mza planning
planning permission without the headaches

14 Devonshire Mews, Chiswick, London W4 2HA
Tel: 020 8995 7848 Fax: 020 8711 5732 office@mzaplanning.com www.mzaplanning.com

TOWN AND COUNTRY PLANNING ACT 1990
(AS AMENDED)

PLANNING STATEMENT

Retrospective application for 3 x AC Units on the roof

9 BRIARY CLOSE, LONDON NW3 3JZ

CONTENTS

APPENDICES

1 SITE AND SURROUNDINGS

1.1 The application site is a residential property located at 9 Briary Close, London NW3 3JZ. It is a four-storey terraced residential premises located on the southern side of the close.

1.2 The surrounding area is predominantly residential, with similar terraced properties adjacent to the site. The south is bounded by Adelaide Road, with further residential properties located on the southern side.

1.3 The application site is not within a Conservation Area nor is the building listed. However, the Belsize Park Conservation is in the nearby vicinity.

2 PLANNING HISTORY

2.1 The following applications are considered relevant to the proposal.

- A planning application for a certificate of lawfulness (proposed) was granted for '*Installation of new Air Source Heat Pump (ASHP) for heating on the roof of dwellinghouse'* on 14/07/2022

- A Planning application for '*Erection of an additional storey to dwellinghouse*' was granted prior approval on 21/01/2022

3 PROPOSED DEVELOPMENT

3.1 The proposal is to install 3 air conditioning units on the roof of the property at 9 Briary Close. This statement should be read alongside the accompanying Overheating Risk & Energy Assessment prepared by L2 Energy Consulting and the Plant Noise Assessment prepared by RBA Acoustics.

3.2 Such installations have important environmental and health benefits. Air conditioning units enable homes to be heated and cooled more sustainably, especially given family needs at times of unusually high temperatures or poor air quality. This has become more important given recent events affecting energy supplies and the effects of climate change where alternatives to fossil fuels are being sought.

4 PLANNING POLICY

- MCHLG National Planning Policy Framework (2023)
- GLA London Plan (2021)
- Camden Local Plan (2017)

Camden Local Plan (2017)

4.1 Policy A1 'Managing the impact of development' seeks to protect the amenity of existing and future occupiers from adverse impacts.

4.2 Policy A4 'Noise and vibration' states that '*We will only grant permission for noise generating development, including any plant and machinery, if it can be operated without causing harm to amenity'.*

4.3 Policy CC1 'Climate change mitigation' supports the use of technologies that reduce carbon emissions and improve sustainability.

4.4 Policy CC2 'Adapting to climate change' encourages development to be adapted to extreme weather events, including heatwaves.

4.5 Policy D1 'Design' requires a high-quality design that preserves or enhances the local character.

5 PLANNING ASSESSMENT

Principle of development

5.1 The principle of installing an air conditioning unit to serve a residential property is considered acceptable, subject to the proposal not causing harm to residential amenities or the character and appearance of the area.

Design, character and appearance

5.2 The proposed air conditioning units have been discreetly placed on the roof of the property. This location ensures that the visibility of the AC units is limited. They will not be easily visible from the public domain and therefore do not have any substantive detrimental effect on the surrounding area.

5.3 The proposal therefore complies with Policy D1 of the Camden Local Plan

Residential amenities

5.4 As confirmed by the Plant Noise Assessment accompanying this application, RBA Acoustics concluded that '*that noise from the operation of the installed plant is expected to be at least 10dB below the otherwise prevailing background sound level, meeting the requirements of London Borough of Camden'.*

5.5 The assessment indicates that the total noise level at the nearest receptor location will be 25dB, which is well within the recommended plant noise emission limits of 34dB for daytime and 30dB for night-time.

5.6 As a result, it is confirmed that the proposed air conditioning units can be installed with no detrimental harm to neighbouring amenities. The proposal therefore complies with Policy A1 and A4 of the Camden Local Plan.

Energy and climate change

5.7 The Overheating Risk & Energy Assessment demonstrates that the installation of the air conditioning units, as part of a broader refurbishment, has contributed to a significant reduction in energy use and CO2 emissions. The assessment shows a 75% reduction in energy use and an 81% reduction in CO2 emissions as a result of the refurbishment works undertaken, which included the installation of the air conditioning units.

5.8 Additionally, the refurbishment includes the removal of gas mains, further highlighting the applicant's commitment to reducing reliance on fossil fuels.

5.9 The assessment also demonstrates that overheating is expected within the building even following extensive refurbishment, justifying the need for the air conditioning units. The inclusion of the units does not adversely affect energy use or CO2 emissions when considered as part of the overall energy strategy for the property.

5.10 It should also be noted that the applicant has installed solar panels on the property ref:2022/2231/P which also contributes to the reduction of

energy use at the site. In addition, the applicant has a battery installed which stores the solar energy which is utilised day and night to power various electronics including the AC units.

5.11 The results of improvements at the home have resulted in an EPC rating of B which demonