	(84)

7. Mean internal temperature (heating season)

-	Temperature during heating periods in the living area from Table 9, Th1 (°C) 21													(85)
Utilisati	Utilisation factor for gains for living area, 21,m (see Table 9a)													
Mean ir	0.99 nternal te	0.99	0.98 n livin	0.94 g area T1	0.84 (follows	0.67	0.51 od 4 in Ta	0.58 ble 9c)	0.82	0.96	0.99	0.99		(86)
wicanii		inperatur		gaica ii		steps 5 ai	10 4 11 10	DIE JUJ						
	21	21	21	21	21	21	21	21	21	21	21	21		(87)
Temper	ature dur	ing heati	ng perioo	ds in rest	of dwelli	ng from ⁻	Table 9, T	'n2 (°C)						
	19.85	19.85	19.85	19.86	19.87	19.88	19.88	19.88	19.87	19.87	19.86	19.86		(88)
Roof Utilisation factor for gains for rest of dwelling, ℤ2,m (see Table 9a)														
	0.99	0.99	0.97	0.92	0.79	0.57	0.39	0.45	0.74	0.94	0.99	0.99		(89)
Roof					Me	ean inter	nal tempe	erature ir	n the rest	of dwell	ing T2			
	19.85	19.85	19.85	19.86	19.87	19.88	19.88	19.88	19.87	19.87	19.86	19.86		(90)
Living a	rea fractio	on											0.44	(91)
Mean ir	nternal te	mperatu	re (for the	e whole a	dwelling)								0.11	(31)
meann			•		0,									(0.0)
	20.36	20.36	20.36	20.37	20.37	20.37	20.37	20.37	20.37	20.37	20.37	20.36		(92)
Adjuste	d mean ir	iternal te	emperatu	re:										
	20.36	20.36	20.36	20.37	20.37	20.37	20.37	20.37	20.37	20.37	20.37	20.36		(93)

8. Space heating requirement





Utilisation factor for gains,

Useful g	0.99 ains, mGn	0.99 n , W	0.97	0.93	0.81	0.62	0.44	0.51	0.78	0.95	0.99	0.99		(94)
Monthly	660.18 average	716.18 external		817.68 ure from			395.53	411.88	574.74	630	622.06	633.91		(95)
Heat los	4.3 s rate for	4.9 mean int	6.5 ernal ten	8.9 nperature	11.7 e	14.6	16.6	16.4	14.1	10.6	7.1	4.2		(96)
Space he	1753.1 eating req		1506.11 t for each		929.61	613.18	400.77	421.35	668.57	1047.58	1428.67	1748.35		(97)
Solar spa	813.13 ace heatir			298.55 Appendi			0 ntity)	0	0	310.68	580.76	829.14		(98a)
Space he	0 eating req	0 Juirement	0 t for each	0 month a	0 Ifter sola	0 r contribu	0 ution	0	0	0	0	0		(98b)
Space he	813.13 eating req	000.1		298.55 m²/year	116.79	0	0	0	0	310.68	580.76	829.14	49.01	(98c) (99)

8c. Space Cooling requirement													
Heat loss ra	Heat loss rate,												
0 Utilisation	-	0 Ioss	0	0	0	0	0	0	0	0	0		(100)
0 Useful loss,		0 atts)	0	0	0	0	0	0	0	0	0		(101)
0 Gains) 0	0	0	0	0	0	0	0	0	0	0		(102)
0 0 0 0 0 0 0 0 0 0 0 0 0 0 (103													(103) (104)
0 Cooled frac Intermitter	ction	0	0	0	0	0	0	0	0	0	0	0	(104) (105)
0 Space cooli	-	0 ement for	0 month	0	0	0	0	0	0	0	0	0	(106)
0 Space cooli		0 ement in k	0 Wh/m²/ye	0 ar	0	0	0	0	0	0	0	0	(107) (108)
8f. Space heating requirement													

Fabric Energy Efficiency,

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



0

(109)

SAP WORKSHEET

0



Fraction of space heat from secondary/supplementary system,00(201)Fraction of space heat from main system(s),1(202)												
	1	(202)										
Fraction of main heating from main system 2,	0	(203)										
Fraction of total space heat from main system 1,	1	(204)										
Fraction of total space heat from main system 2, Efficiency of main space heating system 1 (in %),												
Efficiency of main space heating system 1 (in %), Efficiency of main space heating system 2 (in %)												
Efficiency of main space heating system 2 (in %),	0	(207)										
Efficiency of secondary/supplementary heating system, %,												
Cooling System Seasonal Energy Efficiency Ratio, 0 (209) Space heating requirement (calculated above)												
Space heating requirement (calculated above),												
Space heating fuel (main heating system 1), kWh/month 0	0											
241.43 193.06 161.72 88.64 34.68 0 0 0 92.25 172.44 246.19		(211)										
Space heating fuel (main heating system 2), kWh/month 0	0											
0 0 0 0 0 0 0 0 0 0 0		(213)										
Space heating fuel (secondary), kWh/month 0	0											
0 0 0 0 0 0 0 0 0 0 0		(215)										
Output from water heater), 0	220.69	(216)										
Efficiency of water heater												
220.69 220.69 220.69 220.69 220.69 220.69 220.69 220.69 220.69 220.69 220.69 220.69		(217)										
Fuel for water heating												
130.36 115.07 121.57 105.11 100.71 89.46 87.28 91.43 93.2 105.48 114.09 128.69	1282.45	(219)										
Space Cooling												
0 0 0 0 0 0 0 0 0 0 0		(221)										
Annual totals kWh/year kWh/year												
Space heating fuel used, main system 1	1230.4	(211)										
Space heating fuel used, main system 2	0	(213)										
Space heating fuel used, secondary	0	(215)										
Water heating fuel used	1282.45	(219)										
Electricity for instantaneous electric shower(s)	0	(64a)										
Space cooling fuel used	0	(221)										
Electricity for pumps, fans and electric keep-hot												
Mechanical vent fans - balanced, extract or positive input from outside 0 0	0	(230a)										
warm air heating system fans	0	(230b)										
Heating circulation pump or water pump within warm air heating unit	0	(230c)										
Oil boiler auxiliary (oil pump, flue fan, etc; excludes circulation pump)	0	(230d)										
Gas boiler auxiliary (flue fan, etc; excludes circulation pump)	0	(230e)										
Maintaining electric keep-hot facility for gas combi boiler0(230f)												
Pump for solar water heating 0 (230g)												
Pump for storage WWHRS 0 (230h)												
Total electricity for the above0(231)												
Electricity for lighting 253.03 (231)												





	Energy saving/generation technologies (Appendices M, N) - Energy used in dwelling Electricity generated by PVs (Appendix M) (negative quantity)													
Electricity	0 y genera	0 Ited by w	0 vind turk	0 oines (Ap	0 pendix N	0 1) (negati	0 ve quant	0 ity)	0	0	0	0	0	(233a)
Electricity	0 y genera	0 Ited by h	0 Iydro-ele	0 ectric ger	0 nerators	0	0	0	0	0	0	0	0	(234a)
Electricity	0 y used o	0 r net ele	0 ctricity g	0 generate	0 d by micr	0 ro-CHP	0	0	0	0	0	0	0	(235a)
Energy sa Electricity								0 exported	0	0	0	0	0	(235c)
Electricity	0 y genera	0 Ited by w	0 vind turk	0 oines (Ap	0 pendix N	0 1) (negati	0 ve quant	0 ity)	0	0	0	0	0	(233b)
Electricity	0 y genera	0 Ited by h	0 lydro-ele	0 ectric ger	0 nerators	0	0	0	0	0	0	0	0	(234b)
Electricity	0 y used o	0 r net ele	0 ctricity g	0 generate	0 d by micr	0 ro-CHP	0	0	0	0	0	0	0	(235b)
Appendix Appendix			•.	0	0	0	0	0	0	0	0	0	0	(235d)
energy sa energy us Total deli	ived sed							Fue	21	kWh/yea	r		0 0 2765.88	(236a) (237a)

10a. Fuel costs – Individual heating systems including micro-CHP

Fuel required	kWh/year	Fuel price	Fuel cost £/yea	ar
Space heating - main system 1 (electric off-peak tariff				
High-rate fraction (Table 12a, or Appendix F for electric CPSU)	0		202.89	(240a)
Low-rate fraction	0		202.89	(240b)
High-rate cost	0		0	(240c)
Low-rate cost	0		0	(240d)
Space heating - main system 1 cost (other fuel)	0		0	(240e)
Space heating - main system 2 (electric off-peak tariff				
High-rate fraction (Table 12a, or Appendix F for electric CPSU)	0		202.89	(241a)
Low-rate fraction	0		202.89	(241b)
High-rate cost	0		0	(241c)
Low-rate cost	0		0	(241d)
Space heating - main system 2 cost (other fuel)	0		0	(241e)
Space heating - secondary (electric off-peak tariff)				
High-rate fraction (Table 12a, or Appendix F for electric CPSU)	0		202.89	(242a)





Low-rate fraction	0		202.89	(242b)
High-rate cost	0		0	(242c)
Low-rate cost	0		0	(242d)
Space heating - secondary cost (other fuel)	0		0	(242e)
Water heating (electric off-peak tariff)				
High-rate fraction (Table 12a, or Appendix F for electric CPSU)	0		0	(243)
Low-rate fraction	0		0	(242b)
High-rate cost	0		0	(242c)
Low-rate cost	0		0	(242d)
Water heating cost (other fuel)	0		211.48	(247)
(for a DHW-only heat network use (342a) or (342b) instead of (247)				. ,
Energy For instantaneous electric shower(s)	0		0	(247a)
Space cooling	0		0	(248)
Pumps, fans And electric keep-hot	0		0	(249)
Energy For lighting	0		41.73	(250)
Additional standing charges	0		0	(251)
Energy saving/generation technologies	0		0	(252)
Appendix Q, <item 1="" description=""></item>	Fuel	kWh/year		
energy saved Or generated	0		0	(253)
energy used	0		0	(254)
Total energy cost	0		456.09	(255)
11a. SAP rating – Individual heating systems including micro-CHP				. ,
Energy cost deflator	0		0	(256)
Energy cost factor (ECF)	0		0	(257)
SAP rating	0		0	(258)
				. ,

11a. SAP rating – Individual heating systems including micro-CHP		
Energy cost deflator	0.36	(256)
Energy cost factor (ECF)	1.27	(257)
SAP rating	79.46	(258)
12a. CO2 emissions – Individual heating systems including micro-CHP		

Energy **Emission factor** Emissions KWh/year kg kg CO2/year Space heating - main system 1 190.95 (261) Space heating - main system 2 (262) 0 Space heating - secondary 0 (263) Energy for water heating 181.17 (264) Energy for instantaneous electric shower(s) 0 (264a)





Space and water heating		0	(265)
Space cooling		0	(266)
Electricity for pumps, fans and electric keep		0	(267)
Electricity for lighting		36.52	(268)
energy saved or generated	0	0	(269b)
Appendix Q items			
energy saved	0	0	
energy used	0	0	
energy saved	0	0	(270b)
energy used		0	(271b)
Total CO2, kg/year		408.64	(272)
Dwelling CO2 Emission Rate		4.83	(273)
El rating		96	(274)

13a. Primary Energy – Individual heating systems including micro-CHP

	Energy Emission factor	Emissionsr
	KWh/year kg	kg CO2/year
Space heating - main system 1		1937.36 (275)
Space heating - main system 2		0 (276)
Space heating - secondary		0 (277)
Energy for water heating		1952.36 (278)
Energy for instantaneous electric shower(s)		0 (278a)
Space and water heating		0 (279)
Space cooling		0 (280)
Electricity for pumps, fans and electric keep		0 (281)
Electricity for lighting		388.11 (282)
energy saved or generated	0	0
Appendix Q items		
energy saved	0	0
energy used	0	0
energy saved	0	0 (284b)
energy used		0 (285b)
Total PE, kWh/year		4277.84 (286)
Dwelling PE Rate		50.6 (287)







Dwelling Reference: Dwelling Type: EN5 5SU

Unit 02 Existing Dwelling

1. Overall dwelling dimensions					
	Area(m²)	Av. Height(r	n)	Volume(m³)	
Ground Floor Total floor area TFA Dwelling volume	61.3	(1a) x 3	(2a) =	183.9 61.3 183.9	(3a) (4) (5)
2. Ventilation Rate					
Chimneys/Flues	0	x 80 =		0	(6a)
Open chimneys	0	x 20 =		0	(6b)
Chimneys / flues attached to closed fire	0	x 10 =		0	(6c)
Flues attached to solid fuel boiler	0	x 20 =		0	(6d)
Flues attached to other heater	0	x 35 =		0	(6e)
Number of blocked chimneys	0	x 20 =		0	(6f)
Number of intermittent extract fans	3	x 10 =		30	(7a)
Number of passive vents	0	x 10 =		0	(7b)
Number of flueless gas fires	0	x 40 = Air changes	per hour	0	(7c)
		All changes	per nour		
Number of storeys in the dwelling (ns)			0.16	0.16	(8)
Infiltration due to chimneys, flues, fans, PSVs, etc			0	0	(9)
Additional infiltration			0	0	(10)
Structural infiltration Suspended wooden ground floor			0	0	(11)
No draught lobby			0 0	0 0	(12) (13)
Percentage of windows and doors draught proofed			0	0	(13)
Window infiltration			0	0	(15)
Infiltration rate			0	0	(16)
Air permeability value, AP50, $(m^3/h/m^2)$			5	5	(17)
Air permeability value, AP4, (m³/h/m²)			0	0	(17a)
Air permeability value) Number of sides on which dwelling is sheltered			0.41	0.41	(18)
Shelter factor			2	2 0.85	(19) (20)
Infiltration rate incorporating shelter factor				0.35	(20)
Infiltration rate modified for monthly wind speed				0.55	(41)
Jan Feb Mar Apr May Jun	Jul Aug	Sep Oct M	Nov Dec	Total	(22)







Monthly average wind speed from Table U2

Wind Fa	5.1 ctor	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7	52.5	(22)
Adjustec	1.28 d infiltrati	1.25 ion rate (1.23 allowing	1.1 for shelte	1.08 er and wi	0.95 nd speed	0.95)	0.93	1	1.08	1.13	1.18	13.13	(22a)
Calculate	0.45 e effectiv	0.44 e air chai	0.43 nge rate f	0.39 for the ap	0.38 oplicable	0.33 case:	0.33	0.32	0.35	0.38	0.4	0.41	4.61	(22b)
													0	(23a)
													0	(23b)
													0	(23c)
a) If bala	inced me	chanical	ventilatio	on with he	eat recov	ery (MVI	HR)							
	0	0	0	0	0	0	0	0	0	0	0	0		(24a)
b) If bala	anced me	chanical	ventilatio	on withou	it heat re	covery (I	∕IV)							
	0	0	0	0	0	0	0	0	0	0	0	0		(24b)
c) If who	ole house	extract v	entilatio	n or posit	ive input	ventilati	on from	outside						
	0	0	0	0.	.0	0	0	0	0	0	0	0		(24c)
d) if nati	ural venti			-	-									
	0.6	0.6	0.59	0.57	0.57	0.56	0.56	0.55	0.56	0.57	0.58	0.59		(24d)
Effective	e air chan	-												()
Effoctive	0.6	0.6	0.59	0.57	0.57	0.56	0.56	0.55	0.56	0.57	0.58	0.59		(25)
enective	e air chan	-												()
	0.6	0.6	0.59	0.57	0.57	0.56	0.56	0.55	0.56	0.57	0.58	0.59		(25)

3. Heat losses and heat loss parameter

ELEMENT	A X U (W/K)	A X k kJ/K	
Doors	2.1	(26)	
Windows	7.89	(27)	
Roof window	0	(27a))
Basement floor	0	0 (28)	
Ground floor	0	0 (28a))
Exposed floor	6.74	4597.5 (28b))
Basement wall	0	0 (29)	
External wall	7.35	10742.6 (29a))
Deef			

Roof	0	0	(30)
Total area of external elements ∑A, m ²		126.83	(31)
Party Wall	0	9250.2	(32)
Party floor		0	(32a)
Party ceiling		0	(32b)





Internal wall	**											0	(33c)
Internal floor												0	(32d)
Internal ceili	g floor											0	(32e)
Fabric heat lo	ss, W/K = ∑	(A x U)										24.08	(33)
Heat capacity	Cm = ∑(A x	k)										24590.3	(34)
Thermal mas	s parameter	(TMP = C	m ÷ TFA)	in kJ/m²l	<							250	(35)
Linear Therm	al bridges: ∑	<u>(</u> (L x Ψ) ca	alculated	using Ap	pendix K							16.29	(36)
Point Therma	l bridges: ∑	χ (W/K) if	significan	t point tl	nermal bi	idge pres	sent and	values av	ailable			16.29	(36a)
Total fabric h	eat loss H =	∑(A × U) +	-∑(L×Ψ)	+∑χ								40.37	(37)
Ventilation h	eat loss calc	ulated mo	onthly										
36.		35.96	34.87	34.67	33.72	33.72	33.55	34.09	34.67	35.08	35.51		(38)
Heat transfe	coemcient,	VV/K											
76. Heat loss par		76.33	75.25	75.04	74.09	74.09	73.92	74.46	75.04	75.45	75.88		(39)
•				4.00					4.00	4.99			(40)
1.2 Number of d		1.25 (Table 1:	1.23	1.22	1.21	1.21	1.21	1.21	1.22	1.23	1.24		(40)
				24		24			24		24		(41)
31	28	31	30	31	30	31	31	30	31	30	31		(41)

4. Water heating energy requirement

Assumed occupancy, N	2.02	(42)
Hot water usage in litres per day for mixer showers, Vd, shower (from Appendix J)		
79.83 78.63 76.88 73.54 71.07 68.31 66.75 68.49 70.39 73.34 76.76 79.52		(42a)
Hot water usage in litres per day for baths, Vd,bath (from Appendix J)		
26.41 26.02 25.47 24.45 23.68 22.84 22.38 22.93 23.53 24.43 25.47 26.32		(42b)
Hot water usage in litres per day for other uses, Vd, other (from Appendix J)		
37.16 35.8 34.45 33.1 31.75 30.4 30.4 31.75 33.1 34.45 35.8 37.16		(42c)
Annual average hot water usage in litres per day Vd, average (from Appendix J)	132.07	(43)
Hot water usage in litres per day for each month Vd,m = (42a) + (42b) + (42c)		
143.39 140.45 136.8 131.09 126.5 121.55 119.53 123.17 127.02 132.23 138.04 143	1582.77	7 (44)
Energy content of hot water used = 4.18 x Vd,m x nm x DTm / 3600 kWh/month (from Appendix J)		
227.1 200 210.26 179.45 170.3 149.46 144.56 152.51 156.63 179.43 196.66 223.9	2190.26	5 (45)
Distribution loss (46) = 0.15 x (45)		
34.07 30 31.54 26.92 25.54 22.42 21.68 22.88 23.49 26.91 29.5 33.59		(46)
Storage volume (litres) including any solar or WWHRS storage within same vessel	0	(47)
Water storage loss (or HIU loss)		
a) If manufacturer's declared loss factor is known (kWh/day):	1.56	(48)
Temperature factor from Table 2b	0.54	(49)
Energy lost from water storage, kWh/day (48) x (49) =	0	(50)
b) If manufacturer's declared loss factor is not known :		
Hot water storage loss factor from Table 2 (kWh/litre/day)	0	(51)





Volume factor from Table 2a Temperature factor from Table 2b	0 0	(52) (53)
Energy lost from water storage, kWh/day	0	(54)
Enter (50) or (54) in (55) Water storage (or HIU) loss calculated for each month (56) = (55) × (41)	0.84	(55)
26.11 23.59 26.11 25.27 26.11 25.27 26.11 25.27 26.11 25.27 26.11 25.27 26.11		(56)
If the vessel contains dedicated solar storage or dedicated WWHRS storage,		(50)
(57)m = (56)m 🛛 [(47) – Vs] ÷ (47), else (57)m = (56)m		
where Vs is Vww from Appendix G3 or (H12) from Appendix H (as applicable).		
26.11 23.59 26.11 25.27 26.11 25.27 26.11 26.11 25.27 26.11 25.27 26.11 Primary circuit loss for each month from Table 3		(57)
modified by factor from Table H4 if there is solar water heating and a cylinder thermostat, although not for DHW-only	/ heat netwo	orks)
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		(59)
		(61)
Total heat required for water heating calculated for each month (62) = $0.85 \times (45) + (46) + (57) + (59) + (61)$		()
253.22 223.59 236.37 204.72 196.41 174.74 170.68 178.62 181.9 205.55 221.93 250.02 CWWHRS DHW input calculated using Appendix G (negative quantity) (enter 0 if no WWHRS contribution to water he	2497.7 ating)	4 (62)
0 0 0 0 0 0 0 0 0 0		(63a)
PV diverter DHW input calculated using Appendix G (negative quantity) (enter 0 if no PV diverter contribution)		
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		(63b)
		(63c)
FGHRS DHW input calculated using Appendix G (negative quantity) (enter 0 if no FGHRS contribution to water heating	<u>(</u>)	(050)
0 0 0 0 0 0 0 0 0 0 0		(63d)
Output from water heater for each month, kWh/month (64) = (62) + (63a) + (63b) + (63c) + (63d)		
253.22 223.59 236.37 204.72 196.41 174.74 170.68 178.62 181.9 205.55 221.93 250.02 Output from water heater for each month, kWh/month (64) = (62) + (63a) + (63b) + (63c) + (63d)	2497.7	4 (64)
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		(64a)
75.51 66.5 69.91 59.67 56.62 49.7 48.07 50.71 52.08 59.66 65.39 74.45 include (57) m in calculation of (65) m only if hot water store is in the dwelling or hot water is from heat network		(65)

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

Metabolic gains (Table 5), watts

		121.09							121.09	121.09	121.09	121.09	(66)
Lighting	gains (cal	culated i	n Appeno	lix L, equ	ation L12	or L12a)	, also see	e Table 5					
Applianc		25.93								24.11	28.14	30	(67)
Аррпанс	ces gains (calculate	a in App	enuix L, e	quation		0d), disu	see rable	: 5				
	263	265.73	258.86	244.22	225.73	208.36	196.76	194.03	200.91	215.55	234.03	251.4	(68)





Cooking gains (calculated in Appendix L, equation L18 or L18a), also see Table 5

Pumps a	49.13 and fans g	49.13 ains (Tab	49.13 le 5a)	49.13	49.13	49.13	49.13	49.13	49.13	49.13	49.13	49.13	(69)
Losses e	0 .g. evapo	0 ration (ne	•	0 alues) (Ta	0 Ible 5	0	0	0	0	0	0	0	(70)
Water h	-80.73 eating ga	-80.73 ins (Table	-80.73 e 5)	-80.73	-80.73	-80.73	-80.73	-80.73	-80.73	-80.73	-80.73	-80.73	(71)
Total int	101.49 ernal gaiı	98.96 ns	93.97	82.87	76.11	69.02	64.61	68.16	72.33	80.19	90.82	100.06	(72)
	483.18	480.11	463.4	432.54	403.26	376.95	361.74	365.82	381.72	409.34	442.48	470.95	(73)

6. Solar gains

Solar gains in watts, calculated for each month

7	7.48	131.97	180.57	223.73	250.6	248.79	239.86	219.81	195.52	145.85	92.8	66.3	(83)
Total gains – internal and solar (watts)													
5	60.65	612.08	643.96	656.27	653.86	625.74	601.6	585.64	577.23	555.19	535.28	537.26	(84)

7. Mean internal temperature (heating season)

Tempera	ature dur	ing heati	ng perioc	ls in the l	iving area	a from Ta	able 9, Th	1 (°C)					21	(85)
Utilisatio	on factor	for gains	for living	; area, ⊇1	,m (see T	able 9a)								
	0.99	0.98	0.97	0.93	0.85	0.7	0.53	0.56	0.78	0.93	0.98	0.99		(86)
Mean in	ternal ter	mperatur	re in livin	g area T1	(follow s	steps 3 ar	nd 4 in Ta	ble 9c)						
	21	21	21	21	21	21	21	21	21	21	21	21		(87)
Tempera	ature dur	ing heati	ng perioc	ls in rest	of dwelli	ng from 1	Table 9, T	'n2 (°C)						
	19.88	19.88	19.88	19.9	19.9	19.91	19.91	19.92	19.91	19.9	19.9	19.89		(88)
Roof				ι	Jtilisatio	n factor f	or gains f	or rest of	fdwelling	g, ⊡2,m (s	ee Table	9a)		
	0.98	0.98	0.95	0.91	0.8	0.6	0.4	0.44	0.69	0.91	0.97	0.99		(89)
Roof					Me	ean interi	nal tempe	erature ir	n the rest	of dwell	ing T2			
	19.88	19.88	19.88	19.9	19.9	19.91	19.91	19.92	19.91	19.9	19.9	19.89		(90)
Living ar	ea fractio	on											0.58	(91)
Mean in	ternal tei	mperatur	re (for the	e whole d	lwelling)									
	20.53	20.53	20.54	20.54	20.54	20.55	20.55	20.55	20.55	20.54	20.54	20.54		(92)
Adjusted	d mean in	iternal te	mperatu	re:										
	20.53	20.53	20.54	20.54	20.54	20.55	20.55	20.55	20.55	20.54	20.54	20.54		(93)

8. Space heating requirement







Utilisation factor for gains,

Useful g	0.99 ains, mGr	0.98 n,W	0.96	0.92	0.83	0.66	0.48	0.51	0.74	0.92	0.98	0.99		(94)
Monthly	553.34 v average	000107	619.36 temperat	000.111	544.73 Table U		287.84	300.15	429.37	512.98	522.91	531.43		(95)
Heat los	4.3 s rate for	4.9 mean int	6.5 ernal ter	8.9 nperatur	11.7 e	14.6	16.6	16.4	14.1	10.6	7.1	4.2		(96)
Space he	1246.73 eating rec	3 1197.05 Juiremen			663.58	440.71	292.53	306.69	479.97	746.13	1014.14	1239.81		(97)
Solar spa	515.88 ace heatir			195.03 g Append		0 ative qua	0 Intity)	0	0	173.46	353.69	527.04		(98a)
Space he	0 eating rec	0 Juiremen	0 t for eacl	0 n month a	0 after sola	0 r contrib	0 ution	0	0	0	0	0		(98b)
Space he	515.88 eating rec			195.03 /m²/year		0	0	0	0	173.46	353.69	527.04	42.28	(98c) (99)

8c. Space Cooling requirement														
Heat loss	s rate,													
Utilisatic	0 on factor	0 for loss	0	0	0	0	0	0	0	0	0	0		(100)
Useful lo	0 oss, mLm	0 (watts)	0	0	0	0	0	0	0	0	0	0		(101)
Gains	0	0	0	0	0	0	0	0	0	0	0	0		(102)
Space co	0 ooling red	0 quiremer	0 It for mor	0 nth, whol	0 e dwellin	0 g, contin	0 uous (kW	0 /h)	0	0	0	0		(103) (104)
Cooled f		0 tor	0	0	0	0	0	0	0	0	0	0	0	(104) (105)
Space co	0	0	0 It for mor	0 nth	0	0	0	0	0	0	0	0	0	(106)
Space co	0 ooling red	0 quiremer	0 it in kWh,	0 /m²/year	0	0	0	0	0	0	0	0	0	(107) (108)
8f. Sp	ace hea	ting req	uiremen	t										

Fabric Energy Efficiency,

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



0

(109)

SAP WORKSHEET

0



Fraction of space heat from secondary/supplementary system, 0	0	(201)
Fraction of space heat from main system(s),	1	(202)
Fraction of main heating from main system 2,	0	(203)
Fraction of total space heat from main system 1,	1	(204)
Fraction of total space heat from main system 2,	0	(205)
Efficiency of main space heating system 1 (in %),	328.62	(206)
Efficiency of main space heating system 2 (in %),	0	(207)
Efficiency of secondary/supplementary heating system, %,	0	(208)
Cooling System Seasonal Energy Efficiency Ratio, 0	0	(209)
Space heating requirement (calculated above),		
0 0 0 0 0 0 0 0 0 0 0		(210)
Space heating fuel (main heating system 1), kWh/month 0	0	
156.98 122.28 102.34 59.35 26.91 0 0 0 0 52.78 107.63 160.38	•	(211)
Space heating fuel (main heating system 2), kWh/month 0	0	
0 0 0 0 0 0 0 0 0 0 0		(213)
Space heating fuel (secondary), kWh/month 0	0	
		(215)
Output from water heater), 0	220.69	(216)
Efficiency of water heater		
220.69 220.69 220.69 220.69 220.69 220.69 220.69 220.69 220.69 220.69 220.69 220.69 220.69 220.69 220.69	1	(217)
Fuel for water heating		(240)
114.74 101.32 107.11 92.77 89 79.18 77.34 80.94 82.42 93.14 100.56 113.29 Space Cooling	1131.81	(219)
		(221)
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		(221)
Space heating fuel used, main system 1	788.66	(211)
Space heating fuel used, main system 2	0	(213)
Space heating fuel used, secondary	0	(215)
Water heating fuel used	1131.81	(219)
Electricity for instantaneous electric shower(s)	0	(64a)
Space cooling fuel used	0	(221)
Electricity for pumps, fans and electric keep-hot		()
Mechanical vent fans - balanced, extract or positive input from outside 0 0	0	(230a)
warm air heating system fans	0	(230b)
Heating circulation pump or water pump within warm air heating unit	0	(230c)
Oil boiler auxiliary (oil pump, flue fan, etc; excludes circulation pump)	0	(230d)
Gas boiler auxiliary (flue fan, etc; excludes circulation pump)	0	(230e)
Maintaining electric keep-hot facility for gas combi boiler	0	(230f)
Pump for solar water heating	0	(230g)
Pump for storage WWHRS	0	(230h)
Total electricity for the above	0	(231)
Electricity for lighting	206.2	(232)





Electricity generated by PVs (Appendix M) (negative quantity)	222 \									
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	233a)									
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	234a)									
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	235a)									
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0										
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	233b)									
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	234b)									
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	235b)									
Appendix Q items: annual energy	235d)									
energy saved 0 (236a) 237a)									

10a. Fuel costs – Individual heating systems including micro-CHP

Fuel required	kWh/year	Fuel price	Fuel cost £/yea	ar
Space heating - main system 1 (electric off-peak tariff				
High-rate fraction (Table 12a, or Appendix F for electric CPSU)	0		130.05	(240a)
Low-rate fraction	0		130.05	(240b)
High-rate cost	0		0	(240c)
Low-rate cost	0		0	(240d)
Space heating - main system 1 cost (other fuel)	0		0	(240e)
Space heating - main system 2 (electric off-peak tariff				
High-rate fraction (Table 12a, or Appendix F for electric CPSU)	0		130.05	(241a)
Low-rate fraction	0		130.05	(241b)
High-rate cost	0		0	(241c)
Low-rate cost	0		0	(241d)
Space heating - main system 2 cost (other fuel)	0		0	(241e)
Space heating - secondary (electric off-peak tariff)				
High-rate fraction (Table 12a, or Appendix F for electric CPSU)	0		130.05	(242a)





Low-rate fraction	0		130.05	(242b)
High-rate cost	0		0	(242c)
Low-rate cost	0		0	(242d)
Space heating - secondary cost (other fuel)	0		0	(242e)
Water heating (electric off-peak tariff)				
High-rate fraction (Table 12a, or Appendix F for electric CPSU)	0		0	(243)
Low-rate fraction	0		0	(242b)
High-rate cost	0		0	(242c)
Low-rate cost	0		0	(242d)
Water heating cost (other fuel)	0		186.64	(247)
(for a DHW-only heat network use (342a) or (342b) instead of (247)				
Energy For instantaneous electric shower(s)	0		0	(247a)
Space cooling	0		0	(248)
Pumps, fans And electric keep-hot	0		0	(249)
Energy For lighting	0		34	(250)
Additional standing charges	0		0	(251)
Energy saving/generation technologies	0		0	(252)
Appendix Q, <item 1="" description=""></item>	Fuel	kWh/year		
energy saved Or generated	0		0	(253)
energy used	0		0	(254)
Total energy cost	0		350.69	(255)
11a. SAP rating – Individual heating systems including micro-CHP				
Energy cost deflator	0		0	(256)
Energy cost factor (ECF)	0		0	(257)
SAP rating	0		0	(258)

11a. SAP rating – Individual heating systems including micro-CHP		
Energy cost deflator	0.36	(256)
Energy cost factor (ECF)	1.19	(257)
SAP rating	80.75	(258)
12a. CO2 emissions – Individual heating systems including micro-CHP		

Emissions Energy **Emission factor** KWh/year kg kg CO2/year Space heating - main system 1 122.42 (261) Space heating - main system 2 0 (262) Space heating - secondary 0 (263) Energy for water heating 159.84 (264) Energy for instantaneous electric shower(s) 0 (264a)





Space and water heating		0	(265)
Space cooling		0	(266)
Electricity for pumps, fans and electric keep		0	(267)
Electricity for lighting		29.76	(268)
energy saved or generated	0	0	(269b)
Appendix Q items			
energy saved	0	0	
energy used	0	0	
energy saved	0	0	(270b)
energy used		0	(271b)
Total CO2, kg/year		312.02	(272)
Dwelling CO2 Emission Rate		5.09	(273)
El rating		96	(274)

13a. Primary Energy – Individual heating systems including micro-CHP

	Energy Emission factor	Emissionsr
	KWh/year kg	kg CO2/year
Space heating - main system 1		1241.9 (275)
Space heating - main system 2		0 (276)
Space heating - secondary		0 (277)
Energy for water heating		1722.86 (278)
Energy for instantaneous electric shower(s)		0 (278a)
Space and water heating		0 (279)
Space cooling		0 (280)
Electricity for pumps, fans and electric keep		0 (281)
Electricity for lighting		316.27 (282)
energy saved or generated	0	0
Appendix Q items		
energy saved	0	0
energy used	0	0
energy saved	0	0 (284b)
energy used		0 (285b)
Total PE, kWh/year		3281.03 (286)
Dwelling PE Rate		53.52 (287)







Dwelling Reference: Dwelling Type: EN5 5SU Unit 03 Existing Dwelling

	Area(m²)		Av. Heig	ht(m)	Volume(m³)	
			- 0			
Ground Floor	84	.71(1a) ×	< 3	(2a) =	254.13	(3a
Total floor area TFA					84.71	(4)
Dwelling volume					254.13	(5)
2. Ventilation Rate						
Chimneys/Flues		0 >	x 80 =		0	(6a)
Open chimneys		-	x 20 =		0	(6b)
Chimneys / flues attached to closed fire		0 >	x 10 =		0	(6c)
Flues attached to solid fuel boiler		0 >	x 20 =		0	(6d)
Flues attached to other heater		0 >	x 35 =		0	(6e
Number of blocked chimneys		0 >	x 20 =		0	(6f)
Number of intermittent extract fans		2 >	x 10 =		20	(7a
Number of passive vents		0 >	x 10 =		0	(7b
Number of flueless gas fires		0 >	x 40 =		0	(7c)
			Air chan	ges per hour		
Number of storeys in the dwelling (ns)				0.08	0.08	(8)
Infiltration due to chimneys, flues, fans, PSVs, etc				0	0	(9)
Additional infiltration Structural infiltration				0	0	(10
Suspended wooden ground floor				0 0	0 0	(11 (12
No draught lobby				0	0	(12
Percentage of windows and doors draught proofed				0	0	(14
Window infiltration				0	0	(15
Infiltration rate				0	0	(16
Air permeability value, AP50, (m³/h/m²)				5	5	(17
Air permeability value, AP4, (m³/h/m²) Air permeability value)				0	0	(17
Number of sides on which dwelling is sheltered				0.33 3	0.33 3	(18 (19
Shelter factor				Э	0.78	(19
Infiltration rate incorporating shelter factor					0.25	(20
Infiltration rate modified for monthly wind speed					0.20	(21
Jan Feb Mar Apr May Ju	n Jul Aug	Sep	Oct	Nov Dec	Total	(22)



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Monthly average wind speed from Table U2

Wind F	5.1 actor	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7	52.5	(22)
Adjuste	1.28 ed infiltrat	1.25 tion rate	1.23 (allowing	1.1 for shelt	1.08 er and w	0.95 ind speed	0.95 d)	0.93	1	1.08	1.13	1.18	13.13	(22a)
Calcula	0.32 te effectiv	0.32 ve air cha	0.31 Inge rate	0.28 for the a	0.27 pplicable	0.24 case:	0.24	0.24	0.25	0.27	0.29	0.3	3.34	(22b)
													0	(23a)
													0	(23b)
													0	(23c)
a) If ba	lanced me	echanical	ventilati	on with h	eat recov	very (MV	HR)							
	0	0	0	0	0	0	0	0	0	0	0	0		(24a)
b) If ba	lanced me	echanical	ventilati	on witho	ut heat re	ecovery (MV)							
	0	0	0	0	0	0	0	0	0	0	0	0		(24b)
c) If wh	iole house	e extract	ventilatio	on or posi	tive inpu	t ventilat	ion from	outside						
	0	0	0	0	0	0	0	0	0	0	0	0		(24c)
d) If na	tural vent	ilation or	whole h	ouse pos	itive inpu	it ventilat	tion from	loft						
	0.55	0.55	0.55	0.54	0.54	0.53	0.53	0.53	0.53	0.54	0.54	0.54		(24d)
Effectiv	/e air char	nge rate												
	0.55	0.55	0.55	0.54	0.54	0.53	0.53	0.53	0.53	0.54	0.54	0.54		(25)
Effectiv	/e air char	•												()
	0.55	0.55	0.55	0.54	0.54	0.53	0.53	0.53	0.53	0.54	0.54	0.54		(25)

3. Heat losses and heat loss parameter

Items in the table below are to be expanded as nec	cessary to allow for all different types of element	e.g. 4 wall types. The k -value
FLEMENT	AXU	AXk

	(W/K)	kJ/K
Doors	2.1	(26)
Windows	12.97	(27)
Roof window	0	(27a)
Basement floor	0	0 (28)
Ground floor	0	0 (28a)
Exposed floor	6.74	4597.5 (28b)
Basement wall	0	0 (29)
External wall	10.5	15352 (29a)
Roof	0	0 (30)
Total area of external elements ∑A, m ²		155.53 (31)
Party Wall	0	6274.8 (32)
Party floor		0 (32a)
Party ceiling		0 (32b)





Internal	wall **												0	(33c)
Internal	floor												0	(32d)
Internal	ceiling flo	oor											0	(32e)
Fabric h	eat loss, V	W/K = ∑ (A x U)										32.32	(33)
Heat ca	pacity Cm	i = ∑(A x k	()										26224.3	(34)
Therma	l mass pa	rameter	TMP = C	m ÷ TFA)	in kJ/m²ŀ	<							250	(35)
Linear T	hermal b	ridges:∑	(L x Ψ) ca	lculated	using Ap	pendix K							21.94	(36)
	nermal bri			-		nermal br	idge pres	sent and	values av	ailable			21.94	(36a)
Total fa	bric heat	loss H = ∑	(A × U) +	∑(L×Ψ)	+∑χ								54.26	(37)
Ventilat	ion heat l	oss calcu	lated mo	nthly										
Heat tra	46.35 Insfer coe	46.18 efficient. V	46.01 N/K	45.22	45.08	44.39	44.39	44.26	44.65	45.08	45.38	45.69		(38)
			100.27	99.48	99.33	98.64	98.64	98.52	98.91	99.33	99.63	99.94		(39)
Heat los	s parame			99.48	99.33	98.04	98.04	98.52	98.91	99.33	99.03	99.94		(39)
	1.19	1.19	1.18	1.17	1.17	1.16	1.16	1.16	1.17	1.17	1.18	1.18		(40)
Numbe	r of days i	n month	(Table 1a	ı)										
	31	28	31	30	31	30	31	31	30	31	30	31		(41)

4. Water heating energy requirement

Assumed occupancy, N	2.55	(42)							
Hot water usage in litres per day for mixer showers, Vd, shower (from Appendix J)									
92 90.62 88.61 84.75 81.91 78.73 76.93 78.93 81.12 84.53 88.46 91.65		(42a)							
Hot water usage in litres per day for baths, Vd,bath (from Appendix J)		(424)							
30.42 29.97 29.33 28.16 27.28 26.3 25.78 26.41 27.1 28.14 29.34 30.32 Hot water usage in litres per day for other uses, Vd,other (from Appendix J)		(42b)							
42.85 41.29 39.73 38.17 36.62 35.06 35.06 36.62 38.17 39.73 41.29 42.85		(42c)							
Annual average hot water usage in litres per day Vd,average (from Appendix J) Hot water usage in litres per day for each month Vd,m = (42a) + (42b) + (42c)	152.22	(43)							
165.27 161.88 157.67 151.08 145.8 140.1 137.77 141.96 146.39 152.4 159.09 164.81 Energy content of hot water used = 4.18 x Vd,m x nm x DTm / 3600 kWh/month (from Appendix J)	1824.2	(44)							
261.74 230.51 242.33 206.82 196.27 172.26 166.62 175.77 180.52 206.8 226.66 258.06 Distribution loss (46) = 0.15 x (45)	2524.36	5 (45)							
39.26 34.58 36.35 31.02 29.44 25.84 24.99 26.37 27.08 31.02 34 38.71		(46)							
Storage volume (litres) including any solar or WWHRS storage within same vessel	0	(47)							
Water storage loss (or HIU loss)									
a) If manufacturer's declared loss factor is known (kWh/day):	1.56	(48)							
Temperature factor from Table 2b									
Energy lost from water storage, kWh/day (48) x (49) =									
b) If manufacturer's declared loss factor is not known :									
Hot water storage loss factor from Table 2 (kWh/litre/day)	0	(51)							





Volume factor from Table 2a	0	(52)
Temperature factor from Table 2b	0	(53)
Energy lost from water storage, kWh/day	0	(54)
Enter (50) or (54) in (55)	0.84	(55)
Water storage (or HIU) loss calculated for each month (56) = (55) × (41)		()
26.11 23.59 26.11 25.27 26.11 25.27 26.11 26.11 25.27 26.11 25.27 26.11 25.27 26.11 1 f the vessel contains dedicated solar storage or dedicated WWHRS storage, (57)m = (56)m ☑ [(47) - Vs] ÷ (47), else (57)m = (56)m		(56)
where Vs is Vww from Appendix G3 or (H12) from Appendix H (as applicable).		
26.11 23.59 26.11 25.27 26.11 25.27 26.11 26.11 25.27 26.11 25.27 26.11 25.27 26.11 Primary circuit loss for each month from Table 3		(57)
modified by factor from Table H4 if there is solar water heating and a cylinder thermostat, although not for DHW-onl	y heat netw	orks)
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		(59)
0 0 0 0 0 0 0 0 0 0		(61)
Total heat required for water heating calculated for each month $(62) = 0.85 \times (45) + (46) + (57) + (59) + (61)$		()
287.86 254.1 268.44 232.09 222.39 197.54 192.73 201.88 205.79 232.92 251.93 284.17 CWWHRS DHW input calculated using Appendix G (negative quantity) (enter 0 if no WWHRS contribution to water he		34 (62)
0 0 0 0 0 0 0 0 0 0		(63a)
PV diverter DHW input calculated using Appendix G (negative quantity) (enter 0 if no PV diverter contribution)		()
0 0 0 0 0 0 0 0 0 0		(63b)
Solar DHW input calculated using Appendix H (negative quantity) (enter 0 if no solar contribution to water heating)		. ,
0 0 0 0 0 0 0 0 0 0		(63c)
FGHRS DHW input calculated using Appendix G (negative quantity) (enter 0 if no FGHRS contribution to water heating	g)	. ,
0 0 0 0 0 0 0 0 0 0		(63d)
Output from water heater for each month, kWh/month (64) = (62) + (63a) + (63b) + (63c) + (63d)		
287.86 254.1 268.44 232.09 222.39 197.54 192.73 201.88 205.79 232.92 251.93 284.17 Output from water heater for each month, kWh/month (64) = (62) + (63a) + (63b) + (63c) + (63d)	2831.8	34 (64)
		(64a)
Heat gains from water heating, kWh/month 0.25 x $[0.85 \times (45) + (61) + (64a)] + 0.8 x [(46) + (57) + (59)]$		
87.03 76.64 80.57 68.77 65.26 57.28 55.4 58.44 60.02 68.76 75.36 85.8 include (57) m in calculation of (65) m only if hot water store is in the dwelling or hot water is from heat network		(65)

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

Metabolic gains (Table 5), watts

Lighting	152.77 gains (cal				152.77					152.77	152.77	152.77	(66)
Lighting				-							26.92	20.20	(67)
Applianc	38.2 es gains (15.61 quation l					31.55	36.83	39.26	(07)
	341.79	345.34	336.4	317.38	293.36	270.78	255.7	252.16	261.09	280.12	304.14	326.71	(68)





Cooking gains (calculated in Appendix L, equation L18 or L18a), also see Table 5

52.82 Pumps and fans g	52.82 ains (Tab	52.82 le 5a)	52.82	52.82	52.82	52.82	52.82	52.82	52.82	52.82	52.82	(69)
0 Losses e.g. evapo	0 ration (ne	-	-		0	0	0	0	0	0	0	(70)
-101.85 Water heating gai	-101.85 ins (Table		-101.85	-101.85	-101.85	-101.85	-101.85	-101.85	-101.85	-101.85	-101.85	(71)
116.98 Total internal gair	114.05 IS	108.3	95.51	87.72	79.55	74.46	78.55	83.36	92.42	104.67	115.33	(72)
600.72	597.07	576.04	537.52	500.44	467.27	448.16	452.97	473.05	507.84	549.39	585.05	(73)

6. Solar gains

Solar gains in watts, calculated for each month													
	38.44 76.95 136.62 223.16 300.13 320.29 299.48 238.47 165.93 93.42 48.11 31.57 Total gains – internal and solar (watts)												
Total ga	ains – inter	rnal and s	solar (wat	ts)									
	639.15	674.02	712.66	760.69	800.57	787.56	747.64	691.44	638.99	601.26	597.49	616.61	

7. Mean	internal	temperature	(heating season)
---------	----------	-------------	------------------

Temper	ature dur	ing heati	ng period	ds in the l	living are	a from Ta	able 9, Th	1 (°C)					21	(85)
Utilisati	on factor	for gains	for living	g area, 🛙 1	l,m (see 1	Table 9a)								
	0.99	0.99	0.98	0.96	0.89	0.73	0.56	0.63	0.86	0.97	0.99	1		(86)
Mean in	iternal te	mperatu	re in livin	g area 11	. (follow s	steps 3 ar	nd 4 in Ta	ible 9c)						
	21	21	21	21	21	21	21	21	21	21	21	21		(87)
Temper	ature dur	ing heati	ng perioo	ds in rest	of dwelli	ng from ⁻	Table 9, T	ĥ2 (°C)						
	19.93	19.93	19.93	19.94	19.94	19.95	19.95	19.95	19.95	19.94	19.94	19.94		(88)
Roof				I	Utilisatio	n factor f	or gains f	for rest o	fdwellin	g, ⊡2,m (s	see Table	9a)		
	0.99	0.99	0.98	0.94	0.84	0.64	0.44	0.5	0.79	0.96	0.99	0.99		(89)
Roof					Me	ean inter	nal temp	erature in	n the rest	ofdwell	ing T2			
	19.93	19.93	19.93	19.94	19.94	19.95	19.95	19.95	19.95	19.94	19.94	19.94		(90)
Living a	rea fractio	on											0.36	(91)
Mean ir	nternal te	mperatu	re (for the	e whole o	dwelling)									
	20.31	20.31	20.31	20.32	20.32	20.32	20.32	20.33	20.32	20.32	20.32	20.32		(92)
Adjuste	d mean ir	nternal te	emperatu	re:										
	20.31	20.31	20.31	20.32	20.32	20.32	20.32	20.33	20.32	20.32	20.32	20.32		(93)

8. Space heating requirement



Page 5

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(84)



Utilisation factor for gains,

Useful g	0.99 ains, mGr	0.99 n , W	0.98	0.95	0.86	0.67	0.48	0.55	0.82	0.96	0.99	0.99		(94)
Monthly	634.97 v average	667.53 external	699.17 temperat	722.54 ture from		01010	361.86	376.96	521.66	578.11	590.83	613.24		(95)
Heat los	4.3 s rate for	4.9 mean int	6.5 ernal ten	8.9 nperatur	11.7 e	14.6	16.6	16.4	14.1	10.6	7.1	4.2		(96)
Space he	1611.03 eating rec	3 1548.12 Juiremen			856.26	564.67	367.39	386.69	615.49	965.53	1316.97	1610.76		(97)
Solar spa	726.19 ace heatii		510.41 ated using				0 antity)	0	0	288.24	522.82	742.15		(98a)
Space he	0 eating red	0 Juiremen	0 t for each	0 n month a	0 after sola	0 r contrib	0 ution	0	0	0	0	0		(98b)
Space he	726.19 eating rec		510.41 t in kWh/		125.68	0	0	0	0	288.24	522.82	742.15	44.92	(98c) (99)

8c. Spac	ce Coolir	ng requ	uiremei	nt										
Heat loss ra	ate,													
0 Utilisation	-		0	0	0	0	0	0	0	0	0	0		(100)
0 Useful loss	-		0	0	0	0	0	0	0	0	0	0		(101)
0 Gains	C)	0	0	0	0	0	0	0	0	0	0		(102)
0 Space cooli	-	·	0 for mo	0 nth, who	0 e dwellin	0 g, contin	0 uous (kW	0 'h)	0	0	0	0		(103) (104)
0 Cooled frac Intermitter	ction		0	0	0	0	0	0	0	0	0	0	0	(104) (105)
0 Space cool		•	0 for mo	0 nth	0	0	0	0	0	0	0	0	0	(106)
0 Space cool			0 : in kWh	0 /m²/year	0	0	0	0	0	0	0	0	0	(107) (108)
8f. Spac	e heatir	ıg requ	uiremer	nt										

Fabric Energy Efficiency,

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



0

(109)

SAP WORKSHEET

0



Fraction of space heat from secondary/supplementary system, 0 Fraction of space heat from main system(s), Fraction of main heating from main system 2, Fraction of total space heat from main system 1, Fraction of total space heat from main system 2, Efficiency of main space heating system 1 (in %), Efficiency of main space heating system 2 (in %), Efficiency of secondary/supplementary heating system, %,	0 1 0 1 0 336.78 0 0	 (201) (202) (203) (204) (205) (206) (207) (208)
Cooling System Seasonal Energy Efficiency Ratio, 0	0	(209)
Space heating requirement (calculated above),		(210)
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0	(210)
215.63 175.71 151.56 88.39 37.32 0 0 0 0 85.59 155.24 220.37	0	(211)
Space heating fuel (main heating system 2), kWh/month 0	0	(===)
0 0 0 0 0 0 0 0 0 0		(213)
Space heating fuel (secondary), kWh/month 0	0	
0 0 0 0 0 0 0 0 0 0 0		(215)
Output from water heater), 0	220.69	(216)
Efficiency of water heater		(0.17)
220.69 220.69 220.69 220.69 220.69 220.69 220.69 220.69 220.69 220.69 220.69 220.69 220.69 Fuel for water heating		(217)
130.44 115.14 121.64 105.17 100.77 89.51 87.33 91.48 93.25 105.54 114.16 128.77 Space Cooling	1283.2	(219)
0 0 0 0 0 0 0 0 0 0		(221)
Annual totals kWh/year kWh/year		
Space heating fuel used, main system 1	1129.81	(211)
Space heating fuel used, main system 2 Space heating fuel used, secondary	0	(213)
Water heating fuel used	0 1283.2	(215) (219)
Electricity for instantaneous electric shower(s)	0	(219) (64a)
Space cooling fuel used	0	(221)
Electricity for pumps, fans and electric keep-hot		(/
Mechanical vent fans - balanced, extract or positive input from outside 0 0	0	(230a)
warm air heating system fans	0	(230b)
Heating circulation pump or water pump within warm air heating unit	0	(230c)
Oil boiler auxiliary (oil pump, flue fan, etc; excludes circulation pump)	0	(230d)
Gas boiler auxiliary (flue fan, etc; excludes circulation pump)	0	(230e)
Maintaining electric keep-hot facility for gas combi boiler	0	(230f)
Pump for solar water heating Pump for storage WWHRS	0	(230g)
Total electricity for the above	0	(230h)
Electricity for lighting	0 269.83	(231) (232)
, , , , , , , , , , , , , , , , , , , ,	207.03	(232)





Energy savin Electricity ge							ised in dv	velling					
0 Electricity ge	0 nerated by	0 wind tur	0 bines (Ap	0 pendix N	0 ⁄I) (negati	0 ive quant	0 ity)	0	0	0	0	0	(233a)
0 Electricity ge	0 nerated by	0 hydro-el	0 ectric ger	0 nerators	0	0	0	0	0	0	0	0	(234a)
0 Electricity us	0 ed or net el	0 ectricity	0 generate	0 d by mic	0 ro-CHP	0	0	0	0	0	0	0	(235a)
0 Energy savin Electricity ge							0 exported	0	0	0	0	0	(235c)
0 Electricity ge	0 nerated by	0 wind tur	0 bines (Ap	0 pendix N	0 ⁄I) (negati	0 ive quant	0 ity)	0	0	0	0	0	(233b)
0 Electricity ge	0 nerated by	0 hydro-el	0 ectric ger	0 nerators	0	0	0	0	0	0	0	0	(234b)
0 Electricity us	0 ed or net el	0 ectricity	0 generate	0 d by mici	0 ro-CHP	0	0	0	0	0	0	0	(235b)
0 Appendix Q i Appendix Q,				0	0	0	0 Fue	0	0 kWh/yea	0	0	0	(235d)
energy saved energy used Total deliver	ł						1 44	-1	κντη γεα	ı		0 0 2682.85	(236a) (237a)

10a. Fuel costs – Individual heating systems including micro-CHP

Fuel required	kWh/year	Fuel price	Fuel cost £/yea	ar
Space heating - main system 1 (electric off-peak tariff				
High-rate fraction (Table 12a, or Appendix F for electric CPSU)	0		186.31	(240a)
Low-rate fraction	0		186.31	(240b)
High-rate cost	0		0	(240c)
Low-rate cost	0		0	(240d)
Space heating - main system 1 cost (other fuel)	0		0	(240e)
Space heating - main system 2 (electric off-peak tariff				
High-rate fraction (Table 12a, or Appendix F for electric CPSU)	0		186.31	(241a)
Low-rate fraction	0		186.31	(241b)
High-rate cost	0		0	(241c)
Low-rate cost	0		0	(241d)
Space heating - main system 2 cost (other fuel)	0		0	(241e)
Space heating - secondary (electric off-peak tariff)				
High-rate fraction (Table 12a, or Appendix F for electric CPSU)	0		186.31	(242a)





Low-rate fraction	0		186.31	(242b)
High-rate cost	0		0	(242c)
Low-rate cost	0		0	(242d)
Space heating - secondary cost (other fuel)	0		0	(242e)
Water heating (electric off-peak tariff)				
High-rate fraction (Table 12a, or Appendix F for electric CPSU)	0		0	(243)
Low-rate fraction	0		0	(242b)
High-rate cost	0		0	(242c)
Low-rate cost	0		0	(242d)
Water heating cost (other fuel)	0		211.6	(247)
(for a DHW-only heat network use (342a) or (342b) instead of (247)				
Energy For instantaneous electric shower(s)	0		0	(247a)
Space cooling	0		0	(248)
Pumps, fans And electric keep-hot	0		0	(249)
Energy For lighting	0		44.5	(250)
Additional standing charges	0		0	(251)
Energy saving/generation technologies	0		0	(252)
Appendix Q, <item 1="" description=""></item>	Fuel	kWh/year		
energy saved Or generated	0		0	(253)
energy used	0		0	(254)
Total energy cost	0		442.4	(255)
11a. SAP rating – Individual heating systems including micro-CHP				
Energy cost deflator	0		0	(256)
Energy cost factor (ECF)	0		0	(257)
SAP rating	0		0	(258)

11a. SAP rating – Individual heating systems including micro-CHP		
Energy cost deflator	0.36	(256)
Energy cost factor (ECF)	1.23	(257)
SAP rating	80.1	(258)
12a. CO2 emissions – Individual heating systems including micro-CHP		

Energy **Emission factor** Emissions KWh/year kg kg CO2/year Space heating - main system 1 175.02 (261) Space heating - main system 2 0 (262) Space heating - secondary 0 (263) Energy for water heating 181.27 (264) Energy for instantaneous electric shower(s) 0 (264a)





Space and water heating		0	(265)
Space cooling		0	(266)
Electricity for pumps, fans and electric keep		0	(267)
Electricity for lighting		38.95	(268)
energy saved or generated	0	0	(269b)
Appendix Q items			
energy saved	0	0	
energy used	0	0	
energy saved	0	0	(270b)
energy used		0	(271b)
Total CO2, kg/year		395.24	(272)
Dwelling CO2 Emission Rate		4.67	(273)
El rating		96	(274)

13a. Primary Energy – Individual heating systems including micro-CHP

	Energy Emission factor	Emissionsr
	KWh/year kg	kg CO2/year
Space heating - main system 1		1777.79 (275)
Space heating - main system 2		0 (276)
Space heating - secondary		0 (277)
Energy for water heating		1953.51 (278)
Energy for instantaneous electric shower(s)		0 (278a)
Space and water heating		0 (279)
Space cooling		0 (280)
Electricity for pumps, fans and electric keep		0 (281)
Electricity for lighting		413.88 (282)
energy saved or generated	0	0
Appendix Q items		
energy saved	0	0
energy used	0	0
energy saved	0	0 (284b)
energy used		0 (285b)
Total PE, kWh/year		4145.19 (286)
Dwelling PE Rate		48.93 (287)







Dwelling Reference: Dwelling Type: EN5 5SU

Unit 02 Existing Dwelling

1. Overall dwelling dimensions					
	Area(m²)	Av. Height(m	1)	Volume(m³)	
Ground Floor Total floor area TFA	51.52 (1a) x 3	(2a) =	154.56 51.52	(3a)
Dwelling volume				154.56	(4) (5)
2. Ventilation Rate					
Chimneys/Flues	0	x 80 =		0	(6a)
Open chimneys	0	x 20 =		0	(6b)
Chimneys / flues attached to closed fire	0	x 10 =		0	(6c)
Flues attached to solid fuel boiler	0	x 20 =		0	(6d)
Flues attached to other heater	0	x 35 =		0	(6e)
Number of blocked chimneys	0	x 20 =		0	(6f)
Number of intermittent extract fans	2	x 10 =		20	(7a)
Number of passive vents	0	x 10 =		0	(7b)
Number of flueless gas fires	0	x 40 =		0	(7c)
		Air changes	per hour		
Number of storeys in the dwelling (ns)			0.13	0.13	(8)
Infiltration due to chimneys, flues, fans, PSVs, etc			0	0	(9)
Additional infiltration Structural infiltration			0	0	(10)
Suspended wooden ground floor			0 0	0 0	(11) (12)
No draught lobby			0	0	(12)
Percentage of windows and doors draught proofed			0	0	(14)
Window infiltration			0	0	(15)
Infiltration rate			0	0	(16)
Air permeability value, AP50, $(m^3/h/m^2)$			5	5	(17)
Air permeability value, AP4, (m³/h/m²) Air permeability value)			0	0	(17a)
Number of sides on which dwelling is sheltered			0.38 3	0.38 3	(18) (19)
Shelter factor			5	0.78	(20)
Infiltration rate incorporating shelter factor				0.29	(21)
Infiltration rate modified for monthly wind speed					(/
Jan Feb Mar Apr May Jun	Jul Aug	Sep Oct N	ov Dec	Total	(22)







Monthly average wind speed from Table U2

Wind F	5.1 actor	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7	52.5	(22)
Adjust	1.28 ed infiltrat	1.25 tion rate	1.23 (allowing	1.1 for shelt	1.08 er and w	0.95 ind speed	0.95 d)	0.93	1	1.08	1.13	1.18	13.13	(22a)
Calcula	0.37 ate effectiv	0.37 ve air cha	0.36 ange rate	0.32 for the a	0.32 pplicable	0.28 case:	0.28	0.27	0.29	0.32	0.33	0.35	3.86	(22b)
													0	(23a)
													0	(23b)
													0	(23c)
a) If ba	a) If balanced mechanical ventilation with heat recovery (MVHR)													
	0	0	0	0	0	0	0	0	0	0	0	0		(24a)
b) If ba	lanced m	echanica	ventilati	on witho	ut heat re	ecovery (MV)							
	0	0	0	0	0	0	0	0	0	0	0	0		(24b)
c) If wi	nole house	e extract	ventilatio	on or posi	tive inpu	t ventilat	ion from	outside						
1.1.6	0	0	0	0	. 0	0	0	0	0	0	0	0		(24c)
d) If na	itural vent	ilation of	r whole h	ouse pos	itive inpu	it ventilat	tion from	loft						
	0.57	0.57	0.56	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.55	0.56		(24d)
Effecti	ve air chai	nge rate												
	0.57	0.57	0.56	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.55	0.56		(25)
Effecti	ve air chai	•												()
	0.57	0.57	0.56	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.55	0.56		(25)

3. Heat losses and heat loss parameter

Items in the table below are to be expanded as necessary to allow f	or all different types of element e.g. 4 wall types.	The k -value
ELEMENT	AXU	AXk

	(W/K)	kJ/K	
Doors	2.1		(26)
Windows	10.29		(27)
Roof window	0		(27a)
Basement floor	0	0	(28)
Ground floor	0	0	(28a)
Exposed floor	5.67	3864	(28b)
Basement wall	0	0	(29)
External wall	7.14	10442.4	(29a)
Roof	0	0	(30)
Total area of external elements ∑A, m ²		117.57	(31)
Party Wall	0	8044.2	(32)
Party floor		0	(32a)
Party ceiling		0	(32b)





Internal	wall **												0	(33c)
Internal	floor												0	(32d)
Internal	ceiling fl	oor											0	(32e)
Fabric heat loss, W/K = \sum (A x U)											25.21	(33)		
Heat capacity $Cm = \sum (A \times k)$											22350.6	(34)		
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m ² K											250	(35)		
Linear Thermal bridges: Σ (L x Ψ) calculated using Appendix K											16.72	(36)		
Point Thermal bridges: $\Sigma \chi$ (W/K) if significant point thermal bridge present and values available											16.72	(36a)		
Total fabric heat loss $H = \sum (A \times U) + \sum (L \times \Psi) + \sum \chi$											41.93	(37)		
Ventilati	ion heat l	oss calcu	lated mo	nthly										
	29.09	28.95	28.81	28.17	28.05	27.49	27.49	27.39	27.71	28.05	28.29	28.55		(38)
Heat tra	nsfer coe	efficient,	W/K											
	71.02	70.88	70.74	70.1	69.98	69.42	69.42	69.32	69.64	69.98	70.22	70.48		(39)
Heat los	s parame	eter (HLP)	, W/m²K											
	1.38	1.38	1.37	1.36	1.36	1.35	1.35	1.35	1.35	1.36	1.36	1.37		(40)
Number	of days i	n month	(Table 1a	a)										
	31	28	31	30	31	30	31	31	30	31	30	31		(41)

4. Water heating energy requirement

Assumed occupancy, N	1.73	(42)									
Hot water usage in litres per day for mixer showers, Vd, shower (from Appendix J)											
73.3 72.2 70.59 67.52 65.25 62.73 61.29 62.88 64.63 67.34 70.48 73.02		(42a)									
Hot water usage in litres per day for baths, Vd,bath (from Appendix J)											
24.26 23.9 23.39 22.46 21.76 20.98 20.56 21.06 21.61 22.44 23.4 24.18		(42b)									
Hot water usage in litres per day for other uses, Vd,other (from Appendix J)											
34.1 32.86 31.62 30.38 29.14 27.9 27.9 29.14 30.38 31.62 32.86 34.1		(42c)									
Annual average hot water usage in litres per day Vd,average (from Appendix J)	121.27	(43)									
Hot water usage in litres per day for each month Vd,m = (42a) + (42b) + (42c)											
131.66 128.96 125.61 120.36 116.15 111.61 109.75 113.09 116.62 121.41 126.74 131.3	1453.27	(44)									
Energy content of hot water used = 4.18 x Vd,m x nm x DTm / 3600 kWh/month (from Appendix J)											
208.52 183.64 193.05 164.77 156.36 137.24 132.74 140.03 143.81 164.75 180.57 205.58	2011.05	(45)									
Distribution loss (46) = 0.15 x (45)											
31.28 27.55 28.96 24.72 23.45 20.59 19.91 21 21.57 24.71 27.08 30.84		(46)									
Storage volume (litres) including any solar or WWHRS storage within same vessel	0	(47)									
Water storage loss (or HIU loss)											
a) If manufacturer's declared loss factor is known (kWh/day):	1.56	(48)									
Temperature factor from Table 2b	0.54	(49)									
Energy lost from water storage, kWh/day (48) x (49) =	0	(50)									
b) If manufacturer's declared loss factor is not known :											
Hot water storage loss factor from Table 2 (kWh/litre/day)	0	(51)									





Volume factor from Table 2a Temperature factor from Table 2b	0	(52)
Energy lost from water storage, kWh/day	0 0	(53) (54)
Enter (50) or (54) in (55)	0.84	(55)
Water storage (or HIU) loss calculated for each month (56) = $(55) \times (41)$		()
26.11 23.59 26.11 25.27 26.11 25.27 26.11 26.11 25.27 26.11 25.27 26.11 25.27 26.11 If the vessel contains dedicated solar storage or dedicated WWHRS storage, (57)m = (56)m ☑ [(47) – Vs] ÷ (47), else (57)m = (56)m		(56)
where Vs is Vww from Appendix G3 or (H12) from Appendix H (as applicable).		
26.11 23.59 26.11 25.27 26.11 25.27 26.11 26.11 25.27 26.11 25.27 26.11 25.27 26.11 Primary circuit loss for each month from Table 3		(57)
modified by factor from Table H4 if there is solar water heating and a cylinder thermostat, although not for DHW-only	heat netwo	orks)
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		(59)
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		(61)
234.63 207.22 219.17 190.04 182.48 162.51 158.85 166.14 169.08 190.87 205.84 231.7 CWWHRS DHW input calculated using Appendix G (negative quantity) (enter 0 if no WWHRS contribution to water here)	2318.5 ating)	3 (62)
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		(63a)
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		(63b)
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	;)	(63c)
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		(63d)
234.63 207.22 219.17 190.04 182.48 162.51 158.85 166.14 169.08 190.87 205.84 231.7 Output from water heater for each month, kWh/month (64) = (62) + (63a) + (63b) + (63c) + (63d)	2318.5	3 (64)
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		(64a)
69.33 61.06 64.19 54.79 51.99 45.63 44.13 46.56 47.82 54.78 60.04 68.36 include (57) m in calculation of (65) m only if hot water store is in the dwelling or hot water is from heat network		(65)

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

Metabolic gains (Table 5), watts

	104.09	104.09	104.09	104.09	104.09	104.09	104.09	104.09	104.09	104.09	104.09	104.09	(66)
Lighting gains (calculated in Appendix L, equation L12 or L12a), also see Table 5													
	22.1	19.63	15.97	12.09	9.04	7.63	8.24	10.71	14.38	18.26	21.31	22.72	(67)
Appliances gains (calculated in Appendix L, equation L16 or L16a), also see Table 5													
	225.64	227.98	222.08	209.52	193.67	178.76	168.81	166.47	172.37	184.93	200.78	215.69	(68)





Cooking gains (calculated in Appendix L, equation L18 or L18a), also see Table 5

Pumps a	47.14 and fans g	47.14 gains (Tab	47.14 le 5a)	47.14	47.14	47.14	47.14	47.14	47.14	47.14	47.14	47.14	(69)
Losses e	0 e.g. evapo	0 ration (no	0 egative va	0 alues) (Ta	0 able 5	0	0	0	0	0	0	0	(70)
Water h	-69.4 eating ga	-69.4 ins (Table	-69.4 e 5)	-69.4	-69.4	-69.4	-69.4	-69.4	-69.4	-69.4	-69.4	-69.4	(71)
Total int	93.19 ternal gai	90.86 ns	86.28	76.09	69.88	63.38	59.32	62.58	66.41	73.63	83.39	91.88	(72)
	422.78	420.32	406.17	379.54	354.42	331.61	318.21	321.6	335	358.66	387.32	412.12	(73)

6. Solar gains

Solar gains in watts, calculated for each month													
Total gair	31 ns – inter		113.69 solar (wat		250.97	267.56	250.3	199.54	138.53	77.11	39.01	25.32	(83)
			519.86	,	605.39	599.17	568.51	521.14	473.53	435.77	426.33	437.44	(84)

7. Mean internal temperature (heating season)

•	Temperature during heating periods in the living area from Table 9, Th1 (°C) 21											(85)		
Utilisati	on factor	for gains	for living	g area, 🛙 1	.,m (see 1	able 9a)								
	0.99	0.99	0.97	0.94	0.84	0.68	0.52	0.58	0.82	0.96	0.99	0.99		(86)
Mean in	iternal te	mperatui	re in livin	g area T1	. (follow s	steps 3 ar	nd 4 in Ta	ble 9c)						
	21	21	21	21	21	21	21	21	21	21	21	21		(87)
Temper	ature dur	ing heati	ng perioc	ds in rest	of dwelli	ng from T	Table 9, T	'n2 (°C)						
	19.78	19.78	19.78	19.79	19.8	19.8	19.8	19.81	19.8	19.8	19.79	19.79		(88)
Roof				I	Utilisatio	n factor f	or gains f	or rest of	fdwelling	g, ⊡2,m (s	ee Table	9a)		
	0.99	0.98	0.96	0.91	0.79	0.58	0.39	0.45	0.74	0.93	0.98	0.99		(89)
Roof					Me	ean inter	nal tempe	erature ir	hthe rest	of dwell	ing T2			
	19.78	19.78	19.78	19.79	19.8	19.8	19.8	19.81	19.8	19.8	19.79	19.79		(90)
Living a	rea fractio	on											0.42	(91)
Mean in	iternal tei	mperatui	re (for the	e whole o	dwelling)									
	20.3	20.3	20.3	20.31	20.31	20.31	20.31	20.31	20.31	20.31	20.3	20.3		(92)
Adjuste	d mean ir	nternal te	emperatu	re:										
	20.3	20.3	20.3	20.31	20.31	20.31	20.31	20.31	20.31	20.31	20.3	20.3		(93)

8. Space heating requirement





Utilisation factor for gains,

Useful g	0.99 ains, mGr	0.98 n,W	0.97	0.92	0.81	0.62	0.45	0.51	0.78	0.94	0.98	0.99		(94)
Monthly	448.75 v average	475.62 external	000.00	523.43 ture from	492.18 Table U	372.45 1	253.37	263.82	367.84	411.5	418.65	433.3		(95)
Heat los	4.3 s rate for	4.9 mean int	6.5 ernal ter	8.9 nperatur	11.7 e	14.6	16.6	16.4	14.1	10.6	7.1	4.2		(96)
Space he	1136.08 eating rec	3 1091.41 Juiremen			602.27	396.48	257.64	271.18	432.4	679.25	927.24	1134.82		(97)
Solar spa	511.38 ace heatii			198.78 g Append		0 ative qua	0 Intity)	0	0	199.21	366.19	521.93		(98a)
Space he	0 eating red	0 Juiremen	0 t for each	0 n month a	0 after sola	0 r contrib	0 ution	0	0	0	0	0		(98b)
Space he	511.38 eating rec			198.78 /m²/year		0	0	0	0	199.21	366.19	521.93	51.33	(98c) (99)

8c. Sp	oace Coo	ling req	uiremen	t										
Heat los	s rate,													
Utilisatio	0 on factor	0 for loss	0	0	0	0	0	0	0	0	0	0		(100)
Useful lo	0 oss, mLm	0 (watts)	0	0	0	0	0	0	0	0	0	0		(101)
Gains	0	0	0	0	0	0	0	0	0	0	0	0		(102)
Space co	0 poling req	0 uiremen	0 t for mon	0 th, whole	0 e dwelling	0 g, continu	0 Jous (kW	0 h)	0	0	0	0		(103) (104)
Cooled f Intermit	0 Traction tency fact	0 tor	0	0	0	0	0	0	0	0	0	0	0	(104) (105)
Space co	0 poling req	0 uiremen	0 t for mon	0 th	0	0	0	0 0	0	0	0	0	0	(106)
Space co	0 ooling req	0 uiremen	0 t in kWh/	0 m²/year	0	0	0	0	0	0	0	0	0	(107) (108)
8f. Sp	ace heat	ting requ	uirement	t										

Fabric Energy Efficiency,

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



0

(109)

SAP WORKSHEET

0



Fraction of space heat from secondary/supplementary system, 0 Fraction of space heat from main system(s),	0 (201)
Fraction of main heating from main system 2,	1 (202) 0 (203)
Fraction of total space heat from main system 1,	1 (203)
Fraction of total space heat from main system 2,	0 (205)
Efficiency of main space heating system 1 (in %),	326.22 (206)
Efficiency of main space heating system 2 (in %),	0 (207)
Efficiency of secondary/supplementary heating system, %,	0 (208)
Cooling System Seasonal Energy Efficiency Ratio, 0	0 (209)
Space heating requirement (calculated above),	
0 0 0 0 0 0 0 0 0 0 0	(210)
Space heating fuel (main heating system 1), kWh/month 0	0
156.76 126.85 107.73 60.93 25.11 0 0 0 0 61.07 112.25 15	59.99 (211)
Space heating fuel (main heating system 2), kWh/month 0	0
0 0 0 0 0 0 0 0 0 0 0	(213)
Space heating fuel (secondary), kWh/month 0	0
0 0 0 0 0 0 0 0 0 0 0	(215)
Output from water heater), 0	220.69 (216)
Efficiency of water heater	
	20.69 (217)
Fuel for water heating	
	04.99 1050.61 (219)
Space Cooling	
0 0 0 0 0 0 0 0 0 0 0	(221)
Annual totals kWh/year kWh/year	
Space heating fuel used, main system 1	810.68 (211)
Space heating fuel used, main system 2	0 (213)
Space heating fuel used, secondary	0 (215)
Water heating fuel used	1050.61 (219)
Electricity for instantaneous electric shower(s) Space cooling fuel used	0 (64a)
Electricity for pumps, fans and electric keep-hot	0 (221)
	(220-)
Mechanical vent fans - balanced, extract or positive input from outside 0 0 warm air heating system fans	0 (230a)
Heating circulation pump or water pump within warm air heating unit	0 (230b)
Oil boiler auxiliary (oil pump, flue fan, etc; excludes circulation pump)	0 (230c)
Gas boiler auxiliary (flue fan, etc; excludes circulation pump)	0 (230d)
Maintaining electric keep-hot facility for gas combi boiler	0 (230e) 0 (230f)
Pump for solar water heating	0 (230g)
Pump for storage WWHRS	0 (230h)
Total electricity for the above	0 (2301)
Electricity for lighting	156.14 (232)
	130.17 (232)





Energy sav Electricity							ısed in dv	velling					
(Electricity	0	0 by wind t	0 turbines (A	0 .ppendix N	0 V) (negati	0 ive quant	0 tity)	0	0	0	0	0	(233a)
(Electricity		0 by hydro	0 -electric ge	0 enerators	0	0	0	0	0	0	0	0	(234a)
(Electricity	0	0 t electric	0 ity generat	0 ed by mic	0 ro-CHP	0	0	0	0	0	0	0	(235a)
(Energy sav Electricity							0 exported	0	0	0	0	0	(235c)
(Electricity	0	0 by wind t	0 turbines (A	0 ppendix N	0 M) (negat i	0 ive quant	0 tity)	0	0	0	0	0	(233b)
(Electricity		0 by hydro	0 -electric ge	0 enerators	0	0	0	0	0	0	0	0	(234b)
(Electricity) 0 used or ne	0 t electrici	0 ity generat	0 ed by mic	0 ro-CHP	0	0	0	0	0	0	0	(235b)
(Appendix (Appendix (•	0	0	0	0	0	0	0	0	0	(235d)
energy sav energy use Total deliv	ved ed	·					Fue	1	kWh/yea	I		0 0 2017.42	(236a) (237a)

10a. Fuel costs – Individual heating systems including micro-CHP

Fuel required	kWh/year	Fuel price	Fuel cost £/yea	ar
Space heating - main system 1 (electric off-peak tariff				
High-rate fraction (Table 12a, or Appendix F for electric CPSU)	0		133.68	(240a)
Low-rate fraction	0		133.68	(240b)
High-rate cost	0		0	(240c)
Low-rate cost	0		0	(240d)
Space heating - main system 1 cost (other fuel)	0		0	(240e)
Space heating - main system 2 (electric off-peak tariff				
High-rate fraction (Table 12a, or Appendix F for electric CPSU)	0		133.68	(241a)
Low-rate fraction	0		133.68	(241b)
High-rate cost	0		0	(241c)
Low-rate cost	0		0	(241d)
Space heating - main system 2 cost (other fuel)	0		0	(241e)
Space heating - secondary (electric off-peak tariff)				
High-rate fraction (Table 12a, or Appendix F for electric CPSU)	0		133.68	(242a)





Low-rate fraction	0		133.68	(242b)
High-rate cost	0		0	(242c)
Low-rate cost	0		0	(242d)
Space heating - secondary cost (other fuel)	0		0	(242e)
Water heating (electric off-peak tariff)				
High-rate fraction (Table 12a, or Appendix F for electric CPSU)	0		0	(243)
Low-rate fraction	0		0	(242b)
High-rate cost	0		0	(242c)
Low-rate cost	0		0	(242d)
Water heating cost (other fuel)	0		173.24	(247)
(for a DHW-only heat network use (342a) or (342b) instead of (247)				
Energy For instantaneous electric shower(s)	0		0	(247a)
Space cooling	0		0	(248)
Pumps, fans And electric keep-hot	0		0	(249)
Energy For lighting	0		25.75	(250)
Additional standing charges	0		0	(251)
Energy saving/generation technologies	0		0	(252)
Appendix Q, <item 1="" description=""></item>	Fuel	kWh/year		
energy saved Or generated	0		0	(253)
energy used	0		0	(254)
Total energy cost	0		332.67	(255)
11a. SAP rating – Individual heating systems including micro-CHP				
Energy cost deflator	0		0	(256)
Energy cost factor (ECF)	0		0	(257)
SAP rating	0		0	(258)

11a. SAP rating – Individual heating systems including micro-CHP		
Energy cost deflator	0.36	(256)
Energy cost factor (ECF)	1.24	(257)
SAP rating	79.89	(258)
122 CO2 emissions Individual heating systems including misers CUD		

12a. CO2 emissions – Individual heating systems including micro-CHP

Energy		Emission factor	Emissions	
KWh/yea	ar	kg	kg CO2/year	
Space heating - main system 1			125.69	(261)
Space heating - main system 2			0	(262)
Space heating - secondary			0	(263)
Energy for water heating			148.34	(264)
Energy for instantaneous electric shower(s)			0	(264a)





Space and water heating		0	(265)
Space cooling		0	(266)
Electricity for pumps, fans and electric keep		0	(267)
Electricity for lighting		22.54	(268)
energy saved or generated	0	0	(269b)
Appendix Q items			
energy saved	0	0	
energy used	0	0	
energy saved	0	0	(270b)
energy used		0	(271b)
Total CO2, kg/year		296.57	(272)
Dwelling CO2 Emission Rate		5.76	(273)
El rating		96	(274)

13a. Primary Energy – Individual heating systems including micro-CHP

	Energy Emission factor	Emissionsr
	KWh/year kg	kg CO2/year
Space heating - main system 1		1276.03 (275)
Space heating - main system 2		0 (276)
Space heating - secondary		0 (277)
Energy for water heating		1599.14 (278)
Energy for instantaneous electric shower(s)		0 (278a)
Space and water heating		0 (279)
Space cooling		0 (280)
Electricity for pumps, fans and electric keep		0 (281)
Electricity for lighting		239.49 (282)
energy saved or generated	0	0
Appendix Q items		
energy saved	0	0
energy used	0	0
energy saved	0	0 (284b)
energy used		0 (285b)
Total PE, kWh/year		3114.66 (286)
Dwelling PE Rate		60.46 (287)







Dwelling Reference: Dwelling Type: EN5 5SU

Unit 02 Existing Dwelling

1. Overall dwelling dimensions				
	Area(m²)	Av. Height(m)	Volume(m³)	
Ground Floor	60.99 (1	la) x 3 ((2a) = 182.97	(3a)
Total floor area TFA Dwelling volume			60.99 182.97	(4) (5)
2. Ventilation Rate				
Chimneys/Flues	0	x 80 =	0	(6a)
Open chimneys	0	x 20 =	0	(6b)
Chimneys / flues attached to closed fire	0	x 10 =	0	(6c)
Flues attached to solid fuel boiler	0	x 20 =	0	(6d)
Flues attached to other heater	0	x 35 =	0	(6e)
Number of blocked chimneys	0	x 20 =	0	(6f)
Number of intermittent extract fans	2	x 10 =	20	(7a)
Number of passive vents	0	x 10 =	0	(7b)
Number of flueless gas fires	0	x 40 =	0	(7c)
		Air changes per ho	bur	
Number of storeys in the dwelling (ns)		0.1		(8)
Infiltration due to chimneys, flues, fans, PSVs, etc Additional infiltration		0		(9)
Structural infiltration		0		(10) (11)
Suspended wooden ground floor		0		(12)
No draught lobby		0		(13)
Percentage of windows and doors draught proofed		0	0	(14)
Window infiltration		0		(15)
Infiltration rate Air norman hilitruralus, ADEO, $(m^3/h/m^2)$		0		(16)
Air permeability value, AP50, (m ³ /h/m ²) Air permeability value, AP4, (m ³ /h/m ²)		5		(17)
Air permeability value)		0 0.3		(17a) (18)
Number of sides on which dwelling is sheltered		3		(19)
Shelter factor			0.78	(20)
Infiltration rate incorporating shelter factor			0.28	(21)
Infiltration rate modified for monthly wind speed				
Jan Feb Mar Apr May Jun	Jul Aug S	ep Oct Nov	Dec Total	(22)







Monthly average wind speed from Table U2

Wind Fa	5.1 ctor	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7	52.5	(22)
Adjustec	1.28 1 infiltrati	1.25 on rate (a	1.23 allowing f	1.1 for shelte	1.08 er and wir	0.95 nd speed	0.95)	0.93	1	1.08	1.13	1.18	13.13	(22a)
Calculate	0.36 e effective	0.35 e air char	0.34 nge rate f	0.31 or the ap	0.3 plicable (0.26 case:	0.26	0.26	0.28	0.3	0.31	0.33	3.65	(22b)
													0	(23a)
													0	(23b)
													0	(23c)
a) If bala	inced me	chanical	ventilatio	n with he	eat recov	ery (MVH	IR)							
	0	0	0	0	0	0	0	0	0	0	0	0		(24a)
b) If bala	inced me	chanical	ventilatio	on withou	it heat re	covery (N	Л∨)							
	0	0	0	0	0	0	0	0	0	0	0	0		(24b)
c) If who	le house	extract v	entilatior	n or posit	ive input	ventilati	on from o	outside						
N 16 .	0	0	0	0	0	0	0	0	0	0	0	0		(24c)
d) If nati	ural venti	lation or	whole ho	ouse posit	tive input	: ventilati	on from	loft						
Effective	0.56	0.56	0.56	0.55	0.54	0.53	0.53	0.53	0.54	0.54	0.55	0.55		(24d)
Enective	e air chan													()
Effoctive	0.56	0.56	0.56	0.55	0.54	0.53	0.53	0.53	0.54	0.54	0.55	0.55		(25)
Enective	e air chan													()
	0.56	0.56	0.56	0.55	0.54	0.53	0.53	0.53	0.54	0.54	0.55	0.55		(25)

3. Heat losses and heat loss parameter

Items in the table below are to be expanded as necessary	y to allow for all different types of ele	ment e.g. 4 wall types. The k -value
ELEMENT	AXU	AXk

	(W/K)	kJ/K	
Doors	2.1	(26)	
Windows	11.39	(27)	
Roof window	0	(27a)	
Basement floor	0	0 (28)	
Ground floor	0	0 (28a)	
Exposed floor	6.71	4574.25 (28b)	
Basement wall	0	0 (29)	
External wall	8.47	12380.4 (29a)	
Roof	0	0 (30)	
Total area of external elements ∑A, m ²		138.2 (31)	
Party Wall	0	7650 (32)	
Party floor		0 (32a)	
Party ceiling		0 (32b)	





Interna	wall **												0	(33c)
Interna	floor												0	(32d)
Interna	ceiling fl	oor											0	(32e)
Fabric h	eat loss,	W/K = ∑ ((A x U)										28.67	(33)
Heat ca	pacity Cm	n = ∑(A x I	k)										24604.65	(34)
Therma	Thermal mass parameter (TMP = Cm \div TFA) in kJ/m ² K													(35)
Linear 1	Linear Thermal bridges: $\sum (L \times \Psi)$ calculated using Appendix K													(36)
Point Tl	Point Thermal bridges: $\Sigma \chi$ (W/K) if significant point thermal bridge present and values available													(36a)
Total fa	Total fabric heat loss H = $\Sigma(A \times U) + \Sigma(L \times \Psi) + \Sigma\chi$													(37)
Ventilat	ion heat	loss calcu	lated mo	nthly										
	34	33.85	33.7	33.02	32.9	32.3	32.3	32.19	32.53	32.9	33.15	33.42		(38)
Heat tra	ansfer coe	efficient,	W/K											
	79.21	79.06	78.91	78.23	78.11	77.51	77.51	77.4	77.74	78.11	78.36	78.63		(39)
Heat lo	ss parame	eter (HLP)), W/m²K											
	1.3	1.3	1.29	1.28	1.28	1.27	1.27	1.27	1.27	1.28	1.28	1.29		(40)
Numbe	r of days i	n month	(Table 1a	1)										
	31	28	31	30	31	30	31	31	30	31	30	31		(41)

4. Water heating energy requirement

Assumed occupancy, N	2.01	(42)
Hot water usage in litres per day for mixer showers, Vd, shower (from Appendix J)		
79.63 78.43 76.69 73.35 70.89 68.14 66.58 68.31 70.21 73.16 76.57 79	9.32	(42a)
Hot water usage in litres per day for baths, Vd,bath (from Appendix J)		
26.34 25.95 25.4 24.39 23.63 22.78 22.33 22.87 23.47 24.37 25.41 26	6.26	(42b)
Hot water usage in litres per day for other uses, Vd, other (from Appendix J)		
	7.06	(42c)
Annual average hot water usage in litres per day Vd, average (from Appendix J)	131.74	(43)
Hot water usage in litres per day for each month Vd,m = (42a) + (42b) + (42c)		
143.04 140.1 136.46 130.76 126.19 121.25 119.23 122.86 126.7 131.9 137.69 14	42.64 1578	.81 (44)
Energy content of hot water used = 4.18 x Vd,m x nm x DTm / 3600 kWh/month (from Appendix J)		
	23.34 2184	78 (45)
Distribution loss (46) = 0.15 x (45)		
	3.5	(46)
Storage volume (litres) including any solar or WWHRS storage within same vessel	0	(47)
Water storage loss (or HIU loss)		
a) If manufacturer's declared loss factor is known (kWh/day):	1.56	(48)
Temperature factor from Table 2b	0.54	(49)
Energy lost from water storage, kWh/day (48) x (49) =	0	(50)
b) If manufacturer's declared loss factor is not known :		
Hot water storage loss factor from Table 2 (kWh/litre/day)	0	(51)





Volume factor from Table 2a Temperature factor from Table 2b	0	(52) (53)
Energy lost from water storage, kWh/day	0	(54)
Enter (50) or (54) in (55)	0.84	(55)
Water storage (or HIU) loss calculated for each month (56) = (55) × (41)		
26.11 23.59 26.11 25.27 26.11 25.27 26.11 26.11 25.27 26.11 25.27 26.11 If the vessel contains dedicated solar storage or dedicated WWHRS storage, (57)m = (56)m ☑ [(47) – Vs] ÷ (47), else (57)m = (56)m		(56)
where Vs is Vww from Appendix G3 or (H12) from Appendix H (as applicable).		
26.11 23.59 26.11 25.27 26.11 25.27 26.11 26.11 25.27 26.11 25.27 26.11 25.27 26.11 Primary circuit loss for each month from Table 3		(57)
modified by factor from Table H4 if there is solar water heating and a cylinder thermostat, although not for DHW-only	/ heat netwo	orks)
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		(59)
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		(61)
252.65 223.09 235.84 204.27 195.99 174.36 170.32 178.24 181.51 205.1 221.44 249.46 CWWHRS DHW input calculated using Appendix G (negative quantity) (enter 0 if no WWHRS contribution to water he	2492.2 ating)	6 (62)
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		(63a)
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		(63b)
0 0 0 0 0 0 0 0 0 0	-)	(63c)
FGHRS DHW input calculated using Appendix G (negative quantity) (enter 0 if no FGHRS contribution to water heating	.)	
0 0 0 0 0 0 0 0 0 0		(63d)
252.65 223.09 235.84 204.27 195.99 174.36 170.32 178.24 181.51 205.1 221.44 249.46 Output from water heater for each month, kWh/month (64) = (62) + (63a) + (63b) + (63c) + (63d)	2492.2	6 (64)
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		(64a)
75.32 66.33 69.74 59.52 56.48 49.57 47.95 50.58 51.95 59.51 65.23 74.26 include (57) m in calculation of (65) m only if hot water store is in the dwelling or hot water is from heat network		(65)

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

Metabolic gains (Table 5), watts

		120.57							120.57	120.57	120.57	120.57	(66)
Lighting gains (calculated in Appendix L, equation L12 or L12a), also see Table 5													
Applianc	26.8 ces gains (10.95 quation l					22.14	25.84	27.54	(67)
	261.85	264.56	257.72	243.14	224.74	207.44	195.89	193.17	200.02	214.6	233	250.29	(68)





Cooking gains (calculated in Appendix L, equation L18 or L18a), also see Table 5

Pumps a	49.07 and fans g	49.07 gains (Tab	49.07 le 5a)	49.07	49.07	49.07	49.07	49.07	49.07	49.07	49.07	49.07	(69)
Losses e	0 e.g. evapo	0 ration (ne	0 egative va	0 alues) (Ta	0 ible 5	0	0	0	0	0	0	0	(70)
Water h	-80.38 eating ga	-80.38 ins (Table	-80.38 e 5)	-80.38	-80.38	-80.38	-80.38	-80.38	-80.38	-80.38	-80.38	-80.38	(71)
Total int	101.24 ernal gain	98.71 ns	93.73	82.66	75.92	68.85	64.45	67.99	72.15	79.99	90.59	99.81	(72)
	479.14	476.33	460.06	429.71	400.87	374.8	359.59	363.41	378.86	405.98	438.68	466.91	(73)

6. Solar gains

Solar gains in watts, calculated for each month													
Total gair					277.77	296.13	277.03	220.85	153.32	85.35	43.17	28.02	(83)
U	513.45	546.17	585.89	, 636.36	678.64	670.93	636.61	584.25	532.18	491.33	481.85	494.92	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C)													21	(85)
Utilisati	on factor	for gains	for living	g area, 🛙 1	.,m (see T	able 9a)								
	0.99	0.99	0.98	0.94	0.85	0.68	0.52	0.58	0.83	0.96	0.99	0.99		(86)
Mean internal temperature in living area T1 (follow steps 3 and 4 in Table 9c)														
_	21	21	21	21	21	21	21	21	21	21	21	21		(87)
Temper	ature dur	ing heati	ng period	ls in rest	of dwelli	ng from	Table 9, T	h2 (°C)						
	19.84	19.84	19.85	19.85	19.86	19.86	19.86	19.87	19.86	19.86	19.85	19.85		(88)
Roof				I	Utilisatio	n factor f	or gains f	or rest o	f dwelling	g, ⊇2,m (s	ee Table	9a)		
	0.99	0.98	0.97	0.92	0.79	0.58	0.39	0.45	0.75	0.94	0.98	0.99		(89)
Roof					Me	ean inter	nal temp	erature in	n the rest	of dwell	ing T2			
	19.84	19.84	19.85	19.85	19.86	19.86	19.86	19.87	19.86	19.86	19.85	19.85		(90)
Living a	rea fractio	on											0.33	(91)
Mean in	iternal tei	mperatui	re (for the	e whole o	dwelling)									
	20.22	20.23	20.23	20.23	20.23	20.24	20.24	20.24	20.24	20.23	20.23	20.23		(92)
Adjuste	d mean ir	nternal te	emperatu	re:										
	20.22	20.23	20.23	20.23	20.23	20.24	20.24	20.24	20.24	20.23	20.23	20.23		(93)

8. Space heating requirement





Utilisation factor for gains,

Useful g	0.99 ains, mGr	0.99 n,W	0.97	0.93	0.81	0.62	0.44	0.5	0.77	0.95	0.98	0.99		(94)
Monthly	508.38 average	538.22 external	569.21 temperat	590.23 ure from	552.7 Table U:	414.21 I	278.43	290.75	412.31	465.08	473.95	490.79		(95)
Heat los	4.3 s rate for	4.9 mean int	6.5 ernal ten	8.9 nperature	11.7 e	14.6	16.6	16.4	14.1	10.6	7.1	4.2		(96)
Space he	1261.3 eating rec		. 1083.22 t for each		666.53	437.08	282.05	297.21	477.08	752.45	1029.03	1260.41		(97)
Solar spa	560.17 ace heatir		382.43 Ited using			0 ative qua	0 Intity)	0	0	213.8	399.66	572.6		(98a)
Space he	0 eating rec	0 Juiremen	0 t for each	0 n month a	0 after sola	0 r contrib	0 ution	0	0	0	0	0		(98b)
Space he	560.17 eating rec		382.43 t in kWh/		84.69	0	0	0	0	213.8	399.66	572.6	47.21	(98c) (99)

8c. Sp	bace Co	oling rec	luiremer	nt										
Heat los	s rate,													
Utilisatio	0 on factor	0 for loss	0	0	0	0	0	0	0	0	0	0		(100)
Useful lo	0 oss, mLm	0 (watts)	0	0	0	0	0	0	0	0	0	0		(101)
Gains	0	0	0	0	0	0	0	0	0	0	0	0		(102)
Space co	0 ooling ree	0 quiremer	0 nt for mo	0 nth, who	0 le dwellin	0 Ig, contin	0 uous (kW	0 /h)	0	0	0	0		(103) (104)
Cooled f Intermit		0 ctor	0	0	0	0	0	0	0	0	0	0	0	(104) (105)
Space co	0 poling ree	0 quiremer	0 nt for mo	0 nth	0	0	0	0 0	0	0	0	0	0	(106)
Space co	0 poling ree	0 quiremer	0 nt in kWh	0 /m²/year	0	0	0	0	0	0	0	0	0	(107) (108)
of Cr		ting roo	uiremer	.+										

81. Space heating requirement			
Fabric Energy Efficiency,	0	0	(109)

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





Fraction of space heat from secondary/supplementary system, 0	0	(201)
Fraction of space heat from main system(s),	1	(202)
Fraction of main heating from main system 2,	0	(203)
Fraction of total space heat from main system 1,	1	(204)
Fraction of total space heat from main system 2,	0	(205)
Efficiency of main space heating system 1 (in %),	329.88	(206)
Efficiency of main space heating system 2 (in %),	0	(207)
Efficiency of secondary/supplementary heating system, %,	0	(208)
Cooling System Seasonal Energy Efficiency Ratio, 0	0	(209)
Space heating requirement (calculated above),		
		(210)
Space heating fuel (main heating system 1), kWh/month 0	0	
169.81 137.17 115.93 64.68 25.67 0 0 0 64.81 121.15 173.58		(211)
Space heating fuel (main heating system 2), kWh/month 0	0	
		(213)
Space heating fuel (secondary), kWh/month 0	0	
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		(215)
Output from water heater), 0	220.69	(216)
Efficiency of water heater		()
220.69 220.69 220.69 220.69 220.69 220.69 220.69 220.69 220.69 220.69 220.69 220.69 220.69 220.69		(217)
Fuel for water heating		()
114.48 101.09 106.87 92.56 88.81 79.01 77.18 80.77 82.25 92.94 100.34 113.04	1129.33	(219)
Space Cooling		(00.1)
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		(221)
Annual totals kWh/year kWh/year Space heating fuel used, main system 1	072.0	(244)
Space heating fuel used, main system 1	872.8	(211)
Space heating fuel used, secondary	0	(213)
Water heating fuel used	0 1129.33	(215)
Electricity for instantaneous electric shower(s)		(219)
Space cooling fuel used	0 0	(64a) (221)
Electricity for pumps, fans and electric keep-hot	0	(221)
Mechanical vent fans - balanced, extract or positive input from outside 0 0	0	(230a)
warm air heating system fans	0	(230a) (230b)
Heating circulation pump or water pump within warm air heating unit	0	(2300) (230c)
Oil boiler auxiliary (oil pump, flue fan, etc; excludes circulation pump)	0	(230d)
Gas boiler auxiliary (flue fan, etc; excludes circulation pump)	0	(230e)
Maintaining electric keep-hot facility for gas combi boiler	0	(230E) (230f)
Pump for solar water heating	0	(230g)
Pump for storage WWHRS	0	(230g) (230h)
Total electricity for the above	0	(231)
Electricity for lighting	189.31	(232)
-		()





Energy s Electricit								sed in dv	velling					
Electricit	0 Sy genera	0 ated by v	0 vind turl	0 Dines (Ap	0 pendix N	0 1) (negati	0 ive quant	0 ity)	0	0	0	0	0	(233a)
Electricit	0 Sy genera	0 ated by h	0 iydro-ele	0 ectric ger	0 nerators	0	0	0	0	0	0	0	0	(234a)
Electricit	0 cy used c	0 or net ele	0 ectricity {	0 generate	0 d by micr	0 ro-CHP	0	0	0	0	0	0	0	(235a)
Energy s Electricit								0 exported	0	0	0	0	0	(235c)
Electricit	0 Sy genera	0 ated by v	0 vind turl	0 Dines (Ap	0 pendix N	0 1) (negati	0 ive quant	0 ity)	0	0	0	0	0	(233b)
Electricit	0 Sy genera	0 ated by h	0 iydro-ele	0 ectric ger	0 nerators	0	0	0	0	0	0	0	0	(234b)
Electricit	0 zy used c	0 or net ele	0 ectricity {	0 generate	0 d by micr	0 ro-CHP	0	0	0	0	0	0	0	(235b)
Appendi			•.		0	0	0	0	0	0	0	0	0	(235d)
Appendi energy s energy u Total del	aved ised		·					Fue	51	kWh/yea			0 0 2191.44	(236a) (237a)

10a. Fuel costs – Individual heating systems including micro-CHP

Fuel required	kWh/year	Fuel price	Fuel cost £/year		
Space heating - main system 1 (electric off-peak tariff					
High-rate fraction (Table 12a, or Appendix F for electric CPSU)	0		143.93	(240a)	
Low-rate fraction	0		143.93	(240b)	
High-rate cost	0		0	(240c)	
Low-rate cost	0		0	(240d)	
Space heating - main system 1 cost (other fuel)	0		0	(240e)	
Space heating - main system 2 (electric off-peak tariff					
High-rate fraction (Table 12a, or Appendix F for electric CPSU)	0		143.93	(241a)	
Low-rate fraction	0		143.93	(241b)	
High-rate cost	0		0	(241c)	
Low-rate cost	0		0	(241d)	
Space heating - main system 2 cost (other fuel)	0		0	(241e)	
Space heating - secondary (electric off-peak tariff)					
High-rate fraction (Table 12a, or Appendix F for electric CPSU)	0		143.93	(242a)	





Low-rate fraction	0		143.93	(242b)
High-rate cost	0		0	(242c)
Low-rate cost	0		0	(242d)
Space heating - secondary cost (other fuel)	0		0	(242e)
Water heating (electric off-peak tariff)				
High-rate fraction (Table 12a, or Appendix F for electric CPSU)	0		0	(243)
Low-rate fraction	0		0	(242b)
High-rate cost	0		0	(242c)
Low-rate cost	0		0	(242d)
Water heating cost (other fuel)	0		186.23	(247)
(for a DHW-only heat network use (342a) or (342b) instead of (247)				
Energy For instantaneous electric shower(s)	0		0	(247a)
Space cooling	0		0	(248)
Pumps, fans And electric keep-hot	0		0	(249)
Energy For lighting	0		31.22	(250)
Additional standing charges	0		0	(251)
Energy saving/generation technologies	0		0	(252)
Appendix Q, <item 1="" description=""></item>	Fuel	kWh/year		
energy saved Or generated	0		0	(253)
energy used	0		0	(254)
Total energy cost	0		361.37	(255)
11a. SAP rating – Individual heating systems including micro-CHP				
Energy cost deflator	0		0	(256)
Energy cost factor (ECF)	0		0	(257)
SAP rating	0		0	(258)

11a. SAP rating – Individual heating systems including micro-CHP		
Energy cost deflator	0.36	(256)
Energy cost factor (ECF)	1.23	(257)
SAP rating	80.1	(258)
12a. CO2 emissions – Individual heating systems including micro-CHP		

Emissions Energy **Emission factor** KWh/year kg kg CO2/year Space heating - main system 1 135.4 (261) Space heating - main system 2 0 (262) Space heating - secondary 0 (263) Energy for water heating 159.49 (264) Energy for instantaneous electric shower(s) 0 (264a)





Space and water heating		0	(265)
Space cooling		0	(266)
Electricity for pumps, fans and electric keep		0	(267)
Electricity for lighting		27.32	(268)
energy saved or generated	0	0	(269b)
Appendix Q items			
energy saved	0	0	
energy used	0	0	
energy saved	0	0	(270b)
energy used		0	(271b)
Total CO2, kg/year		322.22	(272)
Dwelling CO2 Emission Rate		5.28	(273)
El rating		96	(274)

13a. Primary Energy – Individual heating systems including micro-CHP

	Energy Emission factor	Emissionsr
	KWh/year kg	kg CO2/year
Space heating - main system 1		1374.11 (275)
Space heating - main system 2		0 (276)
Space heating - secondary		0 (277)
Energy for water heating		1719.08 (278)
Energy for instantaneous electric shower(s)		0 (278a)
Space and water heating		0 (279)
Space cooling		0 (280)
Electricity for pumps, fans and electric keep		0 (281)
Electricity for lighting		290.37 (282)
energy saved or generated	0	0
Appendix Q items		
energy saved	0	0
energy used	0	0
energy saved	0	0 (284b)
energy used		0 (285b)
Total PE, kWh/year		3383.56 (286)
Dwelling PE Rate		55.48 (287)







Dwelling Reference: Dwelling Type: EN5 5SU

Unit 02 Existing Dwelling

1. Overall dwelling dimensions					
	Area(m²)	Av. Height(r	m)	Volume(m³)	
Ground Floor Total floor area TFA	51.82 (1a) x 3	(2a) =	155.46	(3a)
Dwelling volume				51.82 155.46	(4) (5)
2. Ventilation Rate					
Chimneys/Flues	0	x 80 =		0	(6a)
Open chimneys	0	x 20 =		0	(6b)
Chimneys / flues attached to closed fire	0	x 10 =		0	(6c)
Flues attached to solid fuel boiler	0	x 20 =		0	(6d)
Flues attached to other heater	0	x 35 =		0	(6e)
Number of blocked chimneys	0	x 20 =		0	(6f)
Number of intermittent extract fans	2	x 10 =		20	(7a)
Number of passive vents	0	x 10 =		0	(7b)
Number of flueless gas fires	0	x 40 =		0	(7c)
		Air changes	per hour		
Number of storeys in the dwelling (ns)			0.13	0.13	(8)
Infiltration due to chimneys, flues, fans, PSVs, etc			0	0	(9)
Additional infiltration Structural infiltration			0	0	(10)
Suspended wooden ground floor			0 0	0 0	(11) (12)
No draught lobby			0	0	(12)
Percentage of windows and doors draught proofed			0	0	(14)
Window infiltration			0	0	(15)
Infiltration rate			0	0	(16)
Air permeability value, AP50, (m³/h/m²) Air permeability value, AP4, (m³/h/m²)			5	5	(17)
Air permeability value)			0 0.38	0 0.38	(17a) (18)
Number of sides on which dwelling is sheltered			3	3	(18)
Shelter factor			0	0.78	(20)
Infiltration rate incorporating shelter factor				0.29	(21)
Infiltration rate modified for monthly wind speed					. /
Jan Feb Mar Apr May Jun	Jul Aug	Sep Oct I	Nov Dec	Total	(22)







Monthly average wind speed from Table U2

	Wind Fac	5.1 ctor	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7	52.5	(22)
	Adjusted	1.28 d infiltrati	1.25 on rate (a	1.23 allowing	1.1 for shelte	1.08 er and wi	0.95 nd speed	0.95)	0.93	1	1.08	1.13	1.18	13.13	(22a)
	Calculate	0.37 e effectiv	0.37 e air char	0.36 nge rate f	0.32 for the ap	0.32 oplicable	0.28 case:	0.28	0.27	0.29	0.32	0.33	0.34	3.85	(22b)
														0	(23a)
														0	(23b)
														0	(23c)
a) If balanced mechanical ventilation with heat recovery (MVHR)															
		0	0	0	0	0	0	0	0	0	0	0	0		(24a)
	b) If bala	anced me	chanical	ventilatio	on withou	it heat re	covery (N	∕IV)							
		0	0	0	0	.0.	0	0	0	0	0	0	0		(24b)
	c) If who	ole house	extract v	entilatio	n or posit	ive input	ventilati	on from o	outside						
	-I) I f	0	0	0	0	0	0	0	0	0	0	0	0		(24c)
	d) If natural ventilation or whole house positive input ventilation from loft														
	Effective	0.57	0.57	0.56	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.55	0.56		(24d)
	Ellective	e air chan	-												(25)
	Effective	0.57 air chan	0.57 ge rate fr	0.56	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.55	0.56		(25)
	LITECTIVE		-												(25)
		0.57	0.57	0.56	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.55	0.56		(25)

3. Heat losses and heat loss parameter

Items in the table below are to be expanded as nec	essary to allow for all different types of eleme	ent e.g. 4 wall types. The k -value	
ELEMENT	A X U (W/K)	A X k kJ/K	
Doors	2.1	(26)	
Windows	5.89	(27)	
Roof window	0	(27a)	
Basement floor	0	0 (28)	
Ground floor	0	0 (28a)	
Exposed floor	5.7	3886.5 (28b)	
Basement wall	0	0 (29)	
External wall	7.58	11075.1 (29a)	
Roof	0	0 (30)	
Total area of external elements ∑A, m ²		117.35 (31)	
Party Wall	0	5482.8 (32)	
Party floor		0 (32a)	
Party ceiling		0 (32b)	





Internal wall **								0	(33c)					
Internal floor								0	(32d)					
Internal ceiling floor									0	(32e)				
Fabric heat loss, W/K = \sum (A x U)								21.26	(33)					
Heat capacity $Cm = \sum (A \times k)$								20444.4	(34)					
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m ² K									250	(35)				
Linear Thermal bridges: Σ (L x Ψ) calculated using Appendix K									12.8	(36)				
Point Thermal bridges: $\Sigma \chi$ (W/K) if significant point thermal bridge present and values available									12.8	(36a)				
Total fabric heat loss $H = \sum (A \times U) + \sum (L \times \Psi) + \sum \chi$									34.06	(37)				
Ventilation heat loss calculated monthly														
	29.24	29.1	28.97	28.32	28.2	27.64	27.64	27.54	27.86	28.2	28.45	28.7		(38)
Heat transfer coefficient, W/K														
	63.3	63.16	63.02	62.38	62.26	61.7	61.7	61.6	61.92	62.26	62.51	62.76		(39)
Heat loss parameter (HLP), W/m ² K														
	1.22	1.22	1.22	1.2	1.2	1.19	1.19	1.19	1.19	1.2	1.21	1.21		(40)
Number of days in month (Table 1a)														
	31	28	31	30	31	30	31	31	30	31	30	31		(41)

4. Water heating energy requirement

Assumed occupancy, N	1.74	(42)						
Hot water usage in litres per day for mixer showers, Vd,shower (from Appendix J)								
73.5 72.4 70.79 67.71 65.44 62.9 61.46 63.06 64.81 67.53 70.68 73.22		(42a)						
Hot water usage in litres per day for baths, Vd,bath (from Appendix J)								
24.33 23.97 23.46 22.52 21.82 21.04 20.62 21.12 21.67 22.51 23.46 24.25 Hot water usage in litres per day for other uses, Vd,other (from Appendix J)		(42b)						
34.2 32.95 31.71 30.47 29.22 27.98 27.98 29.22 30.47 31.71 32.95 34.2		(42c)						
Annual average hot water usage in litres per day Vd,average (from Appendix J)	121.61	(43)						
Hot water usage in litres per day for each month Vd,m = (42a) + (42b) + (42c)								
132.03 129.32 125.96 120.7 116.48 111.92 110.06 113.4 116.95 121.75 127.09 131.66 Energy content of hot water used = 4.18 x Vd,m x nm x DTm / 3600 kWh/month (from Appendix J)	1457.31	(44)						
209.1 184.15 193.59 165.23 156.8 137.62 133.11 140.42 144.21 165.21 181.07 206.15 Distribution loss (46) = 0.15 x (45)	2016.65	(45)						
31.37 27.62 29.04 24.78 23.52 20.64 19.97 21.06 21.63 24.78 27.16 30.92		(46)						
Storage volume (litres) including any solar or WWHRS storage within same vessel								
Water storage loss (or HIU loss)								
a) If manufacturer's declared loss factor is known (kWh/day):	1.56	(48)						
Temperature factor from Table 2b	0.54	(49)						
Energy lost from water storage, kWh/day (48) x (49) =	0	(50)						
b) If manufacturer's declared loss factor is not known :								
Hot water storage loss factor from Table 2 (kWh/litre/day)								





Volume factor from Table 2a	0	(52)
Temperature factor from Table 2b Energy lost from water storage, kWh/day	0	(53)
Enter (50) or (54) in (55)	0 0.84	(54) (55)
Water storage (or HIU) loss calculated for each month (56) = (55) × (41)	0.04	(55)
26.11 23.59 26.11 25.27 26.11 25.27 26.11 26.11 25.27 26.11 25.27 26.11 25.27 26.11 If the vessel contains dedicated solar storage or dedicated WWHRS storage, (57)m = (56)m ☑ [(47) – Vs] ÷ (47), else (57)m = (56)m		(56)
where Vs is Vww from Appendix G3 or (H12) from Appendix H (as applicable).		
26.11 23.59 26.11 25.27 26.11 25.27 26.11 26.11 25.27 26.11 25.27 26.11 25.27 26.11 Primary circuit loss for each month from Table 3		(57)
modified by factor from Table H4 if there is solar water heating and a cylinder thermostat, although not for DHW-only	/ heat netwo	orks)
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		(59)
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		(61)
235.21 207.74 219.71 190.5 182.91 162.89 159.22 166.53 169.48 191.32 206.34 232.27 CWWHRS DHW input calculated using Appendix G (negative quantity) (enter 0 if no WWHRS contribution to water he	2324.1 ating)	3 (62)
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		(63a)
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		(63b)
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	g)	(63c)
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		(63d)
235.21 207.74 219.71 190.5 182.91 162.89 159.22 166.53 169.48 191.32 206.34 232.27 Output from water heater for each month, kWh/month (64) = (62) + (63a) + (63b) + (63c) + (63d)	2324.1	3 (64)
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		(64a)
69.53 61.23 64.37 54.94 52.14 45.76 44.26 46.69 47.95 54.93 60.21 68.55 include (57) m in calculation of (65) m only if hot water store is in the dwelling or hot water is from heat network		(65)

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

Metabolic gains (Table 5), watts

Liebtin e i						104.63			104.63	104.63	104.63	104.63	(66)
Lighting §	gains (cai	culated li	n Append	lix L, equ	ation L12	or Liza)	, also see	lable 5					
Appliance						8.65 16 or L1				20.7	24.16	25.76	(67)
	226.8	229.16	223.23	210.6	194.66	179.68	169.68	167.32	173.25	185.88	201.82	216.8	(68)





Cooking gains (calculated in Appendix L, equation L18 or L18a), also see Table 5

Pumps a	47.21 and fans g	47.21 gains (Tab	47.21 le 5a)	47.21	47.21	47.21	47.21	47.21	47.21	47.21	47.21	47.21	(69)
Losses e	0 .g. evapo	0 ration (n	0 egative va	0 alues) (Ta	0 able 5	0	0	0	0	0	0	0	(70)
Water h	-69.75 eating ga	-69.75 ins (Table	-69.75 e 5)	-69.75	-69.75	-69.75	-69.75	-69.75	-69.75	-69.75	-69.75	-69.75	(71)
Total int	93.45 ernal gai	91.12 ns	86.52	76.3	70.08	63.55	59.49	62.75	66.6	73.83	83.62	92.13	(72)
	427.4	424.61	409.93	382.69	357.06	333.97	320.59	324.31	338.24	362.5	391.68	416.77	(73)

6. Solar gains

Solar gains in watts, calculated for each month

5	57.8	98.45	134.7	166.91	186.95	185.6	178.93	163.98	145.86	108.81	69.23	49.46	(83)
Total gains	– inter	nal and s	olar (wat	ts)									
4	\$85.19	523.06	544.63	549.6	544.01	519.56	499.52	488.29	484.09	471.31	460.91	466.23	(84)

7. Mean internal temperature (heating season)

•	ature du						-	1 (°C)					21	(85)
Utilisati	on factor	for gains	s for living	g area, 🛙 1	. <i>,</i> m (see 1	Fable 9a)								
Moonir	0.99	0.98	0.96	0.93	0.85 (follow)	0.7	0.53	0.56	0.77	0.93	0.98	0.99		(86)
Ivieali li	nternal te	mperatu		galea II		steps 5 ai	10 4 11 1 a	ible 90)						
	21	21	21	21	21	21	21	21	21	21	21	21		(87)
Temper	ature dur	ring heati	ng period	ds in rest	of dwelli	ng from ⁻	Table 9, T	ĥ2 (°C)						
	19.9	19.9	19.91	19.92	19.92	19.93	19.93	19.93	19.92	19.92	19.92	19.91		(88)
Roof					Utilisatio	n factor f	or gains f	for rest o	fdwelling	g, ⊇2,m (s	ee Table	9a)		
	0.98	0.97	0.95	0.91	0.8	0.61	0.41	0.44	0.69	0.9	0.97	0.99		(89)
Roof					Me	ean inter	nal temp	erature in	n the rest	of dwell	ing T2			
	19.9	19.9	19.91	19.92	19.92	19.93	19.93	19.93	19.92	19.92	19.92	19.91		(90)
Living a	rea fractio	on											0.45	(91)
Mean ir	nternal te	mperatu	re (for th	e whole d	dwelling)									. ,
	20.4	20.4	20.4	20.4	20.41	20.41	20.41	20.41	20.41	20.41	20.4	20.4		(92)
Adjuste	d mean ir		=0		20.41	20.71	20.41	20.11	20.41	20.41	20.4	2017		()
	20.4	20.4	20.4	20.4	20.41	20.41	20.41	20.41	20.41	20.41	20.4	20.4		(93)

8. Space heating requirement





Utilisation factor for gains,

Useful g	0.98 ains, mGi	0.98 m,W	0.96	0.92	0.83	0.65	0.46	0.5	0.73	0.92	0.97	0.99		(94)
Monthly	477.82 v average	01017	522.23 temperat	00.007	450.25 Table U		231.96	242.67	353.63	432.08	448.69	460.29		(95)
Heat los	4.3 s rate for	4.9 mean int	6.5 ternal ter	8.9 nperatur	11.7 e	14.6	16.6	16.4	14.1	10.6	7.1	4.2		(96)
Space he	1018.95 eating red	5 978.88 quiremen			542.04	358.53	235.12	247.1	390.62	610.53	831.55	1016.8		(97)
Solar spa	402.6 ace heati	314.62 ng calcula		153.23 g Append		0 ative qua	0 antity)	0	0	132.77	275.66	414.04		(98a)
Space he	0 eating red	0 quiremen	0 t for eacl	0 n month a	0 after sola	0 r contrib	0 ution	0	0	0	0	0		(98b)
Space he	402.6 eating red	314.62 quiremen		153.23 /m²/year		0	0	0	0	132.77	275.66	414.04	39.07	(98c) (99)

8c. Sp	bace Co	oling rec	luiremer	it										
Heat los	s rate,													
Utilisatio	0 on factor	0 for loss	0	0	0	0	0	0	0	0	0	0		(100)
Useful lo	0 oss, mLm	0 (watts)	0	0	0	0	0	0	0	0	0	0		(101)
Gains	0	0	0	0	0	0	0	0	0	0	0	0		(102)
Space co	0 poling rea	0 quiremer	0 nt for mor	0 nth, whol	0 e dwellin	0 g, contin	0 uous (kW	0 /h)	0	0	0	0		(103) (104)
Cooled f Intermit		0 ctor	0	0	0	0	0	0	0	0	0	0	0	(104) (105)
Space co	0 poling rea	0 quiremer	0 nt for mor	0 nth	0	0	0	0 0	0	0	0	0	0	(106)
Space co	0 poling ree	0 quiremer	0 nt in kWh,	0 /m²/year	0	0	0	0	0	0	0	0	0	(107) (108)
8f. Sp	bace hea	nting req	uiremen	t										

Fabric Energy Efficiency,

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



Page 6

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(109)

SAP WORKSHEET

0



Cooling System Sessoral Everty Influency Ratio 0 <t< th=""><th>Fraction of space Fraction of space Fraction of main h Fraction of total s Fraction of total s Efficiency of main Efficiency of main</th><th>heat from neating fr pace hea pace hea space he space he</th><th>n main sy rom main t from m t from m eating sys eating sys</th><th>vstem(s), system 2 ain syste ain syste item 1 (in item 2 (in</th><th>2, m 1, m 2, ı %),</th><th></th><th>,</th><th></th><th>0</th><th></th><th></th><th></th><th></th><th>0 1 0 1 0 322 0 0</th><th>(201) (202) (203) (204) (205) (206) (207) (208)</th></t<>	Fraction of space Fraction of space Fraction of main h Fraction of total s Fraction of total s Efficiency of main Efficiency of main	heat from neating fr pace hea pace hea space he space he	n main sy rom main t from m t from m eating sys eating sys	vstem(s), system 2 ain syste ain syste item 1 (in item 2 (in	2, m 1, m 2, ı %),		,		0					0 1 0 1 0 322 0 0	(201) (202) (203) (204) (205) (206) (207) (208)
0 0									0					0	(209)
125.03 97.71 81.74 47.59 21.21 0 <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td></td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td>(210)</td>	0	0	0	0	0		0	0	0	0	0	0	0	0	(210)
<t< td=""><td>125.03</td><td>97.71</td><td>81.74</td><td>47.59</td><td>21.21</td><td>0</td><td>0</td><td>0</td><td></td><td>0</td><td>41.23</td><td>85.61</td><td>128.58</td><td></td><td>(211)</td></t<>	125.03	97.71	81.74	47.59	21.21	0	0	0		0	41.23	85.61	128.58		(211)
Output from water heater; 0 220.69 <td< td=""><td>•</td><td>0</td><td>-</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>(213)</td></td<>	•	0	-	0	0	0	0	0	0	0	0	0	0	0	(213)
Fuel for water heating 106.58 94.13 99.56 86.32 82.88 73.81 72.15 75.46 76.8 86.7 93.5 105.25 1053.14 (219) Space Cooling 0 <td>Output from wate</td> <td>er heater)</td> <td>-</td> <td>0</td> <td>220.69</td> <td></td>	Output from wate	er heater)	-	0	0	0	0	0	0	0	0	0	0	220.69	
Space Cooling 0 <			220.69	220.69	220.69	220.69	220.69	22	0.69	220.69	220.69	220.69	220.69		(217)
Annual totalskWh/yearkWh/yearSpace heating fuel used, main system 1628.69(211)Space heating fuel used, main system 20(213)Space heating fuel used, secondary0(215)Water heating fuel used, secondary1053.14(219)Electricity for instantaneous electric shower(s)0(64a)Space cooling fuel used00(213)Electricity for pumps, fans and electric keep-hot0(230a)Warm air heating system fans00(230a)Heating circulation pump or water pump within warm air heating unit0(230c)Oil boiler auxiliary (for pump, flue fan, etc; excludes circulation pump)0(230c)Maintaining electric keep-hot facility for gas combi boiler0(230c)Pump for solar water heating0(230c)(230c)Maintaining electric keep-hot facility for gas combi boiler0(230c)Pump for storage WWHRS0(230c)(230c)Total electricity for the above0(230c)Dot use function function0(230c)Dot use function0(230c)During function function0(230c)Pump for storage WWHRS0(230c)During function function0(230c)During function function0(230c)During function function0(230c)During function function0(230c)During function function0(230c)During function0(230c)		94.13	99.56	86.32	82.88	73.81	72.15	75	.46	76.8	86.7	93.5	105.25	1053.14	(219)
Space heating fuel used, main system 1628.69(211)Space heating fuel used, main system 20(213)Space heating fuel used, secondary0(215)Water heating fuel used1053.14(219)Electricity for instantaneous electric shower(s)0(64a)Space cooling fuel used0(221)Electricity for pumps, fans and electric keep-hot0(230a)Warm air heating system fans00(230a)Warm air heating system fans0(230c)(230c)Oil boiler auxiliary (oil pump, flue fan, etc; excludes circulation pump)0(230c)Gas boiler auxiliary (flue fan, etc; excludes circulation pump)0(230c)Pump for solar water heating0(230c)Pump for solar water heating0(230c)Pump for storage WWHRS0(230c)Total electricity for the above0(230c)Total electricity for the above0(230c)	-	0	0	0	0	0	0		h/vea			0	0		(221)
Pump for storage WWHRS0(230h)Total electricity for the above0(231)	Space heating fue Space heating fue Water heating fue Electricity for inst Space cooling fue Electricity for pur Mechanical vent f warm air heating Heating circulatio Oil boiler auxiliary Gas boiler auxiliar	l used, m l used, se el used antaneou l used nps, fans fans - bala system fa n pump c v (oil pum ry (flue fa ric keep-l	ain syste econdary us electric and elect anced, ex ans or water p op, flue fa in, etc; ex hot facilit	m 2 c showerd cric keep- ctract or p ctract or p oump wit on, etc; ex ccludes ci	hot positive in hin warn kcludes ci rculation	n air heat irculation pump)	ing unit		0		0			0 0 1053.14 0 0 0 0 0 0 0 0 0	(213) (215) (219) (64a) (221) (230a) (230b) (230c) (230c) (230c) (230e) (230f)
	Pump for storage Total electricity fo	WWHRS or the abo	-											0 0	(230h) (231)





Energy sa Electricit								sed in dv	velling					
Electricit	0 y genera	0 ated by v	0 vind turl	0 Dines (Ap	0 pendix N	0 A) (negati	0 ive quant	0 ity)	0	0	0	0	0	(233a)
Electricit	0 y genera	0 ated by h	0 iydro-ele	0 ectric ger	0 nerators	0	0	0	0	0	0	0	0	(234a)
Electricit	0 y used c	0 or net ele	0 ctricity (0 generate	0 d by mici	0 ro-CHP	0	0	0	0	0	0	0	(235a)
Energy sa Electricit								0 exported	0	0	0	0	0	(235c)
Electricit	0 y genera	0 ated by v	0 vind turl	0 Dines (Ap	0 pendix N	0 A) (negati	0 ive quant	0 ity)	0	0	0	0	0	(233b)
Electricit	0 y genera	0 ated by h	0 Iydro-ele	0 ectric ger	0 nerators	0	0	0	0	0	0	0	0	(234b)
Electricit	0 y used c	0 or net ele	0 ctricity (0 generate	0 d by micı	0 ro-CHP	0	0	0	0	0	0	0	(235b)
Appendix Appendix			•.		0	0	0	0	0	0	0	0	0	(235d)
energy sa energy u Total del	aved sed		·					Fue	21	kWh/yea			0 0 1858.87	(236a) (237a)

10a. Fuel costs – Individual heating systems including micro-CHP

Fuel required	kWh/year	Fuel price	Fuel cost £/yea	ar
Space heating - main system 1 (electric off-peak tariff				
High-rate fraction (Table 12a, or Appendix F for electric CPSU)	0		103.67	(240a)
Low-rate fraction	0		103.67	(240b)
High-rate cost	0		0	(240c)
Low-rate cost	0		0	(240d)
Space heating - main system 1 cost (other fuel)	0		0	(240e)
Space heating - main system 2 (electric off-peak tariff				
High-rate fraction (Table 12a, or Appendix F for electric CPSU)	0		103.67	(241a)
Low-rate fraction	0		103.67	(241b)
High-rate cost	0		0	(241c)
Low-rate cost	0		0	(241d)
Space heating - main system 2 cost (other fuel)	0		0	(241e)
Space heating - secondary (electric off-peak tariff)				
High-rate fraction (Table 12a, or Appendix F for electric CPSU)	0		103.67	(242a)





Low-rate fraction	0		103.67	(242b)
High-rate cost	0		0	(242c)
Low-rate cost	0		0	(242d)
Space heating - secondary cost (other fuel)	0		0	(242e)
Water heating (electric off-peak tariff)				
High-rate fraction (Table 12a, or Appendix F for electric CPSU)	0		0	(243)
Low-rate fraction	0		0	(242b)
High-rate cost	0		0	(242c)
Low-rate cost	0		0	(242d)
Water heating cost (other fuel)	0		173.66	(247)
(for a DHW-only heat network use (342a) or (342b) instead of (247)				
Energy For instantaneous electric shower(s)	0		0	(247a)
Space cooling	0		0	(248)
Pumps, fans And electric keep-hot	0		0	(249)
Energy For lighting	0		29.19	(250)
Additional standing charges	0		0	(251)
Energy saving/generation technologies	0		0	(252)
Appendix Q, <item 1="" description=""></item>	Fuel	kWh/year		
energy saved Or generated	0		0	(253)
energy used	0		0	(254)
Total energy cost	0		306.53	(255)
11a. SAP rating – Individual heating systems including micro-CHP				
Energy cost deflator	0		0	(256)
Energy cost factor (ECF)	0		0	(257)
SAP rating	0		0	(258)

11a. SAP rating – Individual heating systems including micro-CHP		
Energy cost deflator	0.36	(256)
Energy cost factor (ECF)	1.14	(257)
SAP rating	81.52	(258)
12a. CO2 emissions – Individual heating systems including micro-CHP		

Energy **Emission factor** Emissions KWh/year kg kg CO2/year Space heating - main system 1 97.62 (261) Space heating - main system 2 0 (262) Space heating - secondary 0 (263) Energy for water heating 148.7 (264) Energy for instantaneous electric shower(s) 0 (264a)





Space and water heating		0	(265)
Space cooling		0	(266)
Electricity for pumps, fans and electric keep		0	(267)
Electricity for lighting		25.55	(268)
energy saved or generated	0	0	(269b)
Appendix Q items			
energy saved	0	0	
energy used	0	0	
energy saved	0	0	(270b)
energy used		0	(271b)
Total CO2, kg/year		271.87	(272)
Dwelling CO2 Emission Rate		5.25	(273)
El rating		96	(274)

13a. Primary Energy – Individual heating systems including micro-CHP

	Energy Emission factor	Emissionsr
	KWh/year kg	kg CO2/year
Space heating - main system 1		990.09 (275)
Space heating - main system 2		0 (276)
Space heating - secondary		0 (277)
Energy for water heating		1603.01 (278)
Energy for instantaneous electric shower(s)		0 (278a)
Space and water heating		0 (279)
Space cooling		0 (280)
Electricity for pumps, fans and electric keep		0 (281)
Electricity for lighting		271.54 (282)
energy saved or generated	0	0
Appendix Q items		
energy saved	0	0
energy used	0	0
energy saved	0	0 (284b)
energy used		0 (285b)
Total PE, kWh/year		2864.64 (286)
Dwelling PE Rate		55.28 (287)







Dwelling Reference: Dwelling Type: EN5 5SU

Unit 02 Existing Dwelling

Total floor area TFA 84.55 (4 Dwelling volume 253.65 (5 2. Ventilation Rate 2 2 Chimneys/Flues 0 x 80 = 0 (6 Open chimneys 0 x 20 = 0 (6 Chimneys / flues attached to closed fire 0 x 10 = 0 (6 Flues attached to solid fuel boiler 0 x 20 = 0 (6 Number of blocked chimneys 0 x 20 = 0 (6 Number of blocked chimneys 0 x 20 = 0 (6 Number of passive vents 0 x 10 = 30 (7 Number of storeys in the dwelling (ns) 0 x 40 = 0 (7 Number of storeys in the dwelling (ns) 0 0 0 (1 Supended wooden ground floor 0 0 0 (1 Number of storeys in the dwelling (ns) 0 0 (1 Supended wooden ground floor 0 0 (1 Number of storeys in the dwelling (ns) 0 0 (1 Supended wooden	1. Overall dwelling dimensions					
Total floor area TFA Bits (14) Bits (14)		Area(m²)	Av. Height(n	n)	Volume(m³)	
Dwelling volume 253,65 (5) 2. Ventilation Rate 2 2 0 (6) Chimneys/Flues 0 x 80 = 0 (6) Open chimneys 0 x 20 = 0 (6) Chimneys / flues attached to closed fire 0 x 10 = 0 (6) Flues attached to other heater 0 x 20 = 0 (6) Number of locked chimneys 0 x 20 = 0 (6) Number of locked chimneys 0 x 20 = 0 (6) Number of locked chimneys 0 x 20 = 0 (6) Number of passive vents 0 x 10 = 0 (7) Number of storeys in the dwelling (ns) 0 x 10 = 0 (7) Number of storeys in the dwelling (ns) 0 x 10 = 0 (7) Suspended wooden ground floor 0 0 11 12 0.12 0.12		84.55	(1a) x 3	(2a) =		(3a)
Chimneys/Flues0x80 =0(6Open chimneys0x20 =0(6Chimneys / flues attached to closed fire0x10 =0(6Flues attached to solid fuel boiler0x20 =0(6Flues attached to other heater0x35 =0(6Number of blocked chimneys0x20 =0(6Number of blocked chimneys0x20 =0(7Number of passive vents0x10 =0(7Number of flueless gas fires0x40 =0(7Number of storeys in the dwelling (ns)0x40 =0(7Number of storeys in the dwelling (ns)0.120.120.12(8Infiltration due to chimneys, flues, fans, PSVs, etc00(1Structural infiltration00(1Nu dditional infiltration00(1No draught lobby00(1Percentage of windows and doors draught proofed00(1Vindow infiltration00(1Air permeability value, AP50, (m³/h/m²)55(1Air permeability value, AP50, (m³/h/m²)00(1Number of sides on which dwelling is sheltered22(1Number of sides on which dwelling is sheltered0.370.37(1Number of sides on which dwelling is sheltered0.31(2 <t< td=""><td></td><td></td><td></td><td></td><td></td><td>(4) (5)</td></t<>						(4) (5)
Open chimneys0x20 =066Chimneys / flues attached to closed fire0x10 =066Flues attached to solid fuel boiler0x20 =066Flues attached to other heater0x35 =066Number of blocked chimneys0x20 =066Number of blocked chimneys0x20 =066Number of blocked chimneys0x20 =066Number of passive vents3x10 =077Number of flueless gas fires0x40 =077Number of storeys in the dwelling (ns)0x40 =066Infiltration00011 <td>2. Ventilation Rate</td> <td></td> <td></td> <td></td> <td></td> <td></td>	2. Ventilation Rate					
Chimneys / flues attached to closed fire0x10 =0(6)Flues attached to solid fuel boiler0x20 =0(6)Flues attached to other heater0x35 =0(6)Number of blocked chimneys0x20 =0(6)Number of intermittent extract fans3x10 =30(7)Number of passive vents0x10 =0(7)Number of flueless gas fires0x40 =0(7)Number of storeys in the dwelling (ns)0x40 =0(7)Number of storeys, flues, fans, PSVs, etc000(1)Additional infiltration00(1)(1)(1)(1)Suspended wooden ground floor00(1)<	Chimneys/Flues	0	x 80 =		0	(6a)
Flues attached to solid fuel boiler0x20 =0(6)Flues attached to other heater0x35 =0(6)Number of blocked chimneys0x20 =0(6)Number of intermittent extract fans3x10 =30(7)Number of passive vents0x10 =0(7)Number of flueless gas fires0x40 =0(7)Number of storeys in the dwelling (ns)0x40 =0(7)Number of storeys in the dwelling (ns)00(1)(1)Structural infiltration00(1)(1)Structural infiltration00(1)(1)Suspended wooden ground floor00(1)(1)Nunder of storeys and doors draught proofed00(1)Vindow infiltration00(1)(1)Number of sides on which dwelling is sheltered22(1)Air permeability value, AP50, (m³/h/m²)55(1)Air permeability value)0.370.37(1)Number of sides on which dwelling is sheltered22(1)Shelter factor0.31(2)(2)(1)Infiltration rate modified for monthly wind speed0.31(2)(3)	Open chimneys	0	x 20 =		0	(6b)
Flues attached to other heater 0 x 10 0 x 10 0 0 Number of blocked chimneys 0 x 20 = 0 66 Number of intermittent extract fans 3 x 10 = 0 (7 Number of passive vents 0 x 10 = 0 (7 Number of flueless gas fires 0 x 40 = 0 (7 Number of storeys in the dwelling (ns) 0 x 40 = 0 (7 Number of storeys in the dwelling (ns) 0 x 40 = 0 (7 Number of storeys in the dwelling (ns) 0 0.12 0.12 (8 0 0 (1 Structural infiltration 0 0 0 11 0 0 11 Suspended wooden ground floor 0 0 0 11 11 10 0 11 No draught lobby 0 0 0 11 11 11 11 11 11 11 <t< td=""><td>Chimneys / flues attached to closed fire</td><td>0</td><td>x 10 =</td><td></td><td>0</td><td>(6c)</td></t<>	Chimneys / flues attached to closed fire	0	x 10 =		0	(6c)
Number of blocked chimneys 0 x 30 0 (6) Number of blocked chimneys 0 x 20 = 0 (6) Number of intermittent extract fans 3 x 10 = 30 (7) Number of passive vents 0 x 10 = 0 (7) Number of flueless gas fires 0 x 40 = 0 (7) Number of storeys in the dwelling (ns) 0 x 40 = 0 (7) Number of storeys in the dwelling (ns) 0 0.12 0.12 (8) Infiltration 0 0 0 (1) Structural infiltration 0 0 (1) Suppended wooden ground floor 0 0 (1) No draught lobby 0 0 (1) Percentage of windows and doors draught proofed 0 0 (1) Window infiltration 0 0 (1) Air permeability value, AP4, (m³/h/m²) 0 0 (1) Air permeability value, AP4, (m³/h/m²) 0 (2) <t< td=""><td>Flues attached to solid fuel boiler</td><td>0</td><td>x 20 =</td><td></td><td>0</td><td>(6d)</td></t<>	Flues attached to solid fuel boiler	0	x 20 =		0	(6d)
Number of intermittent extract fans3x10 =30(7)Number of passive vents0x10 =0(7)Number of flueless gas fires0x40 =0(7)Number of storeys in the dwelling (ns)0.120.12(8)(8)(8)Infiltration due to chimneys, flues, fans, PSVs, etc00(9)(9)(1)Additional infiltration00(1)(1)(1)(1)Structural infiltration00(1)(1)(1)(1)(1)(1)Suspended wooden ground floor00(1)	Flues attached to other heater	0	x 35 =		0	(6e)
Number of passive vents0x1000(7)Number of flueless gas fires0x40 =0(7)Air changes per hourNumber of storeys in the dwelling (ns)0.120.12(8)Infiltration due to chimneys, flues, fans, PSVs, etc00(9)Additional infiltration00(1)Suspended wooden ground floor00(1)No draught lobby00(1)Percentage of windows and doors draught proofed00(1)Infiltration rate00(1)Air permeability value, AP50, (m³/h/m²)55(1)Air permeability value, AP4, (m³/h/m²)00(1)Number of sides on which dwelling is sheltered22(1)Shelter factor0.31(2)(3)(2)Infiltration rate modified for monthly wind speed0(3)(2)	Number of blocked chimneys	0	x 20 =		0	(6f)
Number of flueless gas fires0x40 =0(7)Number of storeys in the dwelling (ns)0.120.120.12(8)Infiltration due to chimneys, flues, fans, PSVs, etc00(9)Additional infiltration00(1)Structural infiltration00(1)Suspended wooden ground floor00(1)No draught lobby00(1)Percentage of windows and doors draught proofed00(1)Window infiltration00(1)Air permeability value, AP50, (m³/h/m²)55(1)Air permeability value, AP4, (m³/h/m²)0.370.37(1)Number of sides on which dwelling is sheltered22(1)Shelter factor0.85(2)(2)(1)Infiltration rate modified for monthly wind speed0.31(2)	Number of intermittent extract fans	3	x 10 =		30	(7a)
Air changes per hourNumber of storeys in the dwelling (ns)0.120.12(8)Infiltration due to chimneys, flues, fans, PSVs, etc00(9)Additional infiltration00(1)Structural infiltration00(1)Suspended wooden ground floor00(1)No draught lobby00(1)Percentage of windows and doors draught proofed00(1)Window infiltration00(1)Infiltration rate00(1)Air permeability value, AP50, (m³/h/m²)55(1)Air permeability value, AP4, (m³/h/m²)0.370.37(1)Number of sides on which dwelling is sheltered22(1)Shelter factor0.85(2)(2)(1)Infiltration rate modified for monthly wind speed0.31(2)(2)	Number of passive vents	0	x 10 =		0	(7b)
Number of storeys in the dwelling (ns)0.120.120.120Infiltration due to chimneys, flues, fans, PSVs, etc000(1)Additional infiltration000(1)Structural infiltration000(1)Suspended wooden ground floor000(1)No draught lobby000(1)Percentage of windows and doors draught proofed00(1)Window infiltration00(1)Infiltration rate00(1)Air permeability value, AP50, (m³/h/m²)55(1)Air permeability value, AP4, (m³/h/m²)0.370.37(1)Number of sides on which dwelling is sheltered22(1)Shelter factor0.85(2)(2)(3)(2)Infiltration rate incorporating shelter factor0.31(2)(2)Infiltration rate modified for monthly wind speed0(2)(3)(2)	Number of flueless gas fires	0	x 40 =		0	(7c)
Infiltration due to chimneys, flues, fans, PSVs, etc0009Additional infiltration000(1)Structural infiltration000(1)Suspended wooden ground floor000(1)No draught lobby000(1)Percentage of windows and doors draught proofed00(1)Window infiltration00(1)Infiltration rate00(1)Air permeability value, AP50, (m³/h/m²)55(1)Air permeability value, AP4, (m³/h/m²)00(1)Air permeability value)0.370.37(1)Number of sides on which dwelling is sheltered22(1)Shelter factor0.85(2)0.31(2)Infiltration rate modified for monthly wind speed00.31(2)			Air changes	per hour		
Additional infiltration00(1)Structural infiltration00(1)Suspended wooden ground floor00(1)No draught lobby00(1)Percentage of windows and doors draught proofed00(1)Window infiltration00(1)Infiltration rate00(1)Air permeability value, AP50, (m³/h/m²)55(1)Air permeability value, AP4, (m³/h/m²)00(1)Number of sides on which dwelling is sheltered22(1)Shelter factor0.85(2)Infiltration rate modified for monthly wind speed0.31(2)				0.12	0.12	(8)
Structural infiltration00(1Suspended wooden ground floor00(1No draught lobby00(1Percentage of windows and doors draught proofed00(1Window infiltration00(1Infiltration rate00(1Air permeability value, AP50, (m³/h/m²)55(1Air permeability value, AP4, (m³/h/m²)00(1Number of sides on which dwelling is sheltered22(1Shelter factor0.370.37(1Infiltration rate incorporating shelter factor0.31(2Infiltration rate modified for monthly wind speed001						(9)
Suspended wooden ground floor0001No draught lobby0001Percentage of windows and doors draught proofed0001Window infiltration0001Infiltration rate0001Air permeability value, AP50, (m³/h/m²)551Air permeability value, AP4, (m³/h/m²)001Air permeability value)0.370.371Number of sides on which dwelling is sheltered221Shelter factor0.85(2Infiltration rate incorporating shelter factor0.31(2Infiltration rate modified for monthly wind speed001						(10)
No draught lobby00(1)Percentage of windows and doors draught proofed00(1)Window infiltration00(1)Infiltration rate00(1)Air permeability value, AP50, (m³/h/m²)55(1)Air permeability value, AP4, (m³/h/m²)00(1)Air permeability value, AP4, (m³/h/m²)0.370.37(1)Number of sides on which dwelling is sheltered22(1)Shelter factor0.85(2)Infiltration rate incorporating shelter factor0.31(2)Infiltration rate modified for monthly wind speed000						(11) (12)
Percentage of windows and doors draught proofed00(1Window infiltration00(1Infiltration rate00(1Air permeability value, AP50, (m³/h/m²)55(1Air permeability value, AP4, (m³/h/m²)00(1Air permeability value)0.370.37(1Number of sides on which dwelling is sheltered22(1Shelter factor0.85(2Infiltration rate incorporating shelter factor0.31(2Infiltration rate modified for monthly wind speed11						(12)
Window infiltration00(1Infiltration rate00(1Air permeability value, AP50, (m³/h/m²)55(1Air permeability value, AP4, (m³/h/m²)00(1Air permeability value)0.370.37(1Number of sides on which dwelling is sheltered22(1Shelter factor0.85(2Infiltration rate incorporating shelter factor0.31(2Infiltration rate modified for monthly wind speed11	Percentage of windows and doors draught proofed					(14)
Air permeability value, AP50, (m³/h/m²)55(1Air permeability value, AP4, (m³/h/m²)00(1Air permeability value)0.370.37(1Number of sides on which dwelling is sheltered22(1Shelter factor0.85(2Infiltration rate incorporating shelter factor0.31(2Infiltration rate modified for monthly wind speed				0	0	(15)
Air permeability value, AP4, (m³/h/m²)00(1Air permeability value)0.370.37(1Number of sides on which dwelling is sheltered22(1Shelter factor0.85(2Infiltration rate incorporating shelter factor0.31(2Infiltration rate modified for monthly wind speed000						(16)
Air permeability value)0.370.37(1Number of sides on which dwelling is sheltered22(1Shelter factor22(1Infiltration rate incorporating shelter factor0.85(2Infiltration rate modified for monthly wind speed0.31(2						(17)
Number of sides on which dwelling is sheltered222(1Shelter factor0.85(2Infiltration rate incorporating shelter factor0.31(2Infiltration rate modified for monthly wind speed0.31(2						(17a
Shelter factor0.85(2Infiltration rate incorporating shelter factor0.31(2Infiltration rate modified for monthly wind speed(2						(18) (19)
Infiltration rate incorporating shelter factor 0.31 (2) Infiltration rate modified for monthly wind speed (2)				2		(20)
Infiltration rate modified for monthly wind speed						(20)
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Total (2					0.31	(44)
	Jan Feb Mar Apr May Jun	Jul Aug	Sep Oct N	lov Dec	Total	(22)







Monthly average wind speed from Table U2

Wind Fac	5.1 ctor	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7	52.5	(22)
Adjusted	1.28 I infiltrati	1.25 on rate (a	1.23 allowing f	1.1 for shelte	1.08 r and wir	0.95 nd speed)	0.95	0.93	1	1.08	1.13	1.18	13.13	(22a)
Calculate	0.4 e effective	0.39 e air char	0.38 nge rate f	0.34 or the ap	0.34 plicable o	0.3 case:	0.3	0.29	0.31	0.34	0.35	0.37	4.11	(22b)
													0	(23a)
													0	(23b)
													0	(23c)
a) If bala	nced mee	chanical v	entilatio/	n with he	eat recove	ery (MVH	IR)							
	0	0	0	0	0	0	0	0	0	0	0	0		(24a)
b) If bala	nced me	chanical v	ventilatio	n withou	t heat ree	covery (N	1V)							
	0	0	0	0	0	0	0	0	0	0	0	0		(24b)
c) If who	le house	extract v	entilatior	i or positi	ive input		on from c	outside						
ما) الأسمعان	0	0	0 whale he	0	0	0	0	0	0	0	0	0		(24c)
d) ir natt	ural ventil			-	-									
Effective	0.58 air chan	0.58 ge rate	0.57	0.56	0.56	0.54	0.54	0.54	0.55	0.56	0.56	0.57		(24d)
Tffe etites	0.58	0.58	0.57	0.56	0.56	0.54	0.54	0.54	0.55	0.56	0.56	0.57		(25)
Effective	air chan	ge rate fr	OIN PCDB											
	0.58	0.58	0.57	0.56	0.56	0.54	0.54	0.54	0.55	0.56	0.56	0.57		(25)

3. Heat losses and heat loss parameter

Items in the table below are to be expanded as necessary to allow	for all different types of element e.g. 4 wall types.	The k -value
ELEMENT	AXU	AXk

	(W/K)	kJ/K
Doors	2.1	(26)
Windows	17.83	(27)
Roof window	0	(27a)
Basement floor	0	0 (28)
Ground floor	0	0 (28a)
Exposed floor	9.3	6341.25 (28b)
Basement wall	0	0 (29)
External wall	8.76	12807.9 (29a)
Roof	0	0 (30)
Total area of external elements ∑A, m ²		169.63 (31)
Party Wall	0	9745.2 (32)
Party floor		0 (32a)
Party ceiling		0 (32b)





Internal wall **	0	(33c)
Internal floor	0	(32d)
Internal ceiling floor	0	(32e)
Fabric heat loss, W/K = \sum (A x U)	37.99	(33)
Heat capacity $Cm = \sum (A \times k)$	28894.35	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m ² K	250	(35)
Linear Thermal bridges: Σ (L x Ψ) calculated using Appendix K	22.66	(36)
Point Thermal bridges: $\Sigma \chi$ (W/K) if significant point thermal bridge present and values available	22.66	(36a)
Total fabric heat loss H = $\Sigma(A \times U) + \Sigma(L \times \Psi) + \Sigma\chi$	60.65	(37)
Ventilation heat loss calculated monthly		
48.52 48.26 48.01 46.81 46.59 45.55 45.55 45.36 45.95 46.59 47.04 47.51 Heat transfer coefficient, W/K		(38)
109.17 108.91 108.66 107.47 107.24 106.21 106.21 106.01 106.61 107.24 107.7 108.17 Heat loss parameter (HLP), W/m ² K		(39)
1.29 1.29 1.29 1.27 1.27 1.26 1.26 1.25 1.26 1.27 1.27 1.28 Number of days in month (Table 1a)		(40)
31 28 31 30 31 31 30 31 30 31		(41)

4. Water heating energy requirement

Assumed assumency N							()
Assumed occupancy, N	ب المعدم مرد	I)				2.54	(42)
Hot water usage in litres per day for mixer showers, Vd, shower (from A	Appendix	1)					
91.94 90.56 88.55 84.69 81.85 78.68 76.88	78.88	81.07	84.47	88.41	91.59		(42a)
Hot water usage in litres per day for baths, Vd, bath (from Appendix J)							
30.4 29.95 29.31 28.14 27.26 26.29 25.76 Hot water usage in litres per day for other uses, Vd,other (from Appen	26.39 dix J)	27.08	28.12	29.32	30.3		(42b)
42.82 41.26 39.71 38.15 36.59 35.03 35.03	36.59	38.15	39.71	41.26	42.82		(42c)
Annual average hot water usage in litres per day Vd,average (from App		50.15	55171	11.20	12.02	152.12	(43)
Hot water usage in litres per day for each month $Vd,m = (42a) + (42b) + (42b)$	+ (42c)						(-)
165.16 161.77 157.56 150.98 145.7 140 137.67	141.86	146.3	152.3	158.99	164.7	1823	(44)
Energy content of hot water used = 4.18 x Vd,m x nm x DTm / 3600 kW	/h/month	(from Ap	opendix J)			
261.57 230.36 242.17 206.69 196.14 172.15 166.51	175.65	180.4	206.67	226.51	257.89	2522.7	(45)
Distribution loss (46) = 0.15 x (45)							
39.24 34.55 36.33 31 29.42 25.82 24.98	26.35	27.06	31	33.98	38.68		(46)
Storage volume (litres) including any solar or WWHRS storage within sa	ame vesse	el				0	(47)
Water storage loss (or HIU loss)							
a) If manufacturer's declared loss factor is known (kWh/day):						0	(48)
Temperature factor from Table 2b						0	(49)
Energy lost from water storage, kWh/day (48) x (49) =						0	(50)
b) If manufacturer's declared loss factor is not known :							
Hot water storage loss factor from Table 2 (kWh/litre/day)						0.14	(51)





Volume factor from Table 2a Temperature factor from Table 2b Energy lost from water storage, kWh/day	0 0 0	(52) (53) (54)
Enter (50) or (54) in (55) Water storage (or HIU) loss calculated for each month (56) = (55) × (41)	0	(55)
0 0 0 0 0 0 0 0 0 0		(56)
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	neat netwo	(57) orks)
128.38 115.95 128.38 124.24 128.38 41.92 43.31 43.31 41.92 128.38 124.24 128.38 Combi loss for each month from Table 3a, 3b or 3c (enter 0 if not a combi boiler)	leat netwo	(59)
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		(61)
389.95 346.31 370.55 330.92 324.52 214.07 209.82 218.97 222.31 335.05 350.74 386.26 CWWHRS DHW input calculated using Appendix G (negative quantity) (enter 0 if no WWHRS contribution to water heat	3699.47 ting)	7 (62)
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		(63a)
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		(63b)
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		(63c)
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		(63d)
389.95 346.31 370.55 330.92 324.52 214.07 209.82 218.97 222.31 335.05 350.74 386.26 Output from water heater for each month, kWh/month (64) = (62) + (63a) + (63b) + (63c) + (63d)	3699.47	7 (64)
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		(64a)
189.67 169.36 183.22 168.11 167.92 90.77 90.01 93.06 93.52 171.42 174.7 188.45 include (57) m in calculation of (65) m only if hot water store is in the dwelling or hot water is from heat network		(65)

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

Metabolic gains (Table 5), watts

		152.61							152.61	152.61	152.61	152.61	(66)
Lighting	gains (cal	culated in	n Appeno	lix L, equ	ation L12	or L12a)	, also see	e Table 5					
Appliance	35.82 ces gains (31.81								29.59	34.53	36.81	(67)
Аррпанс	Les gains (calculate	u in App	enuix L, e	quation		0 <i>a),</i> also	see lable	5				
	341.32	344.87	335.94	316.94	292.95	270.41	255.35	251.81	260.73	279.74	303.72	326.26	(68)





Cooking gains (calculated in Appendix L, equation L18 or L18a), also see Table 5

52.8 Pumps and fans	52.8 gains (Tab	52.8 ole 5a)	52.8	52.8	52.8	52.8	52.8	52.8	52.8	52.8	52.8	(69)
3 Losses e.g. evap	3 oration (n	3 egative va	3 alues) (Ta	3 ble 5	0	0	0	0	3	3	3	(70)
-101.7 Water heating g	4 -101.74 ains (Table		-101.74	-101.74	-101.74	-101.74	-101.74	-101.74	-101.74	-101.74	-101.74	(71)
254.94 Total internal ga		246.27	233.49	225.7	126.07	120.99	125.07	129.88	230.4	242.64	253.29	(72)
738.70	5 735.37	714.76	676.69	639.97	512.52	493.37	497.92	517.59	646.4	687.57	723.05	(73)

6. Solar gains

Solar gains in watts, calculated for each month												
67.33 Total gains – inte		220.63 solar (wa		449.46	474.5	445.69	362.58	262.61	155.59	83.53	55.76	
806.09	865.9	935.38	1020.53	1089.43	8 987.02	939.06	860.5	780.21	801.99	771.1	778.8	

7. Mean internal temperature (heating season)

Temper	ature dur	ing heati	ng perioo	ds in the l	iving are	a from Ta	able 9, Th	1 (°C)					21	(85)
Utilisati	on factor	for gains	for living	g area, 🛙 1	.,m (see T	able 9a)								
	0.99	0.98	0.96	0.91	0.78	0.65	0.49	0.55	0.8	0.93	0.98	0.99		(86)
Mean internal temperature in living area T1 (follow steps 3 and 4 in Table 9c)														
	19.73	19.88	20.16	20.53	20.82	20.95	20.99	20.98	20.86	20.54	20.08	19.7		(87)
Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)														
	19.85	19.85	19.85	19.86	19.87	19.88	19.88	19.88	19.87	19.87	19.86	19.86		(88)
Roof Utilisation factor for gains for rest of dwelling, ☑2,m (see Table 9a)														
	0.98	0.97	0.95	0.88	0.72	0.55	0.37	0.42	0.71	0.9	0.97	0.98		(89)
Roof					Me	ean inter	nal tempe	erature ir	n the rest	of dwell	ing T2			
	18.41	18.6	18.96	19.41	19.73	19.85	19.87	19.87	19.78	19.43	18.86	18.38		(90)
Living a	rea fractio	on											0.44	(91)
Mean ir	nternal te	mperatu	re (for the	e whole o	dwelling)									
	19	19.17	19.49	19.91	20.21	20.33	20.37	20.36	20.26	19.92	19.4	18.97		(92)
Adjuste	d mean ir	nternal te	emperatu	re:										
	19	19.17	19.49	19.91	20.21	20.33	20.37	20.36	20.26	19.92	19.4	18.97		(93)

8. Space heating requirement



Page 5

(83)

(84)



Utilisation factor for gains,

0.98 0.97 0.94 0.88 0.74 0.59 0.42 0.48 0.75 0.9 0.96 0.98 (94) 788.63 838.76 882.65 895.73 809.95 583.1 395.79 412.52 582.07 722.05 743.56 764.09 (95) Monthly average external temperature from Table UT 14.6 16.4 14.1 10.6 7.1 4.2 (96) 4.3 4.9 6.5 8.9 11.7 14.6 16.4 14.1 10.6 7.1 4.2 (96) 1604.3 1554.13 1141.63 1183.1 912.86 609.06 400.04 420.08 656.48 999.73 1324.8 1597.45 (97) Space heating requirement for each 106.4 315.4 3143.5 206.91 76.5 0 0 0 0 (98) Space heating requirement for each 176.57 0 0 0 0 0 0 (98) Space heating requirement for each 176.57 0 0 0 0 0 0 0 </th <th></th> <th></th> <th>-</th> <th></th>			-												
788.63 838.76 882.65 895.73 809.95 583.1 395.79 412.52 582.07 722.05 743.56 764.09 (95) Monthly average external temperature from Table U1 11.7 14.6 16.6 16.4 14.1 10.6 7.1 4.2 (96) Heat loss rate for mean internal temperature 1604.33 1554.13 1183.1 912.86 609.06 400.04 420.08 656.48 999.73 1324.8 1597.45 (97) Space heating requirement for each month 765.77 0 0 0 0 0 0 (98a) Solar space heating calculated using Appendix H (negative quantity) 0 0 0 0 0 (98b) Space heating requirement for each month after solar contribution 0 0 0 0 0 (98b) 606.88 480.73 393.57 206.91 76.57 0 0 0 0 0 0 (98b) Space heating requirement for each month after solar contribution 0 0 0 0 0 0 0 0 0 <td>Useful ø</td> <td></td> <td></td> <td>0.94</td> <td>0.88</td> <td>0.74</td> <td>0.59</td> <td>0.42</td> <td>0.48</td> <td>0.75</td> <td>0.9</td> <td>0.96</td> <td>0.98</td> <td></td> <td>(94)</td>	Useful ø			0.94	0.88	0.74	0.59	0.42	0.48	0.75	0.9	0.96	0.98		(94)
4.3 4.9 6.5 8.9 11.7 14.6 16.6 16.4 14.1 10.6 7.1 4.2 (96) Heat loss rate for mean internal temperature 1604.33 1554.13 1411.63 1183.1 912.86 609.06 400.04 420.08 656.48 999.73 1324.8 1597.45 (97) Space heating requirement for each month 912.86 609.06 400.04 420.08 656.48 999.73 1324.8 1597.45 (97) Space heating requirement for each month 76.57 0 0 0 206.6 418.49 620.02 (98a) Solar space heating calculated using Appendix H (negative quantity) 0 0 0 0 0 0 (98b) Space heating requirement for each month after solar contribution 606.88 480.73 393.57 206.91 76.57 0 0 0 0 0 0 0 (98c) Space heating requirement for each month after solar contribution 0 0 0 0 0 0 0 0	Ū	788.63	838.76					395.79	412.52	582.07	722.05	743.56	764.09		(95)
Heat loss rate for mean internal temperature 1604.33 1554.13 1411.63 1183.1 912.86 609.06 400.04 420.08 656.48 999.73 1324.8 1597.45 (97) Space heating requirement for each month 606.88 480.73 393.57 206.91 76.57 0 0 0 0 0 206.6 418.49 620.02 (98a) Solar space heating calculated using Appendix H (negative quantity) 0 0 0 0 0 0 (97) Space heating requirement for each month 0 0 0 0 0 (98a) Solar space heating calculated using Appendix H (negative quantity) 0 0 0 0 (98b) Space heating requirement for each month after solar contribution 606.88 480.73 393.57 206.91 76.57 0 0 0 0 206.6 418.49 620.02 (98c) 606.88 480.73 393.57 206.91 76.57 0 0 0 0 206.6 418.49 620.02 (98c)	Monthly average external temperature from Table U1														
1604.33 1554.13 1411.63 1183.1 912.86 609.06 400.04 420.08 656.48 999.73 1324.8 1597.45 (97) Space heating requirement for each month 0 0 0 0 0 0 0 0 0 0 0 0 0 0 999.73 1324.8 1597.45 (97) Space heating requirement for each month 76.57 0 0 0 206.6 418.49 620.02 (98a) Solar space heating calculated using Appendix H (negative quantity) 0 0 0 0 0 0 (97) (98b) Space heating requirement for each month 160.58 480.73 393.57 206.91 76.57 0 0 0 0 0 0 (98c) Space heating requirement is built (m2/mark 76.57 0 0 0 206.6 418.49 620.02 (98c) Space heating requirement is built (m2/mark 76.57 0 0 0 206.6 418.49 620.02 (98c) (98c) (98c)	Heat los						14.6	16.6	16.4	14.1	10.6	7.1	4.2		(96)
Space heating requirement for each month 606.88 480.73 393.57 206.91 76.57 0 0 0 0 206.6 418.49 620.02 (98a) Solar space heating calculated using Appendix H (negative quantity) 0 0 0 0 0 0 0 0 0 (98a) Space heating requirement for each month after solar contribution 0 0 0 0 0 0 (98b) Space heating requirement for each month after solar contribution 606.88 480.73 393.57 206.91 76.57 0 0 0 0 0 206.6 418.49 620.02 (98c) (98c)	neat ios	s rate ioi	mean mu	emarten	iperature	2									
606.88 480.73 393.57 206.91 76.57 0 0 0 206.6 418.49 620.02 (98a) Solar space heating calculated using Appendix H (negative quantity) 0 0 0 0 0 0 0 (98a) Space heating requirement for each month after solar contribution 0 0 0 0 0 0 (98b) 606.88 480.73 393.57 206.91 76.57 0 0 0 206.6 418.49 620.02 (98b)						912.86	609.06	400.04	420.08	656.48	999.73	1324.8	1597.45		(97)
Solar space heating calculated using Appendix H (negative quantity) 0 (98b) Space heating requirement for each month after solar contribution 606.88 480.73 393.57 206.91 76.57 0 0 0 206.6 418.49 620.02 (98c)	Space heating requirement for each month														
0 (98b) Space heating requirement for each month after solar contribution 606.88 480.73 393.57 206.91 76.57 0 0 0 0 206.6 418.49 620.02 (98c) Constraints an unities that here?							-	•	0	0	206.6	418.49	620.02		(98a)
Space heating requirement for each month after solar contribution 606.88 480.73 393.57 206.91 76.57 0 0 0 206.6 418.49 620.02 (98c)	Solar spa	ace heatir	ng calcula	ted using	g Append	ix H (nega	ative qua	ntity)							
606.88 480.73 393.57 206.91 76.57 0 0 0 0 206.6 418.49 620.02 (98c)		-	-	-	•	-	-	-	0	0	0	0	0		(98b)
	Space he	eating req	uirement	t for each	i month a	fter sola	r contribu	ution							
	Space he					76.57	0	0	0	0	206.6	418.49	620.02	35.6	

8c. Sp	8c. Space Cooling requirement													
Heat los	s rate,													
Utilisatic	0 on factor	0 for loss	0	0	0	0	0	0	0	0	0	0		(100)
Useful lo	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 (101) Useful loss, mLm (watts)													
Gains	0	0	0	0	0	0	0	0	0	0	0	0		(102)
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 (103)												(103) (104)		
Cooled f	0 raction tency fac	0 tor	0	0	0	0	0	0	0	0	0	0	0	(104) (105)
Space co	0 ooling req	0 Juiremer	0 It for mor	0 nth	0	0	0	0 0	0	0	0	0	0	(106)
Space co	0 ooling req	0 Juiremer	0 it in kWh/	0 /m²/year	0	0	0	0	0	0	0	0	0	(107) (108)
8f. Space heating requirement														

Fabric Energy Efficiency,

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



0

(109)

SAP WORKSHEET

0



Fraction of space heat from secondary/supplementary system,0(201)Fraction of space heat from main system(s),1(202)Fraction of main heating from main system 2,0(203)Fraction of total space heat from main system 1,1(204)Fraction of total space heat from main system 2,0(205)Efficiency of main space heating system 1 (in %),249.9(206)													
	249.9	(206)											
Efficiency of main space heating system 2 (in %),	0	(207)											
Efficiency of secondary/supplementary heating system, %,	0	(208)											
Cooling System Seasonal Energy Efficiency Ratio,0(209)Space heating requirement (calculated above),0(209)													
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0	(210)											
Space heating fuel (main heating system 1), kWh/month 0													
242.85 192.37 157.49 82.8 30.64 0 0 0 82.67 167.46 248.11 Space heating fuel (main heating system 2), kWh/month 0	0	(211)											
	0	(213)											
Space heating fuel (secondary), kWh/month 0	0	(213)											
	0	(215)											
Output from water heater), 0	175.1	(216)											
Efficiency of water heater		()											
175.1 175.1 175.1 175.1 175.1 175.1 175.1 175.1 175.1 175.1 175.1 175.1 175.1 175.1 175.1 175.1		(217)											
222.7 197.78 211.62 188.99 185.34 122.25 119.83 125.05 126.96 191.35 200.31 220.6	2112.77	(219)											
Space Cooling													
0 0 0 0 0 0 0 0 0 0 0		(221)											
Annual totals kWh/year kWh/year													
Space heating fuel used, main system 1	1204.38	(211)											
Space heating fuel used, main system 2	0	(213)											
Space heating fuel used, secondary	0	(215)											
Water heating fuel used	2112.77	(219)											
Electricity for instantaneous electric shower(s)	0	(64a)											
Space cooling fuel used	0	(221)											
Electricity for pumps, fans and electric keep-hot													
Mechanical vent fans - balanced, extract or positive input from outside 0 0	0	(230a)											
warm air heating system fans	0	(230b)											
Heating circulation pump or water pump within warm air heating unit Oil boiler auxiliary (oil pump, flue fan, etc; excludes circulation pump)	0	(230c)											
	0	(230d)											
Gas boiler auxiliary (flue fan, etc; excludes circulation pump)0(230e)Maintaining electric keep-hot facility for gas combi boiler0(230f)													
Maintaining electric keep-hot facility for gas combi boiler0(230f)Pump for solar water heating0(230g)													
Pump for storage WWHRS	0	(230g) (230h)											
Total electricity for the above	0	(2301)											
Electricity for lighting	253.03	(231)											
, , , , , , , , , , , , , , , , , , , ,	200.00	(232)											





	Energy saving/generation technologies (Appendices M, N) - Energy used in dwelling Electricity generated by PVs (Appendix M) (negative quantity)												
0 Electricity g	0 generated by	0 y wind tur	0 bines (Ap	0 opendix N	0 /i) (negat i	0 ive quant	0 ity)	0	0	0	0	0	(233a)
0 Electricity g	0 generated by	0 y hydro-el	0 ectric ger	0 nerators	0	0	0	0	0	0	0	0	(234a)
0 Electricity נ	0 used or net e	0 electricity	0 generate	0 d by mici	0 ro-CHP	0	0	0	0	0	0	0	(235a)
	0 ing/generati generated by						0 exported	0	0	0	0	0	(235c)
0 Electricity g	0 generated by	0 y wind tur	0 bines (Ap	0 opendix N	0 A) (negati	0 ive quant	0 ity)	0	0	0	0	0	(233b)
0 Electricity g	0 generated by	0 y hydro-el	0 ectric ger	0 nerators	0	0	0	0	0	0	0	0	(234b)
0 Electricity נ	0 used or net e	0 electricity	0 generate	0 d by mici	0 ro-CHP	0	0	0	0	0	0	0	(235b)
	0) items: ann	•.		0	0	0	0	0	0	0	0	0	(235d)
energy save		·					Fue	91	kWh/yea	r		0 0 3570.19	(236a) (237a)

10a. Fuel costs – Individual heating systems including micro-CHP

Fuel required	kWh/year	Fuel price	Fuel cost £/yea	ar
Space heating - main system 1 (electric off-peak tariff				
High-rate fraction (Table 12a, or Appendix F for electric CPSU)	0		198.6	(240a)
Low-rate fraction	0		198.6	(240b)
High-rate cost	0		0	(240c)
Low-rate cost	0		0	(240d)
Space heating - main system 1 cost (other fuel)	0		0	(240e)
Space heating - main system 2 (electric off-peak tariff				
High-rate fraction (Table 12a, or Appendix F for electric CPSU)	0		198.6	(241a)
Low-rate fraction	0		198.6	(241b)
High-rate cost	0		0	(241c)
Low-rate cost	0		0	(241d)
Space heating - main system 2 cost (other fuel)	0		0	(241e)
Space heating - secondary (electric off-peak tariff)				
High-rate fraction (Table 12a, or Appendix F for electric CPSU)	0		198.6	(242a)





Low-rate fraction	0		198.6	(242b)
High-rate cost	0		0	(242c)
Low-rate cost	0		0	(242d)
Space heating - secondary cost (other fuel)	0		0	(242e)
Water heating (electric off-peak tariff)				
High-rate fraction (Table 12a, or Appendix F for electric CPSU)	0		0	(243)
Low-rate fraction	0		0	(242b)
High-rate cost	0		0	(242c)
Low-rate cost	0		0	(242d)
Water heating cost (other fuel)	0		348.4	(247)
(for a DHW-only heat network use (342a) or (342b) instead of (247)				
Energy For instantaneous electric shower(s)	0		0	(247a)
Space cooling	0		0	(248)
Pumps, fans And electric keep-hot	0		0	(249)
Energy For lighting	0		41.73	(250)
Additional standing charges	0		0	(251)
Energy saving/generation technologies	0		0	(252)
Appendix Q, <item 1="" description=""></item>	Fuel	kWh/year		
energy saved Or generated	0		0	(253)
energy used	0		0	(254)
Total energy cost	0		588.72	(255)
11a. SAP rating – Individual heating systems including micro-CHP				
Energy cost deflator	0		0	(256)
Energy cost factor (ECF)	0		0	(257)
SAP rating	0		0	(258)

11a. SAP rating – Individual heating systems including micro-CHP		
Energy cost deflator	0.36	(256)
Energy cost factor (ECF)	1.64	(257)
SAP rating	73.48	(258)
12a. CO2 emissions – Individual heating systems including micro-CHP		

Emissions Energy **Emission factor** KWh/year kg kg CO2/year Space heating - main system 1 187.31 (261) Space heating - main system 2 0 (262) Space heating - secondary 0 (263) Energy for water heating 301.51 (264) Energy for instantaneous electric shower(s) 0 (264a)





Space and water heating		0	(265)
Space cooling		0	(266)
Electricity for pumps, fans and electric keep		0	(267)
Electricity for lighting		36.52	(268)
energy saved or generated	0	0	(269b)
Appendix Q items			
energy saved	0	0	
energy used	0	0	
energy saved	0	0	(270b)
energy used		0	(271b)
Total CO2, kg/year		525.34	(272)
Dwelling CO2 Emission Rate		6.21	(273)
El rating		95	(274)

13a. Primary Energy – Individual heating systems including micro-CHP

	Energy Emission factor	Emissionsr
	KWh/year kg	kg CO2/year
Space heating - main system 1		1897.88 (275)
Space heating - main system 2		0 (276)
Space heating - secondary		0 (277)
Energy for water heating		3227.89 (278)
Energy for instantaneous electric shower(s)		0 (278a)
Space and water heating		0 (279)
Space cooling		0 (280)
Electricity for pumps, fans and electric keep		0 (281)
Electricity for lighting		388.11 (282)
energy saved or generated	0	0
Appendix Q items		
energy saved	0	0
energy used	0	0
energy saved	0	0 (284b)
energy used		0 (285b)
Total PE, kWh/year		5513.88 (286)
Dwelling PE Rate		65.21 (287)







Dwelling Reference: Dwelling Type: EN5 5SU

Unit 02 Existing Dwelling

1. Overall dwelling dimensions					
	Area(m²)	Av. Height(r	n)	Volume(m³)	
Ground Floor Total floor area TFA Dwelling volume	61.3	(1a) x 3	(2a) =	183.9 61.3 183.9	(3a) (4) (5)
2. Ventilation Rate					
Chimneys/Flues	0	x 80 =		0	(6a)
Open chimneys	0	x 20 =		0	(6b)
Chimneys / flues attached to closed fire	0	x 10 =		0	(6c)
Flues attached to solid fuel boiler	0	x 20 =		0	(6d)
Flues attached to other heater	0	x 35 =		0	(6e)
Number of blocked chimneys	0	x 20 =		0	(6f)
Number of intermittent extract fans	3	x 10 =		30	(7a)
Number of passive vents	0	x 10 =		0	(7b)
Number of flueless gas fires	0	x 40 = Air changes	per hour	0	(7c)
		All changes	per nour		
Number of storeys in the dwelling (ns)			0.16	0.16	(8)
Infiltration due to chimneys, flues, fans, PSVs, etc			0	0	(9)
Additional infiltration			0	0	(10)
Structural infiltration Suspended wooden ground floor			0	0	(11)
No draught lobby			0 0	0 0	(12) (13)
Percentage of windows and doors draught proofed			0	0	(13)
Window infiltration			0	0	(15)
Infiltration rate			0	0	(16)
Air permeability value, AP50, $(m^3/h/m^2)$			5	5	(17)
Air permeability value, AP4, (m³/h/m²)			0	0	(17a)
Air permeability value) Number of sides on which dwelling is sheltered			0.41	0.41	(18)
Shelter factor			2	2 0.85	(19) (20)
Infiltration rate incorporating shelter factor				0.35	(20)
Infiltration rate modified for monthly wind speed				0.55	(41)
Jan Feb Mar Apr May Jun	Jul Aug	Sep Oct M	Nov Dec	Total	(22)







Monthly average wind speed from Table U2

Wind Fa	5.1 ctor	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7	52.5	(22)
Adjustec	1.28 d infiltrati	1.25 ion rate (1.23 allowing	1.1 for shelte	1.08 er and wi	0.95 nd speed	0.95)	0.93	1	1.08	1.13	1.18	13.13	(22a)
Calculate	0.45 e effectiv	0.44 e air chai	0.43 nge rate f	0.39 for the ap	0.38 oplicable	0.33 case:	0.33	0.32	0.35	0.38	0.4	0.41	4.61	(22b)
													0	(23a)
													0	(23b)
													0	(23c)
a) If balanced mechanical ventilation with heat recovery (MVHR)														
	0	0	0	0	0	0	0	0	0	0	0	0		(24a)
b) If bala	anced me	chanical	ventilatio	on withou	it heat re	covery (I	∕IV)							
	0	0	0	0	0	0	0	0	0	0	0	0		(24b)
c) If who	ole house	extract v	entilatio	n or posit	ive input	ventilati	on from	outside						
	0	0	0	0.	.0	0	0	0	0	0	0	0		(24c)
d) if nati	ural venti			-	-									
	0.6	0.6	0.59	0.57	0.57	0.56	0.56	0.55	0.56	0.57	0.58	0.59		(24d)
Effective	e air chan	-												()
Effoctive	0.6	0.6	0.59	0.57	0.57	0.56	0.56	0.55	0.56	0.57	0.58	0.59		(25)
enective	e air chan	-												()
	0.6	0.6	0.59	0.57	0.57	0.56	0.56	0.55	0.56	0.57	0.58	0.59		(25)

3. Heat losses and heat loss parameter

ELEMENT	A X U (W/K)	A X k kJ/K	
Doors	2.1	(26)	
Windows	7.89	(27)	
Roof window	0	(27a))
Basement floor	0	0 (28)	
Ground floor	0	0 (28a))
Exposed floor	6.74	4597.5 (28b))
Basement wall	0	0 (29)	
External wall	7.35	10742.6 (29a))
Deef			

Roof	0	0	(30)
Total area of external elements ∑A, m ²		126.83	(31)
Party Wall	0	9250.2	(32)
Party floor		0	(32a)
Party ceiling		0	(32b)





Internal wall	**											0	(33c)
Internal floor												0	(32d)
Internal ceili	g floor											0	(32e)
Fabric heat lo	ss, W/K = ∑	(A x U)										24.08	(33)
Heat capacity	Cm = ∑(A x	k)										24590.3	(34)
Thermal mas	s parameter	(TMP = C	m ÷ TFA)	in kJ/m²l	<							250	(35)
Linear Therm	al bridges: ∑	<u>(</u> (L x Ψ) ca	alculated	using Ap	pendix K							16.29	(36)
Point Therma	l bridges: ∑	χ (W/K) if	significan	t point tl	nermal bi	idge pres	sent and	values av	ailable			16.29	(36a)
Total fabric h	eat loss H =	∑(A × U) +	-∑(L×Ψ)	+∑χ								40.37	(37)
Ventilation h	eat loss calc	ulated mo	onthly										
36.		35.96	34.87	34.67	33.72	33.72	33.55	34.09	34.67	35.08	35.51		(38)
Heat transfe	coemcient,	VV/K											
76. Heat loss par		76.33	75.25	75.04	74.09	74.09	73.92	74.46	75.04	75.45	75.88		(39)
•				4.00					4.00	4.99			(40)
1.2 Number of d		1.25 (Table 1:	1.23	1.22	1.21	1.21	1.21	1.21	1.22	1.23	1.24		(40)
				24		24			24		24		(41)
31	28	31	30	31	30	31	31	30	31	30	31		(41)

4. Water heating energy requirement

Assumed occupancy, N	2.02	(42)
Hot water usage in litres per day for mixer showers, Vd, shower (from Appendix J)		
79.83 78.63 76.88 73.54 71.07 68.31 66.75 68.49 70.39 73.34 76.76 79.52		(42a)
Hot water usage in litres per day for baths, Vd,bath (from Appendix J)		
26.41 26.02 25.47 24.45 23.68 22.84 22.38 22.93 23.53 24.43 25.47 26.32		(42b)
Hot water usage in litres per day for other uses, Vd,other (from Appendix J)		
37.16 35.8 34.45 33.1 31.75 30.4 30.4 31.75 33.1 34.45 35.8 37.16		(42c)
Annual average hot water usage in litres per day Vd, average (from Appendix J)	132.07	(43)
Hot water usage in litres per day for each month Vd,m = (42a) + (42b) + (42c)		
143.39 140.45 136.8 131.09 126.5 121.55 119.53 123.17 127.02 132.23 138.04 143	1582.77	(44)
Energy content of hot water used = 4.18 x Vd,m x nm x DTm / 3600 kWh/month (from Appendix J)		
227.1 200 210.26 179.45 170.3 149.46 144.56 152.51 156.63 179.43 196.66 223.9	2190.26	6 (45)
Distribution loss (46) = 0.15 x (45)		
34.07 30 31.54 26.92 25.54 22.42 21.68 22.88 23.49 26.91 29.5 33.59		(46)
Storage volume (litres) including any solar or WWHRS storage within same vessel	0	(47)
Water storage loss (or HIU loss)		(40)
a) If manufacturer's declared loss factor is known (kWh/day): Temperature factor from Table 2b	0	(48)
Energy lost from water storage, kWh/day (48) x (49) =	0	(49)
b) If manufacturer's declared loss factor is not known :	0	(50)
Hot water storage loss factor from Table 2 (kWh/litre/day)	0.1.1	(54)
The water storage loss ractor from rable 2 (kwill/litte/day)	0.14	(51)





Volume factor from Table 2a Temperature factor from Table 2b Energy lost from water storage, kWh/day	0 0 0	(52) (53) (54)
Enter (50) or (54) in (55) Water storage (or HIU) loss calculated for each month (56) = (55) × (41)	0	(55)
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		(56)
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	heat netwr	(57) orks)
128.38 115.95 128.38 124.24 128.38 41.92 43.31 43.31 41.92 128.38 124.24 128.38 Combi loss for each month from Table 3a, 3b or 3c (enter 0 if not a combi boiler)	icut netwo	(59)
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		(61)
355.48 315.95 338.63 303.69 298.68 191.38 187.88 195.82 198.54 307.81 320.89 352.28 CWWHRS DHW input calculated using Appendix G (negative quantity) (enter 0 if no WWHRS contribution to water hea	3367.03 ting)	3 (62)
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		(63a)
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		(63b)
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		(63c)
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		(63d)
355.48 315.95 338.63 303.69 298.68 191.38 187.88 195.82 198.54 307.81 320.89 352.28 Output from water heater for each month, kWh/month (64) = (62) + (63a) + (63b) + (63c) + (63d)	3367.03	3 (64)
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		(64a)
178.21 159.26 172.61 159.06 159.33 83.23 82.72 85.36 85.61 162.36 164.78 177.15 include (57) m in calculation of (65) m only if hot water store is in the dwelling or hot water is from heat network		(65)

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

Metabolic gains (Table 5), watts

		121.09							121.09	121.09	121.09	121.09	(66)
Lighting	gains (cal	culated i	n Appeno	lix L, equ	ation L12	or L12a)	, also see	e Table 5					
Applianc		25.93								24.11	28.14	30	(67)
Аррпанс	ces gains (calculate	a in App	enuix L, e	quation		0d), disu	see rable	: 5				
	263	265.73	258.86	244.22	225.73	208.36	196.76	194.03	200.91	215.55	234.03	251.4	(68)



Page 4



Cooking gains (calculated in Appendix L, equation L18 or L18a), also see Table 5

Pumps a	49.13 and fans g	49.13 ains (Tab	49.13 le 5a)	49.13	49.13	49.13	49.13	49.13	49.13	49.13	49.13	49.13	(69)
Losses e	3 e.g. evapo	3 ration (ne	3 egative va	3 alues) (Ta	3 able 5	0	0	0	0	3	3	3	(70)
Water h	-80.73 leating ga	-80.73 ins (Table	-80.73 e 5)	-80.73	-80.73	-80.73	-80.73	-80.73	-80.73	-80.73	-80.73	-80.73	(71)
Total int	239.53 ternal gain	=07	232.01	220.91	214.15	115.6	111.18	114.73	118.9	218.23	228.86	238.1	(72)
	624.22	621.15	604.44	573.58	544.3	423.52	408.31	412.4	428.29	550.38	583.52	611.99	(73)

6. Solar gains

Solar gains in	n watt	s, ca	lcula	ted	for e	ach mo	onth			
			~ -					~	 	-

	77.48	131.97	180.57	223.73	250.6	248.79	239.86	219.81	195.52	145.85	92.8	66.3	(83)
Total ga	ins – inter	nal and s	olar (wat	tts)									
	701.69	753.12	785	797.31	794.9	672.31	648.17	632.21	623.81	696.23	676.32	678.3	(84)

7. Mean internal temperature (heating season)

Temper	ature dur	ing heati	ng period	ls in the l	iving are	a from Ta	able 9, Th	1 (°C)					21	(85)
Utilisati	on factor	for gains	for living	g area, 🛙 1	.,m (see 1	Table 9a)								
	0.97	0.96	0.93	0.88	0.77	0.66	0.49	0.53	0.74	0.87	0.95	0.98		(86)
Mean in	iternal te	mperatui	re in livin	g area T1	(follow s	steps 3 ar	nd 4 in Ta	ıble 9c)						
	19.97	20.12	20.36	20.64	20.85	20.95	20.99	20.99	20.91	20.7	20.3	19.95		(87)
Temper	ature dur	ing heati	ng perioo	ls in rest	of dwelli	ng from 1	Table 9, T	ĥ2 (°C)						
	19.88	19.88	19.88	19.9	19.9	19.91	19.91	19.92	19.91	19.9	19.9	19.89		(88)
Roof				ι	Utilisatio	n factor f	or gains f	for rest o	fdwelling	g, ⊡2,m (s	ee Table	9a)		
	0.96	0.95	0.91	0.84	0.71	0.57	0.38	0.41	0.65	0.83	0.94	0.97		(89)
Roof					Me	ean inter	nal temp	erature ir	n the rest	of dwell	ing T2			
	18.73	18.93	19.21	19.55	19.78	19.88	19.91	19.91	19.85	19.63	19.16	18.71		(90)
Living a	rea fractio	on											0.58	(91)
Mean in	iternal te	mperatui	re (for the	e whole c	dwelling)									
	19.46	19.63	19.88	20.18	20.41	20.51	20.54	20.54	20.47	20.26	19.83	19.43		(92)
Adjuste	d mean ir	iternal te	mperatu	re:										
	19.46	19.63	19.88	20.18	20.41	20.51	20.54	20.54	20.47	20.26	19.83	19.43		(93)

8. Space heating requirement





Utilisation factor for gains,

Useful g	0.96 ains, mGı	0.94 m,W	0.91	0.85	0.74	0.62	0.45	0.48	0.7	0.84	0.94	0.97		(94)
Monthly	674.27 v average		/ 1/ 10 0		586.21 Table U		288.54	301.17	436.07	587	632.88	654.79		(95)
Heat los	4.3 s rate for	4.9 mean int	6.5 ternal ter	8.9 nperatur	11.7 e	14.6	16.6	16.4	14.1	10.6	7.1	4.2		(96)
Space he	1163.96 eating rec	5 1127.46 quiremen			653.39	437.6	291.98	305.95	474.23	724.56	960.37	1155.87		(97)
Solar spa	364.33 ace heatii	279.51 ng calcula				0 ative qua	0 antity)	0	0	102.34	235.79	372.8		(98a)
Space he	0 eating red	0 quiremen	0 t for eacl	0 n month a	0 after sola	0 r contrib	0 ution	0	0	0	0	0		(98b)
Space he	364.33 eating rec	279.51 quiremen				0	0	0	0	102.34	235.79	372.8	28.6	(98c) (99)

8c. Space Cooling requirement															
Heat loss	Heat loss rate,														
Utilisatio	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 (100) Utilisation factor for loss														
Useful lo	0 oss, mLm	0 (watts)	0	0	0	0	0	0	0	0	0	0		(101)	
Gains	0	0	0	0	0	0	0	0	0	0	0	0		(102)	
Space co	0 ooling rec	0 Juiremen	0 It for mor	0 hth, whol	0 e dwellin	0 g, contin	0 uous (kW	0 ′h)	0	0	0	0		(103) (104)	
Cooled fi Intermitt		0 tor	0	0	0	0	0	0	0	0	0	0	0	(104) (105)	
Space co	0 ooling rec	0 Juiremen	0 It for mor	0 nth	0	0	0	0 0	0	0	0	0	0	(106)	
Space co	0 ooling rec	0 Juiremen	0 it in kWh,	0 /m²/year	0	0	0	0	0	0	0	0	0	(107) (108)	
8f. Sp	ace hea	ting req	uiremen	t		_									

Fabric Energy Efficiency,

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



0

(109)

SAP WORKSHEET

0



Fraction of space heat from secondary/supplementary system, 0	0	(201)				
Fraction of space heat from main system(s),	1	(201)				
Fraction of main heating from main system 2,		(202)				
Fraction of total space heat from main system 1,	1	(203)				
Fraction of total space heat from main system 2,	0	(205)				
Efficiency of main space heating system 1 (in %),	÷	(206)				
Efficiency of main space heating system 2 (in %),	0	(207)				
Efficiency of secondary/supplementary heating system, %,	0	(208)				
Cooling System Seasonal Energy Efficiency Ratio, 0	0	(209)				
Space heating requirement (calculated above),		、				
0 0 0 0 0 0 0 0 0 0		(210)				
Space heating fuel (main heating system 1), kWh/month 0	0					
145.79 111.85 90.47 49 20 0 0 0 0 40.95 94.35 149.18		(211)				
Space heating fuel (main heating system 2), kWh/month 0	0					
0 0 0 0 0 0 0 0 0 0		(213)				
Space heating fuel (secondary), kWh/month 0	0					
0 0 0 0 0 0 0 0 0 0 0		(215)				
Output from water heater), 0	175.1	(216)				
Efficiency of water heater						
175.1 175.		(217)				
Fuel for water heating						
203.01 180.44 193.39 173.44 170.57 109.3 107.3 111.83 113.39 175.79 183.26 201.19	1922.92	(219)				
Space Cooling						
		(221)				
Annual totals kWh/year kWh/year						
Space heating fuel used, main system 1		(211)				
Space heating fuel used, main system 2		(213)				
Space heating fuel used, secondary Water heating fuel used	0	(215)				
Electricity for instantaneous electric shower(s)		(219)				
Space cooling fuel used		(64a)				
Electricity for pumps, fans and electric keep-hot	0	(221)				
	0	(220-)				
Mechanical vent fans - balanced, extract or positive input from outside $_0$ $_0$	0	(230a)				
Heating circulation pump or water pump within warm air heating unit	0	(230b)				
Oil boiler auxiliary (oil pump, flue fan, etc; excludes circulation pump)	0	(230c)				
Gas boiler auxiliary (flue fan, etc; excludes circulation pump)	0 0	(230d)				
Maintaining electric keep-hot facility for gas combi boiler	0	(230e) (230f)				
Pump for solar water heating		(230r) (230g)				
Pump for storage WWHRS		(230g) (230h)				
Electricity for lighting		(231) (232)				
-		()				





Energy saving	/generatio	on techno	logies (A	ppendice	es M, N) -	Energy u	ised in dv	velling					
Electricity ger	erated by	PVs (App	endix M)	(negativ	e quantit	ty)							
0	0	0	0	0	0	0	0	0	0	0	0	0	(233a)
Electricity ger	erated by	wind tur	bines (Ap	pendix N	Л) (negat	ive quant	tity)						
0	0	0	0	0	0	0	0	0	0	0	0	0	(234a)
Electricity ger	erated by	hydro-ele	ectric ger	erators									
0	0	0	0	0	0	0	0	0	0	0	0	0	(235a)
Electricity use	d or net el	lectricity	generate	d by mic	ro-CHP								
0	0	0	0	0	0	0	0	0	0	0	0	0	(235c)
Energy saving	-				-		exported						
Electricity ger	lerated by	PVs (App		(negativ	e quanti								
0 Electricity gor	0 Varatad by	0 wind turl	0 hinos (An	0 nondiv N	0 1) (pagat	0 ivo quant	0	0	0	0	0	0	(233b)
Electricity ger	-			-		-		_	-	_	_	-	(22.41.)
0 Electricity ger	0 Verated by	0 hydro-eli	0 ectric ger	0 Nerators	0	0	0	0	0	0	0	0	(234b)
		-	_		0	0	0	0	0	0	0	0	(225b)
0 Electricity use	0 d or net el	0 lectricity	0 generate	0 d by mic	0 ro-CHP	0	0	0	0	0	0	0	(235b)
0	0	0	0	0	0	0	0	0	0	0	0	0	(235d)
Appendix Q it	0	0		0	0	0	0	0	0	0	0	0	(2000)
Appendix Q, <							Fue	2	kWh/yea	r			
energy saved									,,,			0	(236a)
energy used												0	(237a)
Total delivere	d energy f	or all use	s									2830.7	. ,

10a. Fuel costs – Individual heating systems including micro-CHP

Fuel required	kWh/year	Fuel price	Fuel cost £/yea	ar
Space heating - main system 1 (electric off-peak tariff				
High-rate fraction (Table 12a, or Appendix F for electric CPSU)	0		115.69	(240a)
Low-rate fraction	0		115.69	(240b)
High-rate cost	0		0	(240c)
Low-rate cost	0		0	(240d)
Space heating - main system 1 cost (other fuel)	0		0	(240e)
Space heating - main system 2 (electric off-peak tariff				
High-rate fraction (Table 12a, or Appendix F for electric CPSU)	0		115.69	(241a)
Low-rate fraction	0		115.69	(241b)
High-rate cost	0		0	(241c)
Low-rate cost	0		0	(241d)
Space heating - main system 2 cost (other fuel)	0		0	(241e)
Space heating - secondary (electric off-peak tariff)				
High-rate fraction (Table 12a, or Appendix F for electric CPSU)	0		115.69	(242a)





Low-rate fraction	0		115.69	(242b)
High-rate cost	0		0	(242c)
Low-rate cost	0		0	(242d)
Space heating - secondary cost (other fuel)	0		0	(242e)
Water heating (electric off-peak tariff)				
High-rate fraction (Table 12a, or Appendix F for electric CPSU)	0		0	(243)
Low-rate fraction	0		0	(242b)
High-rate cost	0		0	(242c)
Low-rate cost	0		0	(242d)
Water heating cost (other fuel)	0		317.09	(247)
(for a DHW-only heat network use (342a) or (342b) instead of (247)				
Energy For instantaneous electric shower(s)	0		0	(247a)
Space cooling	0		0	(248)
Pumps, fans And electric keep-hot	0		0	(249)
Energy For lighting	0		34	(250)
Additional standing charges	0		0	(251)
Energy saving/generation technologies	0		0	(252)
Appendix Q, <item 1="" description=""></item>	Fuel	kWh/year		
energy saved Or generated	0		0	(253)
energy used	0		0	(254)
Total energy cost	0		466.78	(255)
11a. SAP rating – Individual heating systems including micro-CHP				
Energy cost deflator	0		0	(256)
Energy cost factor (ECF)	0		0	(257)
SAP rating	0		0	(258)

11a. SAP rating – Individual heating systems including micro-CHP		
Energy cost deflator	0.36	(256)
Energy cost factor (ECF)	1.58	(257)
SAP rating	74.37	(258)
12a CO2 emissions – Individual heating systems including micro-CHP		

Energy	Energy Emission factor		Emissions	
KWh/year	r	kg	kg CO2/year	
Space heating - main system 1			109.28	(261)
Space heating - main system 2			0	(262)
Space heating - secondary			0	(263)
Energy for water heating			274.63	(264)
Energy for instantaneous electric shower(s)			0	(264a)





Space and water heating		0	(265)
Space cooling		0	(266)
Electricity for pumps, fans and electric keep		0	(267)
Electricity for lighting		29.76	(268)
energy saved or generated	0	0	(269b)
Appendix Q items			
energy saved	0	0	
energy used	0	0	
energy saved	0	0	(270b)
energy used		0	(271b)
Total CO2, kg/year		413.67	(272)
Dwelling CO2 Emission Rate		6.75	(273)
El rating		95	(274)

13a. Primary Energy – Individual heating systems including micro-CHP

	Energy Emission factor	Emissionsr
	KWh/year kg	kg CO2/year
Space heating - main system 1		1106.17 (275)
Space heating - main system 2		0 (276)
Space heating - secondary		0 (277)
Energy for water heating		2938.64 (278)
Energy for instantaneous electric shower(s)		0 (278a)
Space and water heating		0 (279)
Space cooling		0 (280)
Electricity for pumps, fans and electric keep		0 (281)
Electricity for lighting		316.27 (282)
energy saved or generated	0	0
Appendix Q items		
energy saved	0	0
energy used	0	0
energy saved	0	0 (284b)
energy used		0 (285b)
Total PE, kWh/year		4361.08 (286)
Dwelling PE Rate		71.14 (287)







Dwelling Reference: Dwelling Type: EN5 5SU Unit 03 Existing Dwelling

	Area(m ²)		Av. Heig	ht(m)	Volume(m³)	
			- 0			
Ground Floor	84	.71(1a) ×	< 3	(2a) =	254.13	(3a
Total floor area TFA					84.71	(4)
Dwelling volume					254.13	(5)
2. Ventilation Rate						
Chimneys/Flues		0 >	x 80 =		0	(6a)
Open chimneys		-	x 20 =		0	(6b)
Chimneys / flues attached to closed fire		0 >	x 10 =		0	(6c)
Flues attached to solid fuel boiler		0 >	x 20 =		0	(6d)
Flues attached to other heater		0 >	x 35 =		0	(6e
Number of blocked chimneys		0 >	x 20 =		0	(6f)
Number of intermittent extract fans		2 >	x 10 =		20	(7a
Number of passive vents		0 >	x 10 =		0	(7b
Number of flueless gas fires		0 >	x 40 =		0	(7c)
			Air chan	ges per hour		
Number of storeys in the dwelling (ns)				0.08	0.08	(8)
Infiltration due to chimneys, flues, fans, PSVs, etc				0	0	(9)
Additional infiltration Structural infiltration				0	0	(10
Suspended wooden ground floor				0 0	0 0	(11 (12
No draught lobby				0	0	(12
Percentage of windows and doors draught proofed				0	0	(14
Window infiltration				0	0	(15
Infiltration rate				0	0	(16
Air permeability value, AP50, (m³/h/m²)				5	5	(17
Air permeability value, AP4, (m³/h/m²) Air permeability value)				0	0	(17
Number of sides on which dwelling is sheltered				0.33 3	0.33 3	(18 (19
Shelter factor				Э	0.78	(19
Infiltration rate incorporating shelter factor					0.25	(20
Infiltration rate modified for monthly wind speed					0.20	(21
Jan Feb Mar Apr May Ju	n Jul Aug	Sep	Oct	Nov Dec	Total	(22)



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Monthly average wind speed from Table U2

Wind F	5.1 actor	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7	52.5	(22)
Adjuste	1.28 ed infiltrat	1.25 tion rate	1.23 (allowing	1.1 for shelt	1.08 er and w	0.95 ind speed	0.95 d)	0.93	1	1.08	1.13	1.18	13.13	(22a)
Calcula	0.32 te effectiv	0.32 ve air cha	0.31 Inge rate	0.28 for the a	0.27 pplicable	0.24 case:	0.24	0.24	0.25	0.27	0.29	0.3	3.34	(22b)
													0	(23a)
													0	(23b)
													0	(23c)
a) If ba	lanced me	echanical	ventilati	on with h	eat recov	very (MV	HR)							
	0	0	0	0	0	0	0	0	0	0	0	0		(24a)
b) If ba	lanced me	echanical	ventilati	on witho	ut heat re	ecovery (MV)							
	0	0	0	0	0	0	0	0	0	0	0	0		(24b)
c) If wh	iole house	e extract	ventilatio	on or posi	tive inpu	t ventilat	ion from	outside						
	0	0	0	0	0	0	0	0	0	0	0	0		(24c)
d) If na	tural vent	ilation or	whole h	ouse pos	itive inpu	it ventilat	tion from	loft						
	0.55	0.55	0.55	0.54	0.54	0.53	0.53	0.53	0.53	0.54	0.54	0.54		(24d)
Effectiv	/e air char	nge rate												
	0.55	0.55	0.55	0.54	0.54	0.53	0.53	0.53	0.53	0.54	0.54	0.54		(25)
Effectiv	/e air char	•												()
	0.55	0.55	0.55	0.54	0.54	0.53	0.53	0.53	0.53	0.54	0.54	0.54		(25)

3. Heat losses and heat loss parameter

Items in the table below are to be expanded as nec	cessary to allow for all different types of element	e.g. 4 wall types. The k -value
FLEMENT	AXU	AXk

	(W/K)	kJ/K
Doors	2.1	(26)
Windows	12.97	(27)
Roof window	0	(27a)
Basement floor	0	0 (28)
Ground floor	0	0 (28a)
Exposed floor	6.74	4597.5 (28b)
Basement wall	0	0 (29)
External wall	10.5	15352 (29a)
Roof	0	0 (30)
Total area of external elements ∑A, m ²		155.53 (31)
Party Wall	0	6274.8 (32)
Party floor		0 (32a)
Party ceiling		0 (32b)





Internal wall **	0	(33c)
Internal floor	0	(32d)
Internal ceiling floor	0	(32e)
Fabric heat loss, W/K = \sum (A x U)	32.32	(33)
Heat capacity $Cm = \sum (A \times k)$	26224.3	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m ² K	250	(35)
Linear Thermal bridges: Σ (L x Ψ) calculated using Appendix K	21.94	(36)
Point Thermal bridges: $\Sigma \chi$ (W/K) if significant point thermal bridge present and values available	21.94	(36a)
Total fabric heat loss $H = \sum (A \times U) + \sum (L \times \Psi) + \sum \chi$	54.26	(37)
Ventilation heat loss calculated monthly		
46.35 46.18 46.01 45.22 45.08 44.39 44.39 44.26 44.65 45.08 45.38 45.69 Heat transfer coefficient, W/K		(38)
100.61 100.44 100.27 99.48 99.33 98.64 98.64 98.52 98.91 99.33 99.63 99.94 Heat loss parameter (HLP), W/m²K		(39)
1.19 1.19 1.18 1.17 1.17 1.16 1.16 1.16 1.17 1.17 1.18 1.18 Number of days in month (Table 1a)		(40)
31 28 31 30 31 31 30 31 30 31		(41)

4. Water heating energy requirement

Assumed occupancy, N	2.55	(42)
Hot water usage in litres per day for mixer showers, Vd,shower (from Appendix J)	2.33	(74)
92 90.62 88.61 84.75 81.91 78.73 76.93 78.93 81.12 84.53 88.46 91.65		(42a)
Hot water usage in litres per day for baths, Vd,bath (from Appendix J)		
30.42 29.97 29.33 28.16 27.28 26.3 25.78 26.41 27.1 28.14 29.34 30.32 Hot water usage in litres per day for other uses, Vd,other (from Appendix J)		(42b)
42.85 41.29 39.73 38.17 36.62 35.06 35.06 36.62 38.17 39.73 41.29 42.85		(42c)
Annual average hot water usage in litres per day Vd, average (from Appendix J)	152.22	(43)
Hot water usage in litres per day for each month Vd,m = (42a) + (42b) + (42c)		
165.27 161.88 157.67 151.08 145.8 140.1 137.77 141.96 146.39 152.4 159.09 164.81 Energy content of hot water used = 4.18 x Vd,m x nm x DTm / 3600 kWh/month (from Appendix J)	1824.2	(44)
261.74 230.51 242.33 206.82 196.27 172.26 166.62 175.77 180.52 206.8 226.66 258.06 Distribution loss (46) = 0.15 x (45)	2524.36	(45)
39.26 34.58 36.35 31.02 29.44 25.84 24.99 26.37 27.08 31.02 34 38.71		(46)
Storage volume (litres) including any solar or WWHRS storage within same vessel	0	(47)
Water storage loss (or HIU loss)		
a) If manufacturer's declared loss factor is known (kWh/day):	0	(48)
Temperature factor from Table 2b	0	(49)
Energy lost from water storage, kWh/day (48) x (49) =	0	(50)
b) If manufacturer's declared loss factor is not known :		
Hot water storage loss factor from Table 2 (kWh/litre/day)	0.14	(51)





Volume factor from Table 2a Temperature factor from Table 2b Energy lost from water storage, kWh/day	0 0 0	(52) (53) (54)
Enter (50) or (54) in (55) Water storage (or HIU) loss calculated for each month (56) = (55) × (41)	0	(55)
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		(56)
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	heat netwo	(57) orks)
128.38 115.95 128.38 124.24 128.38 41.92 43.31 43.31 41.92 128.38 124.24 128.38 Combi loss for each month from Table 3a, 3b or 3c (enter 0 if not a combi boiler)		(59)
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		(61)
390.12 346.46 370.71 331.06 324.65 214.18 209.93 219.08 222.43 335.18 350.89 386.43 CWWHRS DHW input calculated using Appendix G (negative quantity) (enter 0 if no WWHRS contribution to water hea	3701.13 ting)	3 (62)
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		(63a)
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		(63b)
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		(63c)
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		(63d)
390.12 346.46 370.71 331.06 324.65 214.18 209.93 219.08 222.43 335.18 350.89 386.43 Output from water heater for each month, kWh/month (64) = (62) + (63a) + (63b) + (63c) + (63d)	3701.13	3 (64)
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		(64a)
189.73 169.41 183.28 168.16 167.96 90.81 90.05 93.09 93.55 171.46 174.75 188.51 include (57) m in calculation of (65) m only if hot water store is in the dwelling or hot water is from heat network		(65)

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

Metabolic gains (Table 5), watts

									152.77	152.77	152.77	152.77	(66)
Lighting	gains (cal	culated i	n Appenc	lix L, equ	ation L12	or L12a)	, also see	Table 5					
									24.85	31.55	36.83	39.26	(67)
Applianc	es gains (calculate	d in Appe	endix L, e	quation I	_16 or L1	6a), also	see Table	e 5				
	341.79	345.34	336.4	317.38	293.36	270.78	255.7	252.16	261.09	280.12	304.14	326.71	(68)





Cooking gains (calculated in Appendix L, equation L18 or L18a), also see Table 5

52.82 Pumps and fans g	52.82 ains (Tabl	52.82 le 5a)	52.82	52.82	52.82	52.82	52.82	52.82	52.82	52.82	52.82	(69)
3 Losses e.g. evapor	3 ration (ne	3 gative va	3 Ilues) (Ta	-	0	0	0	0	3	3	3	(70)
-101.85 Water heating gai	-101.85 ns (Table		-101.85	-101.85	-101.85	-101.85	-101.85	-101.85	-101.85	-101.85	-101.85	(71)
255.02 Total internal gair		246.34	233.55	225.76	126.13	121.04	125.13	129.94	230.46	242.71	253.37	(72)
741.76	738.11	717.08	678.56	641.48	513.84	494.73	499.54	519.63	648.88	690.43	726.09	(73)

6. Solar gains

Solar gains in watts, calculated for each month

3	8.44	76.95	136.62	223.16	300.13	320.29	299.48	238.47	165.93	93.42	48.11	31.57	(83)
Total gains – internal and solar (watts)													
7	80.19	815.06	853.7	901.73	941.61	834.13	794.21	738.02	685.56	742.3	738.53	757.65	(84)

7. Mean internal temperature (heating season)

Temper	ature dur	ing heati	ng perioo	ds in the l	iving are	a from Ta	able 9, Th	1 (°C)					21	(85)
Utilisati	on factor	for gains	for living	g area, 🛙 1	.,m (see 1	Table 9a)								
	0.99	0.98	0.97	0.93	0.82	0.7	0.53	0.59	0.83	0.94	0.98	0.99		(86)
Mean ir	iternal te	mperatu	re in livin	g area T1	(follow s	steps 3 ar	nd 4 in Ta	ble 9c)						
	19.86	19.97	20.21	20.54	20.81	20.94	20.99	20.98	20.86	20.57	20.17	19.83		(87)
Temper	ature dur	ing heati	ng perioo	ds in rest	of dwelli	ng from 1	Table 9, T	'h2 (°C)						
	19.93	19.93	19.93	19.94	19.94	19.95	19.95	19.95	19.95	19.94	19.94	19.94		(88)
Roof				I	Utilisatio	n factor f	or gains f	or rest o	fdwelling	g, ⊵2 ,m (s	ee Table	9a)		
	0.98	0.98	0.96	0.9	0.77	0.61	0.41	0.47	0.75	0.91	0.97	0.99		(89)
Roof					Me	ean inter	nal tempe	erature ir	n the rest	of dwell	ing T2			
	18.63	18.78	19.08	19.48	19.79	19.91	19.94	19.94	19.85	19.53	19.03	18.6		(90)
Living a	rea fractio	on											0.36	(91)
Mean ir	ternal te	mperatui	re (for the	e whole o	dwelling)									
	19.07	19.21	19.48	19.86	20.16	20.28	20.32	20.31	20.21	19.91	19.44	19.04		(92)
Adjuste	d mean ir	nternal te	emperatu	re:										
	19.07	19.21	19.48	19.86	20.16	20.28	20.32	20.31	20.21	19.91	19.44	19.04		(93)

8. Space heating requirement





Utilisation factor for gains,

Useful g	0.98 ains, mGr	0.97 n,W	0.95	0.9	0.78	0.64	0.46	0.51	0.78	0.91	0.97	0.98		(94)
Monthly	764.04 v average			811.48 ure from			362.43	378.1	531.84	674.53	713.46	743.83		(95)
Heat los	4.3 s rate for	4.9 mean int	6.5 ernal ten	8.9 nperature	11.7 e	14.6	16.6	16.4	14.1	10.6	7.1	4.2		(96)
•													(97)	
Solar spa	537.1 ace heatii		363.47 ated using			0 ative qua	0 Intity)	0	0	185.85	371.26	550.15		(98a)
Space he	0 eating rec	0 Juiremen	0 t for each	0 n month a	0 after sola	0 r contrib	0 ution	0	0	0	0	0		(98b)
Space he	537.1 eating rec		363.47 t in kWh/		77.7	0	0	0	0	185.85	371.26	550.15	32.1	(98c) (99)

8c. Space Cooling requirement														
Heat loss r	Heat loss rate,													
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 (100) Utilisation factor for loss														
(Useful loss	0 s, mLm	0 (watts)	0	0	0	0	0	0	0	0	0	0		(101)
(Gains	0	0	0	0	0	0	0	0	0	0	0	0		(102)
(Space coo	0 ling req	0 uiremen	0 t for mon	0 th, whol	0 e dwellin	0 g, contin	0 uous (kW	0 'h)	0	0	0	0		(103) (104)
(Cooled fra Intermitte		0 tor	0	0	0	0	0	0	0	0	0	0	0	(104) (105)
(Space coo	0 ling req	0 uiremen	0 t for mon	0 th	0	0	0	0 0	0	0	0	0	0	(106)
(Space coo	0 ling req	0 uiremen	0 t in kWh/	0 m²/year	0	0	0	0	0	0	0	0	0	(107) (108)
8f. Spa	ce heat	ting rea	uirement	:	_	_	_	_	_	_	_			

	C 1			
Fabric Energy Ef	fficiency,	0	0	(109)

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





Fraction of space heat from secondary/supplementary system,0Fraction of space heat from main system(s),0Fraction of main heating from main system 2,0Fraction of total space heat from main system 1,0Fraction of total space heat from main system 2,0Efficiency of main space heating system 1 (in %),0Efficiency of main space heating system 2 (in %),0Efficiency of secondary/supplementary heating system, %,0	1 (0 (1 (0 (249.9 (0 ((201) (202) (203) (204) (205) (206) (207) (208)											
Cooling System Seasonal Energy Efficiency Ratio, 0 Space heating requirement (calculated above),	0 ((209)											
Space heating fuel (main heating system 1), kWh/month 0	0	()											
214.93 173.33 145.45 80.27 31.09 0 0 0 0 74.37 148.56 220.15 Space heating fuel (main heating system 2), kWh/month 0) 0	(211)											
	((213)											
Space heating fuel (secondary), kWh/month 0	0	(245)											
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		(215) (216)											
Efficiency of water heater	173.1 ((210)											
175.1 175.1 175.1 175.1 175.1 175.1 175.1 175.1 175.1 175.1 175.1 175.1 175.1 175.1 175.1 175.1	((217)											
222.8 197.87 211.71 189.07 185.41 122.32 119.89 125.12 127.03 191.42 200.4 220.69 Space Cooling	2113.72 ((219)											
0 0 0 0 0 0 0 0 0 0 0	((221)											
Annual totals kWh/year kWh/year													
Space heating fuel used, main system 1 Space heating fuel used, main system 2		(211)											
Space heating fuel used, secondary		(213)											
Water heating fuel used		(215) (219)											
Electricity for instantaneous electric shower(s)		(21 <i>9</i>) (64a)											
Space cooling fuel used		(221)											
Electricity for pumps, fans and electric keep-hot	0 ((221)											
Mechanical vent fans - balanced, extract or positive input from outside 0 0	0 ((230a)											
warm air heating system fans		(230b)											
Heating circulation pump or water pump within warm air heating unit		(230c)											
Oil boiler auxiliary (oil pump, flue fan, etc; excludes circulation pump)	0 ((230d)											
Gas boiler auxiliary (flue fan, etc; excludes circulation pump)	0 ((230e)											
Maintaining electric keep-hot facility for gas combi boiler	0 ((230f)											
Pump for solar water heating	0 ((230g)											
Pump for storage WWHRS	0 ((230h)											
Total electricity for the above	0 ((231)											
Electricity for lighting	269.83 ((232)											





Energy sav Electricity								ed in dwe	lling					
Electricity	0 generate	0 ed by wi	0 nd turbir	0 nes (Appe	0 ndix M)	0 (negative	0 e quantity	0 /)	0	0	0	0	0	(233a)
Electricity	0	0 ed by hy	0 dro-elect	0 tric gener	0 ators	0	0	0	0	0	0	0	0	(234a)
Electricity	•	0 net elec	0 tricity ge	0 nerated b	0 by micro-	0 CHP	0	0	0	0	0	0	0	(235a)
Energy sav Electricity	ving/gene							0 oorted	0	0	0	0	0	(235c)
Electricity	0	0 ed by wi	0 nd turbir	0 nes (Appe	0 ndix M)	0 (negative	0 e quantity	0 /)	0	0	0	0	0	(233b)
Electricity	0	0 ed by hy	0 dro-elect	0 tric gener	0 ators	0	0	0	0	0	0	0	0	(234b)
Electricity	0	0 net elec	0 tricity ge	0 nerated k	0 by micro-	0 CHP	0	0	0	0	0	0	0	(235b)
Appendix	Q items:		•.	0	0	0	0	0	0	0	0	0	0	(235d)
Appendix energy sav energy us Total deliv	ved ed							Fuel		kWh/year			0 0 3471.71	(236a) (237a)

10a. Fuel costs – Individual heating systems including micro-CHP

Fuel required	kWh/year	Fuel price	Fuel cost £/year	
Space heating - main system 1 (electric off-peak tariff				
High-rate fraction (Table 12a, or Appendix F for electric CPSU)	0		179.44	(240a)
Low-rate fraction	0		179.44	(240b)
High-rate cost	0		0	(240c)
Low-rate cost	0		0	(240d)
Space heating - main system 1 cost (other fuel)	0		0	(240e)
Space heating - main system 2 (electric off-peak tariff				
High-rate fraction (Table 12a, or Appendix F for electric CPSU)	0		179.44	(241a)
Low-rate fraction	0		179.44	(241b)
High-rate cost	0		0	(241c)
Low-rate cost	0		0	(241d)
Space heating - main system 2 cost (other fuel)	0		0	(241e)
Space heating - secondary (electric off-peak tariff)				
High-rate fraction (Table 12a, or Appendix F for electric CPSU)	0		179.44	(242a)





Low-rate fraction	0		179.44	(242b)
High-rate cost	0		0	(242c)
Low-rate cost	0		0	(242d)
Space heating - secondary cost (other fuel)	0		0	(242e)
Water heating (electric off-peak tariff)				
High-rate fraction (Table 12a, or Appendix F for electric CPSU)	0		0	(243)
Low-rate fraction	0		0	(242b)
High-rate cost	0		0	(242c)
Low-rate cost	0		0	(242d)
Water heating cost (other fuel)	0		348.55	(247)
(for a DHW-only heat network use (342a) or (342b) instead of (247)				
Energy For instantaneous electric shower(s)	0		0	(247a)
Space cooling	0		0	(248)
Pumps, fans And electric keep-hot	0		0	(249)
Energy For lighting	0		44.5	(250)
Additional standing charges	0		0	(251)
Energy saving/generation technologies	0		0	(252)
Appendix Q, <item 1="" description=""></item>	Fuel	kWh/year		
energy saved Or generated	0		0	(253)
energy used	0		0	(254)
Total energy cost	0		572.48	(255)
11a. SAP rating – Individual heating systems including micro-CHP				
Energy cost deflator	0		0	(256)
Energy cost factor (ECF)	0		0	(257)
SAP rating	0		0	(258)

11a. SAP rating – Individual heating systems including micro-CHP		
Energy cost deflator	0.36	(256)
Energy cost factor (ECF)	1.59	(257)
SAP rating	74.24	(258)
12a. CO2 emissions – Individual heating systems including micro-CHP		

	Energy	Emission factor	Emissions	
	KWh/year	kg	kg CO2/year	
Space heating - main system 1			169.03	(261)
Space heating - main system 2			0	(262)
Space heating - secondary			0	(263)
Energy for water heating			301.64	(264)
Energy for instantaneous electric shower(s)			0	(264a)





Space and water heating		0	(265)
Space cooling		0	(266)
Electricity for pumps, fans and electric keep		0	(267)
Electricity for lighting		38.95	(268)
energy saved or generated	0	0	(269b)
Appendix Q items			
energy saved	0	0	
energy used	0	0	
energy saved	0	0	(270b)
energy used		0	(271b)
Total CO2, kg/year		509.62	(272)
Dwelling CO2 Emission Rate		6.02	(273)
El rating		95	(274)

13a. Primary Energy – Individual heating systems including micro-CHP

	Energy Emission factor	Emissionsr
	KWh/year kg	kg CO2/year
Space heating - main system 1		1713.97 (275)
Space heating - main system 2		0 (276)
Space heating - secondary		0 (277)
Energy for water heating		3229.34 (278)
Energy for instantaneous electric shower(s)		0 (278a)
Space and water heating		0 (279)
Space cooling		0 (280)
Electricity for pumps, fans and electric keep		0 (281)
Electricity for lighting		413.88 (282)
energy saved or generated	0	0
Appendix Q items		
energy saved	0	0
energy used	0	0
energy saved	0	0 (284b)
energy used		0 (285b)
Total PE, kWh/year		5357.19 (286)
Dwelling PE Rate		63.24 (287)







Dwelling Reference: Dwelling Type: EN5 5SU

Unit 02 Existing Dwelling

1. Overall dwelling dimensions					
	Area(m²)	Av. Height(m	1)	Volume(m³)	
Ground Floor Total floor area TFA	51.52 (1a) x 3	(2a) =	154.56 51.52	(3a)
Dwelling volume				154.56	(4) (5)
2. Ventilation Rate					
Chimneys/Flues	0	x 80 =		0	(6a)
Open chimneys	0	x 20 =		0	(6b)
Chimneys / flues attached to closed fire	0	x 10 =		0	(6c)
Flues attached to solid fuel boiler	0	x 20 =		0	(6d)
Flues attached to other heater	0	x 35 =		0	(6e)
Number of blocked chimneys	0	x 20 =		0	(6f)
Number of intermittent extract fans	2	x 10 =		20	(7a)
Number of passive vents	0	x 10 =		0	(7b)
Number of flueless gas fires	0	x 40 =		0	(7c)
		Air changes	per hour		
Number of storeys in the dwelling (ns)			0.13	0.13	(8)
Infiltration due to chimneys, flues, fans, PSVs, etc			0	0	(9)
Additional infiltration Structural infiltration			0	0	(10)
Suspended wooden ground floor			0 0	0 0	(11) (12)
No draught lobby			0	0	(12)
Percentage of windows and doors draught proofed			0	0	(14)
Window infiltration			0	0	(15)
Infiltration rate			0	0	(16)
Air permeability value, AP50, $(m^3/h/m^2)$			5	5	(17)
Air permeability value, AP4, (m³/h/m²) Air permeability value)			0	0	(17a)
Number of sides on which dwelling is sheltered			0.38 3	0.38 3	(18) (19)
Shelter factor			5	0.78	(20)
Infiltration rate incorporating shelter factor				0.29	(21)
Infiltration rate modified for monthly wind speed					(/
Jan Feb Mar Apr May Jun	Jul Aug	Sep Oct N	ov Dec	Total	(22)







Monthly average wind speed from Table U2

Wind F	5.1 actor	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7	52.5	(22)
Adjust	1.28 ed infiltrat	1.25 tion rate	1.23 (allowing	1.1 for shelt	1.08 er and w	0.95 ind speed	0.95 d)	0.93	1	1.08	1.13	1.18	13.13	(22a)
Calcula	0.37 ate effectiv	0.37 ve air cha	0.36 ange rate	0.32 for the a	0.32 pplicable	0.28 case:	0.28	0.27	0.29	0.32	0.33	0.35	3.86	(22b)
													0	(23a)
													0	(23b)
													0	(23c)
a) If ba	lanced me	echanical	ventilati	on with h	leat recov	very (MV	HR)							
	0	0	0	0	0	0	0	0	0	0	0	0		(24a)
b) If ba	lanced m	echanica	ventilati	on witho	ut heat re	ecovery (MV)							
	0	0	0	0	0	0	0	0	0	0	0	0		(24b)
c) If wi	nole house	e extract	ventilatio	on or posi	tive inpu	t ventilat	ion from	outside						
1.1.6	0	0	0	0	. 0	0	0	0	0	0	0	0		(24c)
d) If na	itural vent	ilation of	r whole h	ouse pos	itive inpu	it ventilat	tion from	loft						
	0.57	0.57	0.56	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.55	0.56		(24d)
Effecti	ve air chai	nge rate												
	0.57	0.57	0.56	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.55	0.56		(25)
Effecti	ve air chai	•												()
	0.57	0.57	0.56	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.55	0.56		(25)

3. Heat losses and heat loss parameter

Items in the table below are to be expanded as necessary to allow f	or all different types of element e.g. 4 wall types.	The k -value
ELEMENT	AXU	AXk

	(W/K)	kJ/K	
Doors	2.1		(26)
Windows	10.29		(27)
Roof window	0		(27a)
Basement floor	0	0	(28)
Ground floor	0	0	(28a)
Exposed floor	5.67	3864	(28b)
Basement wall	0	0	(29)
External wall	7.14	10442.4	(29a)
Roof	0	0	(30)
Total area of external elements ∑A, m ²		117.57	(31)
Party Wall	0	8044.2	(32)
Party floor		0	(32a)
Party ceiling		0	(32b)





Internal	wall **												0	(33c)
Internal floor													0	(32d)
Internal ceiling floor													0	(32e)
Fabric heat loss, W/K = \sum (A x U)												25.21	(33)	
Heat capacity $Cm = \sum (A \times k)$												22350.6	(34)	
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m ² K												250	(35)	
Linear Tl	Linear Thermal bridges: Σ (L x Ψ) calculated using Appendix K												16.72	(36)
Point Thermal bridges: $\Sigma \chi$ (W/K) if significant point thermal bridge present and values available												16.72	(36a)	
Total fabric heat loss H = $\Sigma(A \times U) + \Sigma(L \times \Psi) + \Sigma\chi$											41.93	(37)		
Ventilati	ion heat l	oss calcu	lated mo	nthly										
	29.09	28.95	28.81	28.17	28.05	27.49	27.49	27.39	27.71	28.05	28.29	28.55		(38)
Heat tra	nsfer coe	efficient,	W/K											
	71.02	70.88	70.74	70.1	69.98	69.42	69.42	69.32	69.64	69.98	70.22	70.48		(39)
Heat los	s parame	eter (HLP)	, W/m²K											
	1.38	1.38	1.37	1.36	1.36	1.35	1.35	1.35	1.35	1.36	1.36	1.37		(40)
Number	of days i	n month	(Table 1a	a)										
	31	28	31	30	31	30	31	31	30	31	30	31		(41)

4. Water heating energy requirement

Assumed occupancy, N	4 70	(42)
Hot water usage in litres per day for mixer showers, Vd,shower (from Appendix J)	1.73	(42)
		(12-)
73.3 72.2 70.59 67.52 65.25 62.73 61.29 62.88 64.63 67.34 70.48 73.02 Hot water usage in litres per day for baths, Vd,bath (from Appendix J)		(42a)
24.26 23.9 23.39 22.46 21.76 20.98 20.56 21.06 21.61 22.44 23.4 24.18		(42b)
Hot water usage in litres per day for other uses, Vd,other (from Appendix J)		(120)
34.1 32.86 31.62 30.38 29.14 27.9 27.9 29.14 30.38 31.62 32.86 34.1		(42c)
Annual average hot water usage in litres per day Vd, average (from Appendix J)	121.27	(43)
Hot water usage in litres per day for each month Vd,m = (42a) + (42b) + (42c)		
131.66 128.96 125.61 120.36 116.15 111.61 109.75 113.09 116.62 121.41 126.74 131.3	1453.2	27 (44)
Energy content of hot water used = 4.18 x Vd,m x nm x DTm / 3600 kWh/month (from Appendix J)		
208.52 183.64 193.05 164.77 156.36 137.24 132.74 140.03 143.81 164.75 180.57 205.58	2011.0)5 (45)
Distribution loss (46) = 0.15 x (45)		
31.28 27.55 28.96 24.72 23.45 20.59 19.91 21 21.57 24.71 27.08 30.84		(46)
Storage volume (litres) including any solar or WWHRS storage within same vessel	0	(47)
Water storage loss (or HIU loss)	_	()
a) If manufacturer's declared loss factor is known (kWh/day):	0	(48)
Temperature factor from Table 2b	0	(49)
Energy lost from water storage, kWh/day (48) x (49) =	0	(50)
b) If manufacturer's declared loss factor is not known :		(= -)
Hot water storage loss factor from Table 2 (kWh/litre/day)	0.14	(51)





Volume factor from Table 2a Temperature factor from Table 2b Energy lost from water storage, kWh/day	0 0 0	(52) (53) (54)
Enter (50) or (54) in (55) Water storage (or HIU) loss calculated for each month (56) = (55) × (41)	0	(55)
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		(56)
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	heat netwo	(57) orks)
128.38 115.95 128.38 124.24 128.38 41.92 43.31 43.31 41.92 128.38 124.24 128.38 Combi loss for each month from Table 3a, 3b or 3c (enter 0 if not a combi boiler)	icut netwo	(59)
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		(61)
336.9 299.59 321.43 289 284.74 179.15 176.05 183.34 185.73 293.13 304.8 333.96 CWWHRS DHW input calculated using Appendix G (negative quantity) (enter 0 if no WWHRS contribution to water hea	3187.82 ting)	2 (62)
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		(63a)
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		(63b)
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		(63c)
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		(63d)
336.9 299.59 321.43 289 284.74 179.15 176.05 183.34 185.73 293.13 304.8 333.96 Output from water heater for each month, kWh/month (64) = (62) + (63a) + (63b) + (63c) + (63d)	3187.82	2 (64)
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		(64a)
172.03 153.82 166.89 154.17 154.69 79.16 78.79 81.21 81.35 157.48 159.43 171.06 include (57) m in calculation of (65) m only if hot water store is in the dwelling or hot water is from heat network		(65)

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

Metabolic gains (Table 5), watts

	104.09	104.09	104.09	104.09	104.09	104.09	104.09	104.09	104.09	104.09	104.09	104.09	(66)
Lighting	gains (cal	culated in	n Append	lix L, equ	ation L12	or L12a)	, also see	e Table 5					
	22.1	19.63	15.97	12.09	9.04	7.63	8.24	10.71	14.38	18.26	21.31	22.72	(67)
Appliances gains (calculated in Appendix L, equation L16 or L16a), also see Table 5													
	225.64	227.98	222.08	209.52	193.67	178.76	168.81	166.47	172.37	184.93	200.78	215.69	(68)





Cooking gains (calculated in Appendix L, equation L18 or L18a), also see Table 5

Pumps a	47.14 and fans g	47.14 gains (Tab	47.14 le 5a)	47.14	47.14	47.14	47.14	47.14	47.14	47.14	47.14	47.14	(69)
Losses e	3 e.g. evapo	3 ration (ne	3 egative va	3 alues) (Ta	3 able 5	0	0	0	0	3	3	3	(70)
Water h	-69.4 eating ga	-69.4 ins (Table	-69.4 e 5)	-69.4	-69.4	-69.4	-69.4	-69.4	-69.4	-69.4	-69.4	-69.4	(71)
Total int	231.23 ernal gai	==0.0	224.32	214.13	207.92	109.95	105.89	109.15	112.99	211.67	221.43	229.92	(72)
	563.82	561.36	547.21	520.58	495.46	378.18	364.79	368.18	381.57	499.7	528.36	553.16	(73)

6. Solar gains

Solar gains in watts, calculated for each month

3	1	63.1	113.69	186.71	250.97	267.56	250.3	199.54	138.53	77.11	39.01	25.32	(83)
Total gains – internal and solar (watts)													
5	94.82	624.46	660.9	707.29	746.43	645.74	615.08	567.71	520.1	576.81	567.37	578.48	(84)

7. Mean internal temperature (heating season)

Temper	ature dur	ing heati	ng perioc	ls in the l	iving are	a from Ta	able 9, Th	1 (°C)					21	(85)
Utilisati	on factor	for gains	for living	g area, 🛙 1	.,m (see 1	Table 9a)								
	0.97	0.97	0.94	0.88	0.76	0.64	0.49	0.54	0.78	0.9	0.96	0.98		(86)
Mean ir	iternal te	mperatui	re in livin	g area T1	(tollow s	steps 3 ar	nd 4 in Ta	ble 9c)						
	19.79	19.93	20.19	20.55	20.83	20.94	20.99	20.98	20.85	20.58	20.14	19.76		(87)
Temper	ature dur	ing heati	ng perioc	ls in rest	of dwelli	ng from T	Table 9, T	'h2 (°C)						
	19.78	19.78	19.78	19.79	19.8	19.8	19.8	19.81	19.8	19.8	19.79	19.79		(88)
Roof				l	Utilisatio	n factor f	or gains f	or rest o	fdwelling	g, ⊇2,m (s	ee Table	9a)		
	0.97	0.96	0.92	0.84	0.69	0.54	0.36	0.41	0.69	0.86	0.95	0.97		(89)
Roof					Me	ean interi	nal temp	erature in	n the rest	of dwell	ing T2			
	18.44	18.61	18.94	19.37	19.66	19.77	19.8	19.8	19.71	19.41	18.88	18.41		(90)
Living a	rea fractio	on											0.42	(91)
Mean ir	iternal te	mperatui	re (for the	e whole d	dwelling)									
	19.01	19.17	19.47	19.87	20.15	20.27	20.3	20.3	20.19	19.91	19.41	18.98		(92)
Adjuste	d mean ir	nternal te	mperatu	re:										
	19.01	19.17	19.47	19.87	20.15	20.27	20.3	20.3	20.19	19.91	19.41	18.98		(93)

8. Space heating requirement





Utilisation factor for gains,

Useful g	0.96 ains, mGr	0.95 n,W	0.92	0.85	0.71	0.58	0.41	0.47	0.72	0.86	0.94	0.96		(94)
Monthly	571.69 average	592.96 external	607.75 temperat	599.22 ture from	000.111	375.08 1	253.91	264.89	376.76	496.58	533.25	558.12		(95)
Heat los	4.3 s rate for	4.9 mean int	6.5 ernal ter	8.9 nperatur	11.7 e	14.6	16.6	16.4	14.1	10.6	7.1	4.2		(96)
Space he	1044.68 eating rec	3 1011.18 Juiremen			591.68	393.38	257.06	270.22	424.21	651.22	864.59	1041.83		(97)
Solar spa	351.9 ace heatir			122.12 g Append		0 ative qua	0 Intity)	0	0	115.05	238.57	359.89		(98a)
Space he	0 eating rec	0 Juiremen	0 t for eacl	0 n month a	0 after sola	0 r contrib	0 ution	0	0	0	0	0		(98b)
Space he	351.9 eating rec			122.12 /m²/year	45.81	0	0	0	0	115.05	238.57	359.89	33.87	(98c) (99)

8c. Space	8c. Space Cooling requirement												
Heat loss rat	te,												
0 Utilisation fa	0 actor for loss	0	0	0	0	0	0	0	0	0	0		(100)
0 Useful loss,	0 mLm (watts)	0	0	0	0	0	0	0	0	0	0		(101)
0 Gains	0	0	0	0	0	0	0	0	0	0	0		(102)
											(103) (104)		
0 Cooled fract Intermittend		0	0	0	0	0	0	0	0	0	0	0	(104) (105)
0 Space coolir	0 ng requireme	0 ent for m	0 nonth	0	0	0	0	0	0	0	0	0	(106)
0 Space coolir	0 ng requireme	0 ent in kW	0 Vh/m²/yea	0 ar	0	0	0	0	0	0	0	0	(107) (108)
8f. Space heating requirement													

Fabric Energy Efficiency,

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



0

(109)

SAP WORKSHEET

0



Fraction of space heat from secondary/supplementary system, 0	0	(201)									
Fraction of space heat from main system(s),	1	(201)									
Fraction of main heating from main system 2,	0	(202)									
Fraction of total space heat from main system 1,	1	(203)									
Fraction of total space heat from main system 2,	0	(205)									
Efficiency of main space heating system 1 (in %),	249.9	(206)									
Efficiency of main space heating system 2 (in %),	0	(207)									
Efficiency of secondary/supplementary heating system, %,	0	(208)									
Cooling System Seasonal Energy Efficiency Ratio, 0	0	(209)									
Space heating requirement (calculated above),											
0 0 0 0 0 0 0 0 0 0		(210)									
Space heating fuel (main heating system 1), kWh/month 0	0	. ,									
140.82 112.46 92.28 48.87 18.33 0 0 0 0 46.04 95.46 144.01	L	(211)									
Space heating fuel (main heating system 2), kWh/month 0	0										
0 0 0 0 0 0 0 0 0 0		(213)									
Space heating fuel (secondary), kWh/month 0	0										
0 0 0 0 0 0 0 0 0 0		(215)									
Output from water heater), 0	175.1	(216)									
Efficiency of water heater											
175.1 175.1 175.1 175.1 175.1 175.1 175.1 175.1 175.1 175.1 175.1 175.1		(217)									
Fuel for water heating											
192.4 171.1 183.57 165.05 162.62 102.31 100.54 104.71 106.07 167.41 174.07 190.72	1820.57	(219)									
Space Cooling											
0 0 0 0 0 0 0 0 0 0 0		(221)									
Annual totals kWh/year kWh/year											
Space heating fuel used, main system 1	698.28	(211)									
Space heating fuel used, main system 2	0	(213)									
Space heating fuel used, secondary	0	(215)									
Water heating fuel used	1820.57	(219)									
Electricity for instantaneous electric shower(s)	0	(64a)									
Space cooling fuel used	0	(221)									
Electricity for pumps, fans and electric keep-hot											
Mechanical vent fans - balanced, extract or positive input from outside 0 0	0	(230a)									
warm air heating system fans	0	(230b)									
Heating circulation pump or water pump within warm air heating unit	0	(230c)									
Oil boiler auxiliary (oil pump, flue fan, etc; excludes circulation pump)	0	(230d)									
Gas boiler auxiliary (flue fan, etc; excludes circulation pump)											
Maintaining electric keep-hot facility for gas combi boiler	0	(230f)									
Pump for solar water heating	0	(230g)									
Pump for storage WWHRS	0	(230h)									
Total electricity for the above	0	(231)									
Electricity for lighting	156.14	(232)									





Energy saving,	Energy saving/generation technologies (Appendices M, N) - Energy used in dwelling												
Electricity gen	erated by	PVs (App	endix M)	(negativ	e quantit	ty)							
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0													(233a)
Electricity gen	erated by	wind turk	oines (Ap	pendix N	1) (negat	ive quant	ity)						
0	0	0	0	0	0	0	0	0	0	0	0	0	(234a)
Electricity gen	erated by	hydro-ele	ectric gen	nerators									
0	0	0	0	0	0	0	0	0	0	0	0	0	(235a)
Electricity use	d or net el	ectricity §	generated	d by mic	ro-CHP								
0	0	0	0	0	0	0	0	0	0	0	0	0	(235c)
Energy saving,	-						xported						
Electricity gen	erated by	PVs (App	-	(negativ	e quanti								
0 Electricity gon	0 oratod by	0 wind turk	0 Dinos (An	0 nondiv N	0 (hogat	0 ivo quant	0 •i+v	0	0	0	0	0	(233b)
Electricity gen	-			-		-		-	_	_	-	_	(22.41.)
0 Electricity gen	0 erated by	0 hvdro-ele	0 ectric gen	0 Nerators	0	0	0	0	0	0	0	0	(234b)
		-	-		0	0	0	0	0	0	0	0	(225b)
0 Electricity use	0 d or net el	0 ectricity (0 generated	0 d by mic	0 ro-CHP	0	0	0	0	0	0	0	(235b)
0	0	0	0	0	0	0	0	0	0	0	0	0	(235d)
Appendix Q ite	0	•		0	0	0	0	0	0	0	0	0	(2000)
Appendix Q, <							Fue	2	kWh/yea	r			
energy saved									,,,			0	(236a)
energy used												0	(237a)
Total delivered	d energy fo	or all uses	\$									2674.99	. ,

10a. Fuel costs – Individual heating systems including micro-CHP

Fuel required	kWh/year	Fuel price	Fuel cost £/yea	ar
Space heating - main system 1 (electric off-peak tariff				
High-rate fraction (Table 12a, or Appendix F for electric CPSU)	0		115.15	(240a)
Low-rate fraction	0		115.15	(240b)
High-rate cost	0		0	(240c)
Low-rate cost	0		0	(240d)
Space heating - main system 1 cost (other fuel)	0		0	(240e)
Space heating - main system 2 (electric off-peak tariff				
High-rate fraction (Table 12a, or Appendix F for electric CPSU)	0		115.15	(241a)
Low-rate fraction	0		115.15	(241b)
High-rate cost	0		0	(241c)
Low-rate cost	0		0	(241d)
Space heating - main system 2 cost (other fuel)	0		0	(241e)
Space heating - secondary (electric off-peak tariff)				
High-rate fraction (Table 12a, or Appendix F for electric CPSU)	0		115.15	(242a)





Low-rate fraction	0		115.15	(242b)
High-rate cost	0		0	(242c)
Low-rate cost	0		0	(242d)
Space heating - secondary cost (other fuel)	0		0	(242e)
Water heating (electric off-peak tariff)				
High-rate fraction (Table 12a, or Appendix F for electric CPSU)	0		0	(243)
Low-rate fraction	0		0	(242b)
High-rate cost	0		0	(242c)
Low-rate cost	0		0	(242d)
Water heating cost (other fuel)	0		300.21	(247)
(for a DHW-only heat network use (342a) or (342b) instead of (247)				
Energy For instantaneous electric shower(s)	0		0	(247a)
Space cooling	0		0	(248)
Pumps, fans And electric keep-hot	0		0	(249)
Energy For lighting	0		25.75	(250)
Additional standing charges	0		0	(251)
Energy saving/generation technologies	0		0	(252)
Appendix Q, <item 1="" description=""></item>	Fuel	kWh/year		
energy saved Or generated	0		0	(253)
energy used	0		0	(254)
Total energy cost	0		441.11	(255)
11a. SAP rating – Individual heating systems including micro-CHP				
Energy cost deflator	0		0	(256)
Energy cost factor (ECF)	0		0	(257)
SAP rating	0		0	(258)

11a. SAP rating – Individual heating systems including micro-CHP		
Energy cost deflator	0.36	(256)
Energy cost factor (ECF)	1.65	(257)
SAP rating	73.33	(258)
12a. CO2 emissions – Individual heating systems including micro-CHP		

Energy **Emission factor** Emissions KWh/year kg kg CO2/year Space heating - main system 1 108.62 (261) Space heating - main system 2 0 (262) Space heating - secondary 0 (263) Energy for water heating 260.14 (264) Energy for instantaneous electric shower(s) 0 (264a)





Space and water heating		0	(265)
Space cooling		0	(266)
Electricity for pumps, fans and electric keep		0	(267)
Electricity for lighting		22.54	(268)
energy saved or generated	0	0	(269b)
Appendix Q items			
energy saved	0	0	
energy used	0	0	
energy saved	0	0	(270b)
energy used		0	(271b)
Total CO2, kg/year		391.3	(272)
Dwelling CO2 Emission Rate		7.6	(273)
El rating		95	(274)

13a. Primary Energy – Individual heating systems including micro-CHP

	Energy Emission factor	Emissionsr
	KWh/year kg	kg CO2/year
Space heating - main system 1		1100.44 (275)
Space heating - main system 2		0 (276)
Space heating - secondary		0 (277)
Energy for water heating		2782.71 (278)
Energy for instantaneous electric shower(s)		0 (278a)
Space and water heating		0 (279)
Space cooling		0 (280)
Electricity for pumps, fans and electric keep		0 (281)
Electricity for lighting		239.49 (282)
energy saved or generated	0	0
Appendix Q items		
energy saved	0	0
energy used	0	0
energy saved	0	0 (284b)
energy used		0 (285b)
Total PE, kWh/year		4122.64 (286)
Dwelling PE Rate		80.02 (287)







Dwelling Reference: Dwelling Type: EN5 5SU

Unit 02 Existing Dwelling

1. Overall dwelling dimensions				
	Area(m²)	Av. Height(m)	Volume(m³)	
Ground Floor	60.99 (1	la) x 3 ((2a) = 182.97	(3a)
Total floor area TFA Dwelling volume			60.99 182.97	(4) (5)
2. Ventilation Rate				
Chimneys/Flues	0	x 80 =	0	(6a)
Open chimneys	0	x 20 =	0	(6b)
Chimneys / flues attached to closed fire	0	x 10 =	0	(6c)
Flues attached to solid fuel boiler	0	x 20 =	0	(6d)
Flues attached to other heater	0	x 35 =	0	(6e)
Number of blocked chimneys	0	x 20 =	0	(6f)
Number of intermittent extract fans	2	x 10 =	20	(7a)
Number of passive vents	0	x 10 =	0	(7b)
Number of flueless gas fires	0	x 40 =	0	(7c)
		Air changes per ho	bur	
Number of storeys in the dwelling (ns)		0.1		(8)
Infiltration due to chimneys, flues, fans, PSVs, etc Additional infiltration		0		(9)
Structural infiltration		0		(10) (11)
Suspended wooden ground floor		0		(12)
No draught lobby		0		(13)
Percentage of windows and doors draught proofed		0	0	(14)
Window infiltration		0		(15)
Infiltration rate Air norman hilitruralus, ADEO, $(m^3/h/m^2)$		0		(16)
Air permeability value, AP50, (m ³ /h/m ²) Air permeability value, AP4, (m ³ /h/m ²)		5		(17)
Air permeability value)		0 0.3		(17a) (18)
Number of sides on which dwelling is sheltered		3		(19)
Shelter factor			0.78	(20)
Infiltration rate incorporating shelter factor			0.28	(21)
Infiltration rate modified for monthly wind speed				
Jan Feb Mar Apr May Jun	Jul Aug S	ep Oct Nov	Dec Total	(22)







Monthly average wind speed from Table U2

Wind Fa	5.1 ctor	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7	52.5	(22)
Adjustec	1.28 1 infiltrati	1.25 on rate (a	1.23 allowing f	1.1 for shelte	1.08 er and wir	0.95 nd speed	0.95)	0.93	1	1.08	1.13	1.18	13.13	(22a)
Calculate	0.36 e effective	0.35 e air char	0.34 nge rate f	0.31 or the ap	0.3 plicable (0.26 case:	0.26	0.26	0.28	0.3	0.31	0.33	3.65	(22b)
													0	(23a)
													0	(23b)
													0	(23c)
a) If bala	inced me	chanical	ventilatio	n with he	eat recov	ery (MVH	IR)							
	0	0	0	0	0	0	0	0	0	0	0	0		(24a)
b) If bala	inced me	chanical	ventilatio	on withou	it heat re	covery (N	Л∨)							
	0	0	0	0	0	0	0	0	0	0	0	0		(24b)
c) If who	le house	extract v	entilatior	n or posit	ive input	ventilati	on from o	outside						
N 16 .	0	0	0	0	0	0	0	0	0	0	0	0		(24c)
d) If nati	ural venti	lation or	whole ho	ouse posit	tive input	: ventilati	on from	loft						
Effective	0.56	0.56	0.56	0.55	0.54	0.53	0.53	0.53	0.54	0.54	0.55	0.55		(24d)
Enective	e air chan													()
Effoctive	0.56	0.56	0.56	0.55	0.54	0.53	0.53	0.53	0.54	0.54	0.55	0.55		(25)
Enective	e air chan													()
	0.56	0.56	0.56	0.55	0.54	0.53	0.53	0.53	0.54	0.54	0.55	0.55		(25)

3. Heat losses and heat loss parameter

Items in the table below are to be expanded as necessary	y to allow for all different types of ele	ment e.g. 4 wall types. The k -value
ELEMENT	AXU	AXk

	(W/K)	kJ/K	
Doors	2.1	(26)	
Windows	11.39	(27)	
Roof window	0	(27a)	
Basement floor	0	0 (28)	
Ground floor	0	0 (28a)	
Exposed floor	6.71	4574.25 (28b)	
Basement wall	0	0 (29)	
External wall	8.47	12380.4 (29a)	
Roof	0	0 (30)	
Total area of external elements ∑A, m ²		138.2 (31)	
Party Wall	0	7650 (32)	
Party floor		0 (32a)	
Party ceiling		0 (32b)	





Interna	wall **												0	(33c)
Interna	floor												0	(32d)
Interna	ceiling fl	oor											0	(32e)
Fabric h	eat loss,	W/K = ∑ ((A x U)										28.67	(33)
Heat ca	pacity Cm	n = ∑(A x I	k)										24604.65	(34)
Therma	l mass pa	rameter	(TMP = C	m ÷ TFA)	in kJ/m²ł	<							250	(35)
Linear 1	hermal b	ridges: ∑	(L x Ψ) ca	lculated	using Ap	pendix K							16.54	(36)
Point Tl	Point Thermal bridges: $\sum \chi$ (W/K) if significant point thermal bridge present and values available Total fabric heat loss $H = \sum (A \times U) + \sum (U \times U) + \sum \chi$													(36a)
Total fa	Total fabric heat loss $H = \sum (A \times U) + \sum (L \times \Psi) + \sum \chi$												45.21	(37)
Ventilat	ion heat	loss calcu	lated mo	nthly										
	34	33.85	33.7	33.02	32.9	32.3	32.3	32.19	32.53	32.9	33.15	33.42		(38)
Heat tra	ansfer coe	efficient,	W/K											
	79.21	79.06	78.91	78.23	78.11	77.51	77.51	77.4	77.74	78.11	78.36	78.63		(39)
Heat lo	ss parame	eter (HLP)), W/m²K											
	1.3	1.3	1.29	1.28	1.28	1.27	1.27	1.27	1.27	1.28	1.28	1.29		(40)
Numbe	r of days i	n month	(Table 1a	1)										
	31	28	31	30	31	30	31	31	30	31	30	31		(41)

4. Water heating energy requirement

Assumed occupancy, N	2.01	(42)
Hot water usage in litres per day for mixer showers, Vd, shower (from Appendix J)		. ,
79.63 78.43 76.69 73.35 70.89 68.14 66.58 68.31 70.21 73.16 76.57 79.32 Hot water usage in litres per day for baths, Vd,bath (from Appendix J)		(42a)
26.34 25.95 25.4 24.39 23.63 22.78 22.33 22.87 23.47 24.37 25.41 26.26 Hot water usage in litres per day for other uses, Vd,other (from Appendix J)		(42b)
37.06 35.71 34.37 33.02 31.67 30.32 30.32 31.67 33.02 34.37 35.71 37.06 Annual average hot water usage in litres per day Vd,average (from Appendix J) Hot water usage in litres per day for each month Vd,m = (42a) + (42b) + (42c)	131.74	(42c) (43)
143.04 140.1 136.46 130.76 126.19 121.25 119.23 122.86 126.7 131.9 137.69 142.64 Energy content of hot water used = 4.18 x Vd,m x nm x DTm / 3600 kWh/month (from Appendix J)	1578.81	(44)
226.53 199.5 209.73 179 169.87 149.09 144.2 152.13 156.23 178.98 196.17 223.34 Distribution loss (46) = 0.15 x (45)	2184.78	3 (45)
33.98 29.93 31.46 26.85 25.48 22.36 21.63 22.82 23.43 26.85 29.42 33.5 Storage volume (litres) including any solar or WWHRS storage within same vessel Water storage loss (or HIU loss)	0	(46) (47)
a) If manufacturer's declared loss factor is known (kWh/day):	0	(48)
Temperature factor from Table 2b	0	(49)
Energy lost from water storage, kWh/day (48) x (49) = b) If manufacturer's declared loss factor is not known :	0	(50)
Hot water storage loss factor from Table 2 (kWh/litre/day)	0.14	(51)





Volume factor from Table 2a Temperature factor from Table 2b Energy lost from water storage, kWh/day	0 0 0	(52) (53) (54)
Enter (50) or (54) in (55) Water storage (or HIU) loss calculated for each month (56) = (55) × (41)	0	(55)
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		(56)
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	heat netwo	(57) orks)
128.38 115.95 128.38 124.24 128.38 41.92 43.31 43.31 41.92 128.38 124.24 128.38 Combi loss for each month from Table 3a, 3b or 3c (enter 0 if not a combi boiler)	neutnetwo	(59)
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		(61)
354.91 315.45 338.11 303.24 298.25 191.01 187.52 195.44 198.15 307.36 320.4 351.72 CWWHRS DHW input calculated using Appendix G (negative quantity) (enter 0 if no WWHRS contribution to water hea	3361.55 ting)	5 (62)
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		(63a)
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		(63b)
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		(63c)
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		(63d)
354.91 315.45 338.11 303.24 298.25 191.01 187.52 195.44 198.15 307.36 320.4 351.72 Output from water heater for each month, kWh/month (64) = (62) + (63a) + (63b) + (63c) + (63d)	3361.55	5 (64)
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		(64a)
178.02 159.1 172.44 158.91 159.18 83.11 82.6 85.23 85.48 162.21 164.61 176.96 include (57) m in calculation of (65) m only if hot water store is in the dwelling or hot water is from heat network		(65)

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

Metabolic gains (Table 5), watts

		120.57							120.57	120.57	120.57	120.57	(66)
Lighting	gains (cal	culated i	n Appeno	lix L, equ	ation L12	or L12a)	, also see	Table 5					
Applianc	26.8 ces gains (10.95 quation l					22.14	25.84	27.54	(67)
	261.85	264.56	257.72	243.14	224.74	207.44	195.89	193.17	200.02	214.6	233	250.29	(68)





Cooking gains (calculated in Appendix L, equation L18 or L18a), also see Table 5

Pumps a	49.07 and fans g	49.07 ains (Tab	49.07 le 5a)	49.07	49.07	49.07	49.07	49.07	49.07	49.07	49.07	49.07	(69)
Losses e	3 e.g. evapo	3 ration (ne	3 egative va	3 alues) (Ta	3 Ible 5	0	0	0	0	3	3	3	(70)
Water h	-80.38 eating ga	-80.38 ins (Table	-80.38 e 5)	-80.38	-80.38	-80.38	-80.38	-80.38	-80.38	-80.38	-80.38	-80.38	(71)
Total int	239.28 ernal gai	2001/0	231.77	220.7	213.96	115.42	111.02	114.56	118.72	218.03	228.63	237.85	(72)
	620.18	617.37	601.1	570.75	541.91	421.37	406.16	409.98	425.43	547.02	579.72	607.95	(73)

6. Solar gains

Solar gains in watts, calculated for each month

	34.31	69.84	125.83	206.64	277.77	296.13	277.03	220.85	153.32	85.35	43.17	28.02	(83)
Total gai	ns – inter	nal and s	solar (wat	ts)									
	654.49	687.21	726.93	777.4	819.68	717.51	683.18	630.83	578.76	632.37	622.89	635.96	(84)

7. Mean internal temperature (heating season)

Temper	ature dur	ing heati	ng perioc	ls in the l	iving are	a from Ta	able 9, Th	1 (°C)					21	(85)
Utilisati	on factor	for gains	for living	g area, ⊡1	,m (see T	Table 9a)								
	0.98	0.97	0.95	0.89	0.77	0.65	0.49	0.55	0.79	0.91	0.97	0.98		(86)
Mean ir	iternal te	mperatui	re in livin	g area T1	(follow s	steps 3 ar	nd 4 in Ta	ble 9c)						
	19.83	19.96	20.22	20.57	20.84	20.95	20.99	20.98	20.86	20.59	20.16	19.81		(87)
Temper	ature dur	ing heati	ng perioc	ls in rest	of dwelli	ng from ⁻	Table 9, T	ˈh2 (°C)						
	19.84	19.84	19.85	19.85	19.86	19.86	19.86	19.87	19.86	19.86	19.85	19.85		(88)
Roof				ι	Jtilisatio	n factor f	or gains f	or rest o	fdwelling	g, ⊡2,m (s	ee Table	9a)		
	0.97	0.96	0.94	0.86	0.71	0.55	0.37	0.42	0.7	0.87	0.95	0.98		(89)
Roof					Me	ean inter	nal tempe	erature ir	n the rest	of dwell	ing T2			
	18.54	18.7	19.02	19.44	19.73	19.83	19.86	19.86	19.77	19.48	18.96	18.51		(90)
Living a	rea fractio	on											0.33	(91)
Mean ir	iternal tei	mperatu	re (for the	e whole c	lwelling)									
	18.96	19.12	19.42	19.81	20.09	20.2	20.23	20.23	20.13	19.85	19.36	18.94		(92)
Adjuste	d mean ir	nternal te	mperatu	re:										
	18.96	19.12	19.42	19.81	20.09	20.2	20.23	20.23	20.13	19.85	19.36	18.94		(93)

8. Space heating requirement





Utilisation factor for gains,

Useful g	0.97 ains, mGr	0.96 n,W	0.93	0.86	0.72	0.58	0.41	0.46	0.73	0.87	0.95	0.97		(94)
Monthly	632.77 v average	657.11 external	674.68 temperat	666.89 ture from	590.05 Table U	416.48 1	278.85	291.62	420.58	551.29	590.19	617.04		(95)
Heat los	4.3 s rate for	4.9 mean int	6.5 ernal ter	8.9 nperatur	11.7 e	14.6	16.6	16.4	14.1	10.6	7.1	4.2		(96)
Space he	1161.56 eating rec	5 1124.11 Juiremen			655.52	434.16	281.57	296.38	468.94	722.14	960.57	1158.76		(97)
Solar spa	393.42 ace heatir	313.83 ng calcula			48.71 ix H (neg	0 ative qua	0 antity)	0	0	127.11	266.68	403.04		(98a)
Space he	0 eating rec	0 Juiremen	0 t for each	0 n month a	0 after sola	0 r contrib	0 ution	0	0	0	0	0		(98b)
Space he	393.42 eating rec	313.83 Juiremen				0	0	0	0	127.11	266.68	403.04	31.87	(98c) (99)

8c. Spa	8c. Space Cooling requirement													
Heat loss	eat loss rate,													
Utilisation	0 factor	0 for loss	0	0	0	0	0	0	0	0	0	0		(100)
Useful los	0 s, mLm	0 (watts)	0	0	0	0	0	0	0	0	0	0		(101)
Gains	0	0	0	0	0	0	0	0	0	0	0	0		(102)
Space coo	0 ling req	0 uiremer	0 It for mor	0 nth, whol	0 e dwellin	0 g, contin	0 uous (kW	0 ′h)	0	0	0	0		(103) (104)
Cooled fra Intermitte		0 tor	0	0	0	0	0	0	0	0	0	0	0	(104) (105)
Space coo	0 ling req	0 uiremer	0 It for mor	0 nth	0	0	0	0 0	0	0	0	0	0	(106)
Space coo	0 Iling req	0 uiremer	0 it in kWh,	0 /m²/year	0	0	0	0	0	0	0	0	0	(107) (108)
8f. Spa	ce hea	ting req	uiremen	t										

Fabric Energy Efficie	ency,	0	0	(109)

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





Fraction of space heat from secondary/supplementary system, 0	0	(201)
Fraction of space heat from main system(s),	1	(202)
Fraction of main heating from main system 2,	0	(203)
Fraction of total space heat from main system 1,	1	(204)
Fraction of total space heat from main system 2,	0	(205)
Efficiency of main space heating system 1 (in %),	249.9	(206)
Efficiency of main space heating system 2 (in %),	0	(207)
Efficiency of secondary/supplementary heating system, %,	0	(208)
Cooling System Seasonal Energy Efficiency Ratio, 0	0	(209)
Space heating requirement (calculated above),		
0 0 0 0 0 0 0 0 0 0 0		(210)
Space heating fuel (main heating system 1), kWh/month 0	0	
157.43 125.58 102.69 53.78 19.49 0 0 0 0 50.86 106.71 161.28		(211)
Space heating fuel (main heating system 2), kWh/month 0	0	
		(213)
Space heating fuel (secondary), kWh/month 0	0	
		(215)
Output from water heater), 0	175.1	(216)
Efficiency of water heater		
175.1 175.1 175.1 175.1 175.1 175.1 175.1 175.1 175.1 175.1 175.1 175.1		(217)
Fuel for water heating		
202.69 180.16 193.09 173.18 170.33 109.08 107.09 111.62 113.16 175.53 182.98 200.87	1919.79	(219)
Space Cooling		()
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		(221)
Annual totals kWh/year kWh/year Space heating fuel used, main system 1	777 00	(244)
Space heating fuel used, main system 2	777.83	(211)
Space heating fuel used, main system 2 Space heating fuel used, secondary	0	(213)
Water heating fuel used	0	(215)
Electricity for instantaneous electric shower(s)	1919.79	(219)
Space cooling fuel used	0	(64a)
Electricity for pumps, fans and electric keep-hot	0	(221)
Mechanical vent fans - balanced, extract or positive input from outside 0 0	0	(230a)
warm air heating system fans	0	(230a) (230b)
Heating circulation pump or water pump within warm air heating unit	0	(2300) (230c)
Oil boiler auxiliary (oil pump, flue fan, etc; excludes circulation pump)	0	(2300) (230d)
Gas boiler auxiliary (flue fan, etc; excludes circulation pump)	0	(230u) (230e)
Maintaining electric keep-hot facility for gas combi boiler	0	(230e) (230f)
Pump for solar water heating	0	(2301) (230g)
Pump for storage WWHRS	0	(230g) (230h)
Total electricity for the above	0	(2301)
Electricity for lighting	189.31	(231)
	100.01	(202)





Energy savin Electricity ge							ised in dv	velling					
0 Electricity ge	0 nerated by	0 wind tur	0 bines (Ap	0 pendix N	0 ⁄I) (negati	0 ive quant	0 :ity)	0	0	0	0	0	(233a)
0 Electricity ge	0 nerated by	0 hydro-el	0 ectric ger	0 nerators	0	0	0	0	0	0	0	0	(234a)
0 Electricity us	0 ed or net el	0 ectricity	0 generate	0 d by mici	0 ro-CHP	0	0	0	0	0	0	0	(235a)
	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0												
0 Electricity ge	0 nerated by	0 wind tur	0 bines (Ap	0 pendix N	0 ⁄I) (negati	0 ive quant	0 ity)	0	0	0	0	0	(233b)
0 Electricity ge	0 nerated by	0 hydro-el	0 ectric ger	0 nerators	0	0	0	0	0	0	0	0	(234b)
0 Electricity us	0 ed or net el	0 ectricity	0 generate	0 d by mici	0 ro-CHP	0	0	0	0	0	0	0	(235b)
0 Appendix Q Appendix Q,				0	0	0	0	0	0	0	0	0	(235d)
energy saved energy used Total deliver	ł	·					Fue	21	kWh/yea	I		0 0 2886.93	(236a) (237a)

10a. Fuel costs – Individual heating systems including micro-CHP

Fuel required	kWh/year	Fuel price	Fuel cost £/yea	ar
Space heating - main system 1 (electric off-peak tariff				
High-rate fraction (Table 12a, or Appendix F for electric CPSU)	0		128.26	(240a)
Low-rate fraction	0		128.26	(240b)
High-rate cost	0		0	(240c)
Low-rate cost	0		0	(240d)
Space heating - main system 1 cost (other fuel)	0		0	(240e)
Space heating - main system 2 (electric off-peak tariff				
High-rate fraction (Table 12a, or Appendix F for electric CPSU)	0		128.26	(241a)
Low-rate fraction	0		128.26	(241b)
High-rate cost	0		0	(241c)
Low-rate cost	0		0	(241d)
Space heating - main system 2 cost (other fuel)	0		0	(241e)
Space heating - secondary (electric off-peak tariff)				
High-rate fraction (Table 12a, or Appendix F for electric CPSU)	0		128.26	(242a)





Low-rate fraction	0		128.26	(242b)
High-rate cost	0		0	(242c)
Low-rate cost	0		0	(242d)
Space heating - secondary cost (other fuel)	0		0	(242e)
Water heating (electric off-peak tariff)				
High-rate fraction (Table 12a, or Appendix F for electric CPSU)	0		0	(243)
Low-rate fraction	0		0	(242b)
High-rate cost	0		0	(242c)
Low-rate cost	0		0	(242d)
Water heating cost (other fuel)	0		316.57	(247)
(for a DHW-only heat network use (342a) or (342b) instead of (247)				
Energy For instantaneous electric shower(s)	0		0	(247a)
Space cooling	0		0	(248)
Pumps, fans And electric keep-hot	0		0	(249)
Energy For lighting	0		31.22	(250)
Additional standing charges	0		0	(251)
Energy saving/generation technologies	0		0	(252)
Appendix Q, <item 1="" description=""></item>	Fuel	kWh/year		
energy saved Or generated	0		0	(253)
energy used	0		0	(254)
Total energy cost	0		476.06	(255)
11a. SAP rating – Individual heating systems including micro-CHP				
Energy cost deflator	0		0	(256)
Energy cost factor (ECF)	0		0	(257)
SAP rating	0		0	(258)

11a. SAP rating – Individual heating systems including micro-CHP		
Energy cost deflator	0.36	(256)
Energy cost factor (ECF)	1.62	(257)
SAP rating	73.79	(258)
12a. CO2 emissions – Individual heating systems including micro-CHP		

Energy **Emission factor** Emissions KWh/year kg kg CO2/year Space heating - main system 1 121.05 (261) Space heating - main system 2 0 (262) Space heating - secondary 0 (263) Energy for water heating 274.18 (264) Energy for instantaneous electric shower(s) 0 (264a)





Space and water heating		0	(265)
Space cooling		0	(266)
Electricity for pumps, fans and electric keep		0	(267)
Electricity for lighting		27.32	(268)
energy saved or generated	0	0	(269b)
Appendix Q items			
energy saved	0	0	
energy used	0	0	
energy saved	0	0	(270b)
energy used		0	(271b)
Total CO2, kg/year		422.56	(272)
Dwelling CO2 Emission Rate		6.93	(273)
El rating		95	(274)

13a. Primary Energy – Individual heating systems including micro-CHP

	Energy Emission facto	or Emissionsr
	KWh/year kg	kg CO2/year
Space heating - main system 1		1225.99 (275)
Space heating - main system 2		0 (276)
Space heating - secondary		0 (277)
Energy for water heating		2933.87 (278)
Energy for instantaneous electric shower(s)		0 (278a)
Space and water heating		0 (279)
Space cooling		0 (280)
Electricity for pumps, fans and electric keep		0 (281)
Electricity for lighting		290.37 (282)
energy saved or generated	0	0
Appendix Q items		
energy saved	0	0
energy used	0	0
energy saved	0	0 (284b)
energy used		0 (285b)
Total PE, kWh/year		4450.24 (286)
Dwelling PE Rate		72.97 (287)







Dwelling Reference: Dwelling Type: EN5 5SU

Unit 02 Existing Dwelling

1. Overall dwelling dimensions					
	Area(m²)	Av. Height(r	m)	Volume(m³)	
Ground Floor Total floor area TFA	51.82 (1a) x 3	(2a) =	155.46	(3a)
Dwelling volume				51.82 155.46	(4) (5)
2. Ventilation Rate					
Chimneys/Flues	0	x 80 =		0	(6a)
Open chimneys	0	x 20 =		0	(6b)
Chimneys / flues attached to closed fire	0	x 10 =		0	(6c)
Flues attached to solid fuel boiler	0	x 20 =		0	(6d)
Flues attached to other heater	0	x 35 =		0	(6e)
Number of blocked chimneys	0	x 20 =		0	(6f)
Number of intermittent extract fans	2	x 10 =		20	(7a)
Number of passive vents	0	x 10 =		0	(7b)
Number of flueless gas fires	0	x 40 =		0	(7c)
		Air changes	per hour		
Number of storeys in the dwelling (ns)			0.13	0.13	(8)
Infiltration due to chimneys, flues, fans, PSVs, etc			0	0	(9)
Additional infiltration Structural infiltration			0	0	(10)
Suspended wooden ground floor			0 0	0 0	(11) (12)
No draught lobby			0	0	(12)
Percentage of windows and doors draught proofed			0	0	(14)
Window infiltration			0	0	(15)
Infiltration rate			0	0	(16)
Air permeability value, AP50, (m³/h/m²) Air permeability value, AP4, (m³/h/m²)			5	5	(17)
Air permeability value)			0 0.38	0 0.38	(17a) (18)
Number of sides on which dwelling is sheltered			3	3	(18)
Shelter factor			0	0.78	(20)
Infiltration rate incorporating shelter factor				0.29	(21)
Infiltration rate modified for monthly wind speed					. /
Jan Feb Mar Apr May Jun	Jul Aug	Sep Oct I	Nov Dec	Total	(22)







Monthly average wind speed from Table U2

	Wind Fac	5.1 ctor	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7	52.5	(22)
	Adjusted	1.28 d infiltrati	1.25 on rate (a	1.23 allowing	1.1 for shelte	1.08 er and wi	0.95 nd speed	0.95)	0.93	1	1.08	1.13	1.18	13.13	(22a)
	Calculate	0.37 e effectiv	0.37 e air char	0.36 nge rate f	0.32 for the ap	0.32 oplicable	0.28 case:	0.28	0.27	0.29	0.32	0.33	0.34	3.85	(22b)
														0	(23a)
														0	(23b)
														0	(23c)
a) If balanced mechanical ventilation with heat recovery (MVHR)															
		0	0	0	0	0	0	0	0	0	0	0	0		(24a)
	b) If bala	anced me	chanical	ventilatio	on withou	it heat re	covery (N	∕IV)							
		0	0	0	0	.0.	0	0	0	0	0	0	0		(24b)
	c) If who	ole house	extract v	entilatio	n or posit	ive input	ventilati	on from o	outside						
	-I) I f	0	0	0	0	0	0	0	0	0	0	0	0		(24c)
	d) if hatt	ural venti	lation or	whole no	ouse posi	•									
	Effective	0.57	0.57	0.56	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.55	0.56		(24d)
	Ellective	e air chan	-												(25)
	Effective	0.57 air chan	0.57 ge rate fr	0.56	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.55	0.56		(25)
	LITECTIVE		-												(25)
		0.57	0.57	0.56	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.55	0.56		(25)

3. Heat losses and heat loss parameter

Items in the table below are to be expanded as nec	essary to allow for all different types of eleme	ent e.g. 4 wall types. The k -value	
ELEMENT	A X U (W/K)	A X k kJ/K	
Doors	2.1	(26)	
Windows	5.89	(27)	
Roof window	0	(27a)	
Basement floor	0	0 (28)	
Ground floor	0	0 (28a)	
Exposed floor	5.7	3886.5 (28b)	
Basement wall	0	0 (29)	
External wall	7.58	11075.1 (29a)	
Roof	0	0 (30)	
Total area of external elements ∑A, m ²		117.35 (31)	
Party Wall	0	5482.8 (32)	
Party floor		0 (32a)	
Party ceiling		0 (32b)	





Internal	wall **												0	(33c)
Internal	floor												0	(32d)
Internal ceiling floor											0	(32e)		
Fabric h	eat loss,	W/K = ∑ (AxU)										21.26	(33)
Heat ca	oacity Cm	n = ∑(A x ł	<)										20444.4	(34)
Therma	l mass pa	rameter	(TMP = C	m ÷ TFA)	in kJ/m²ł	<							250	(35)
Linear Thermal bridges: Σ (L x Ψ) calculated using Appendix K									12.8	(36)				
Point Thermal bridges: $\Sigma \chi$ (W/K) if significant point thermal bridge present and values available								12.8	(36a)					
Total fal	oric heat	loss H = ∑	5(A × U) +	· Σ(L × Ψ)	+∑χ								34.06	(37)
Ventilat	ion heat	loss calcu	lated mo	nthly										
	29.24	29.1	28.97	28.32	28.2	27.64	27.64	27.54	27.86	28.2	28.45	28.7		(38)
Heat tra	nsfer coe	efficient,	W/K											
	63.3	63.16	63.02	62.38	62.26	61.7	61.7	61.6	61.92	62.26	62.51	62.76		(39)
Heat los	s parame	eter (HLP)	, W/m²K											
	1.22	1.22	1.22	1.2	1.2	1.19	1.19	1.19	1.19	1.2	1.21	1.21		(40)
Number	of days i	n month	(Table 1a	a)										
	31	28	31	30	31	30	31	31	30	31	30	31		(41)

4. Water heating energy requirement

Assumed occupancy, N	1.74	(42)						
Hot water usage in litres per day for mixer showers, Vd,shower (from Appendix J)								
73.5 72.4 70.79 67.71 65.44 62.9 61.46 63.06 64.81 67.53 70.68 73.22 Hot water usage in litres per day for baths, Vd,bath (from Appendix J)		(42a)						
24.33 23.97 23.46 22.52 21.82 21.04 20.62 21.12 21.67 22.51 23.46 24.25		(42b)						
Hot water usage in litres per day for other uses, Vd,other (from Appendix J)								
34.2 32.95 31.71 30.47 29.22 27.98 27.98 29.22 30.47 31.71 32.95 34.2		(42c)						
Annual average hot water usage in litres per day Vd,average (from Appendix J) Hot water usage in litres per day for each month Vd,m = (42a) + (42b) + (42c)	121.61	(43)						
132.03 129.32 125.96 120.7 116.48 111.92 110.06 113.4 116.95 121.75 127.09 131.66 Energy content of hot water used = 4.18 x Vd,m x nm x DTm / 3600 kWh/month (from Appendix J)	1457.31	(44)						
209.1 184.15 193.59 165.23 156.8 137.62 133.11 140.42 144.21 165.21 181.07 206.15 Distribution loss (46) = 0.15 x (45)	2016.65	(45)						
31.37 27.62 29.04 24.78 23.52 20.64 19.97 21.06 21.63 24.78 27.16 30.92		(46)						
Storage volume (litres) including any solar or WWHRS storage within same vessel	0	(47)						
Water storage loss (or HIU loss)								
a) If manufacturer's declared loss factor is known (kWh/day):	0	(48)						
Temperature factor from Table 2b	0	(49)						
Energy lost from water storage, kWh/day (48) x (49) =	0	(50)						
b) If manufacturer's declared loss factor is not known : Hot water storage loss factor from Table 2 (kWh/litre/day)								





Volume factor from Table 2a Temperature factor from Table 2b Energy lost from water storage, kWh/day	0 0 0	(52) (53) (54)
Enter (50) or (54) in (55) Water storage (or HIU) loss calculated for each month (56) = (55) × (41)	0	(55)
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		(56)
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	heat netwo	(57) orks)
128.38 115.95 128.38 124.24 128.38 41.92 43.31 43.31 41.92 128.38 124.24 128.38 Combi loss for each month from Table 3a, 3b or 3c (enter 0 if not a combi boiler)		(59)
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		(61)
337.48 300.1 321.97 289.46 285.18 179.53 176.42 183.73 186.13 293.59 305.31 334.53 CWWHRS DHW input calculated using Appendix G (negative quantity) (enter 0 if no WWHRS contribution to water heat	3193.42 ting)	2 (62)
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		(63a)
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		(63b)
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		(63c)
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		(63d)
337.48 300.1 321.97 289.46 285.18 179.53 176.42 183.73 186.13 293.59 305.31 334.53 Output from water heater for each month, kWh/month (64) = (62) + (63a) + (63b) + (63c) + (63d)	3193.42	2 (64)
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		(64a)
172.23 153.99 167.07 154.33 154.84 79.29 78.91 81.34 81.48 157.63 159.59 171.25 include (57) m in calculation of (65) m only if hot water store is in the dwelling or hot water is from heat network		(65)

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

Metabolic gains (Table 5), watts

	104.63	104.63	104.63	104.63	104.63	104.63	104.63	104.63	104.63	104.63	104.63	104.63	(66)
Lighting §	gains (cal	culated i	n Append	lix L, equ	ation L12	or L12a)	, also see	e Table 5					
	25.06	22.26	18.1	13.7	10.24	8.65	9.35	12.15	16.3	20.7	24.16	25.76	(67)
Applianc	es gains (calculate	ed in App	endix L, e	quation I	16 or L1	6a), also	see Table	25				
	226.8	229.16	223.23	210.6	194.66	179.68	169.68	167.32	173.25	185.88	201.82	216.8	(68)





Cooking gains (calculated in Appendix L, equation L18 or L18a), also see Table 5

Pumps	47.21 and fans g	47.21 gains (Tab	47.21 le 5a)	47.21	47.21	47.21	47.21	47.21	47.21	47.21	47.21	47.21	(69)
Losses	3 e.g. evapo	3 ration (ne	3 egative va	3 alues) (Ta	3 Ible 5	0	0	0	0	3	3	3	(70)
Water	-69.75 heating ga	00170	-69.75 e 5)	-69.75	-69.75	-69.75	-69.75	-69.75	-69.75	-69.75	-69.75	-69.75	(71)
Total ir	231.49 Iternal gai	229.16 ns	224.56	214.34	208.12	110.13	106.06	109.33	113.17	211.87	221.66	230.17	(72)
	568.44	565.65	550.97	523.73	498.1	380.54	367.16	370.88	384.81	503.54	532.72	557.81	(73)

6. Solar gains

Solar gains in watts, calculated for each month

5	57.8	98.45	134.7	166.91	186.95	185.6	178.93	163.98	145.86	108.81	69.23	49.46	(83)
Total gains	– inter	nal and s	olar (wat	ts)									
6	526.23	664.1	685.67	690.64	685.05	566.14	546.1	534.86	530.67	612.35	601.95	607.27	(84)

7. Mean internal temperature (heating season)

Temper	ature dur	ing heati	ng perioc	ls in the l	iving are	a from Ta	able 9, Th	1 (°C)					21	(85)
Utilisati	on factor	for gains	for living	garea, 🛛 1	,m (see T	Table 9a)								
	0.97	0.95	0.92	0.86	0.75	0.66	0.49	0.52	0.73	0.85	0.94	0.97		(86)
Mean in	iternal tei	mperatur	re in livin	g area T1	(follow s	steps 3 ar	nd 4 in Ta	ble 9c)						
	20.08	20.21	20.43	20.68	20.87	20.95	20.99	20.99	20.92	20.74	20.38	20.05		(87)
Temper	ature dur	ing heati	ng perioc	ls in rest	of dwelli	ng from ⁻	Table 9, T	'n2 (°C)						
	19.9	19.9	19.91	19.92	19.92	19.93	19.93	19.93	19.92	19.92	19.92	19.91		(88)
Roof				ι	Jtilisatio	n factor f	or gains f	or rest o	fdwelling	g, ⊡2,m (s	ee Table	9a)		
	0.96	0.94	0.9	0.83	0.69	0.56	0.37	0.4	0.64	0.81	0.92	0.96		(89)
Roof					Me	ean inter	nal temp	erature in	n the rest	of dwell	ing T2			
	18.88	19.05	19.31	19.61	19.82	19.9	19.92	19.92	19.87	19.69	19.27	18.85		(90)
Living a	rea fractio	on											0.45	(91)
Mean in	iternal tei	mperatur	re (for the	e whole o	welling)									
	19.42	19.58	19.81	20.09	20.29	20.37	20.4	20.4	20.34	20.16	19.77	19.39		(92)
Adjuste	d mean in	nternal te	mperatu	re:										
	19.42	19.58	19.81	20.09	20.29	20.37	20.4	20.4	20.34	20.16	19.77	19.39		(93)

8. Space heating requirement





Utilisation factor for gains,

Useful ga	0.95 ains, mGr	0.93 n,W	0.9	0.83	0.71	0.6	0.43	0.46	0.68	0.82	0.92	0.96		(94)
Monthly	595.19 average	619.65 external		575.55 ture from			232.59	243.58	360.04	500.51	553.98	580.28		(95)
Heat los	4.3 s rate for	4.9 mean int	6.5 ernal ter	8.9 nperatur	11.7 e	14.6	16.6	16.4	14.1	10.6	7.1	4.2		(96)
Space he	957.1 eating rec	926.91 Juiremen		698.1 n month	534.95	356.29	234.76	246.61	386.57	595.48	791.98	953.39		(97)
Solar spa	269.26 ace heatir	206.48 ng calcula			34.33 ix H (neg	0 ative qua	0 antity)	0	0	70.66	171.35	277.6		(98a)
Space he	0 eating rec	0 Juiremen	0 t for each	0 n month a	0 after sola	0 r contrib	0 ution	0	0	0	0	0		(98b)
Space he	269.26 eating rec		165.33 t in kWh/		34.33	0	0	0	0	70.66	171.35	277.6	24.76	(98c) (99)

8c. Sp	bace Coo	oling rec	quiremer	ıt										
Heat los	s rate,													
Utilisatio	0 on factor	0 for loss	0	0	0	0	0	0	0	0	0	0		(100)
Useful lo	0 oss, mLm	0 (watts)	0	0	0	0	0	0	0	0	0	0		(101)
Gains	0	0	0	0	0	0	0	0	0	0	0	0		(102)
Space co	0 poling rea	0 quiremer	0 nt for mor	0 nth, whol	0 e dwellin	0 g, contin	0 uous (kW	0 ′h)	0	0	0	0		(103) (104)
Cooled f Intermit	0 Fraction tency fac	0 ctor	0	0	0	0	0	0	0	0	0	0	0	(104) (105)
Space co	0 poling rea	0 quiremer	0 nt for mor	0 nth	0	0	0	0 0	0	0	0	0	0	(106)
Space co	0 Doling rea	0 quiremer	0 nt in kWh,	0 /m²/year	0	0	0	0	0	0	0	0	0	(107) (108)
06.5	h		uiromon											

8f. Space heating requirement

Fabric Energy Efficiency,

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



0

(109)

SAP WORKSHEET

0



Fraction of space heat from secondary/supplementary system, 0 Fraction of space heat from main system(s), Fraction of main heating from main system 2, Fraction of total space heat from main system 1, Fraction of total space heat from main system 2, Efficiency of main space heating system 1 (in %), Efficiency of main space heating system 2 (in %), Efficiency of secondary/supplementary heating system, %,	0 1 0 1 0 249.9 0 0	(201) (202) (203) (204) (205) (206) (207) (208)
Cooling System Seasonal Energy Efficiency Ratio,	0	(209)
Space heating requirement (calculated above),		
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0	(210)
107.75 82.62 66.16 35.31 13.74 0 0 0 0 28.27 68.57 111.08		(211)
Space heating fuel (main heating system 2), kWh/month 0	0	(212)
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0	(213)
	0	(215)
Output from water heater), 0	175.1	(216)
Efficiency of water heater		(-)
175.1 175.1 175.1 175.1 175.1 175.1 175.1 175.1 175.1 175.1 175.1 175.1 175.1 175.1 175.1 175.1		(217)
192.73 171.39 183.88 165.31 162.87 102.53 100.75 104.93 106.3 167.67 174.36 191.05	1823.77	7 (219)
Space Cooling		
0 0 0 0 0 0 0 0 0 0 0		(221)
Annual totals kWh/year kWh/year		
Space heating fuel used, main system 1	513.5	(211)
Space heating fuel used, main system 2 Space heating fuel used, secondary	0	(213)
Water heating fuel used	0	(215)
Electricity for instantaneous electric shower(s)	1823.77	(219)
Space cooling fuel used	0	(64a)
Electricity for pumps, fans and electric keep-hot	0	(221)
Mechanical vent fans - balanced, extract or positive input from outside 0 0	0	(230a)
warm air heating system fans	0	(230a) (230b)
Heating circulation pump or water pump within warm air heating unit	0	(2300) (230c)
Oil boiler auxiliary (oil pump, flue fan, etc; excludes circulation pump)	0	(230d)
Gas boiler auxiliary (flue fan, etc; excludes circulation pump)	0	(230d) (230e)
Maintaining electric keep-hot facility for gas combi boiler	0	(230c) (230f)
Pump for solar water heating	0	(230g)
Pump for storage WWHRS	0	(230h)
Total electricity for the above		
	0	(231)
Electricity for lighting	0 177.03	(231) (232)





Energy sa Electricity								ed in dwe	elling					
Electricity	0 generat	0 ted by w	0 ind turbi	0 nes (Appe	0 endix M)	0 (negative	0 e quantit	0 y)	0	0	0	0	0	(233a)
Electricity	0 generat	0 ted by hy	0 ydro-elec	0 tric gene	0 rators	0	0	0	0	0	0	0	0	(234a)
Electricity	0 v used or	0 net elec	0 ctricity ge	0 enerated	0 by micro	0 -CHP	0	0	0	0	0	0	0	(235a)
Energy sa Electricity								0 ported	0	0	0	0	0	(235c)
Electricity	0 generat	0 ted by w	0 ind turbi	0 nes (Appe	0 endix M)	0 (negative	0 e quantit	0 y)	0	0	0	0	0	(233b)
Electricity	0 generat	0 ted by hy	0 ydro-elec	0 tric gene	0 rators	0	0	0	0	0	0	0	0	(234b)
Electricity	0 v used or	0 net elec	0 ctricity ge	0 enerated	0 by micro	0 -CHP	0	0	0	0	0	0	0	(235b)
Appendix			•.	0	0	0	0	0	0	0	0	0	0	(235d)
Appendix energy sa energy us Total deliv	ved ed							Fuel		kWh/year			0 0 2514.31	(236a) (237a)

10a. Fuel costs – Individual heating systems including micro-CHP

Fuel required	kWh/year	Fuel price	Fuel cost £/ye	ar
Space heating - main system 1 (electric off-peak tariff				
High-rate fraction (Table 12a, or Appendix F for electric CPSU)	0		84.68	(240a)
Low-rate fraction	0		84.68	(240b)
High-rate cost	0		0	(240c)
Low-rate cost	0		0	(240d)
Space heating - main system 1 cost (other fuel)	0		0	(240e)
Space heating - main system 2 (electric off-peak tariff				
High-rate fraction (Table 12a, or Appendix F for electric CPSU)	0		84.68	(241a)
Low-rate fraction	0		84.68	(241b)
High-rate cost	0		0	(241c)
Low-rate cost	0		0	(241d)
Space heating - main system 2 cost (other fuel)	0		0	(241e)
Space heating - secondary (electric off-peak tariff)				
High-rate fraction (Table 12a, or Appendix F for electric CPSU)	0		84.68	(242a)





Low-rate fraction	0		84.68	(242b)
High-rate cost	0		0	(242c)
Low-rate cost	0		0	(242d)
Space heating - secondary cost (other fuel)	0		0	(242e)
Water heating (electric off-peak tariff)				
High-rate fraction (Table 12a, or Appendix F for electric CPSU)	0		0	(243)
Low-rate fraction	0		0	(242b)
High-rate cost	0		0	(242c)
Low-rate cost	0		0	(242d)
Water heating cost (other fuel)	0		300.74	(247)
(for a DHW-only heat network use (342a) or (342b) instead of (247)				
Energy For instantaneous electric shower(s)	0		0	(247a)
Space cooling	0		0	(248)
Pumps, fans And electric keep-hot	0		0	(249)
Energy For lighting	0		29.19	(250)
Additional standing charges	0		0	(251)
Energy saving/generation technologies	0		0	(252)
Appendix Q, <item 1="" description=""></item>	Fuel	kWh/year		
energy saved Or generated	0		0	(253)
energy used	0		0	(254)
Total energy cost	0		414.61	(255)
11a. SAP rating – Individual heating systems including micro-CHP				
Energy cost deflator	0		0	(256)
Energy cost factor (ECF)	0		0	(257)
SAP rating	0		0	(258)

11a. SAP rating – Individual heating systems including micro-CHP		
Energy cost deflator	0.36	(256)
Energy cost factor (ECF)	1.54	(257)
SAP rating	75.01	(258)
12a. CO2 emissions – Individual heating systems including micro-CHP		

	Energy	Emission factor	Emissions	
	KWh/year	kg	kg CO2/year	
Space heating - main system 1			80.07	(261)
Space heating - main system 2			0	(262)
Space heating - secondary			0	(263)
Energy for water heating			260.59	(264)
Energy for instantaneous electric shower(s)			0	(264a)





Space and water heating		0	(265)
Space cooling		0	(266)
Electricity for pumps, fans and electric keep		0	(267)
Electricity for lighting		25.55	(268)
energy saved or generated	0	0	(269b)
Appendix Q items			
energy saved	0	0	
energy used	0	0	
energy saved	0	0	(270b)
energy used		0	(271b)
Total CO2, kg/year		366.21	(272)
Dwelling CO2 Emission Rate		7.07	(273)
El rating		95	(274)

13a. Primary Energy – Individual heating systems including micro-CHP

	Energy Emission factor	Emissionsr
	KWh/year kg	kg CO2/year
Space heating - main system 1		809.95 (275)
Space heating - main system 2		0 (276)
Space heating - secondary		0 (277)
Energy for water heating		2787.59 (278)
Energy for instantaneous electric shower(s)		0 (278a)
Space and water heating		0 (279)
Space cooling		0 (280)
Electricity for pumps, fans and electric keep		0 (281)
Electricity for lighting		271.54 (282)
energy saved or generated	0	0
Appendix Q items		
energy saved	0	0
energy used	0	0
energy saved	0	0 (284b)
energy used		0 (285b)
Total PE, kWh/year		3869.08 (286)
Dwelling PE Rate		74.66 (287)

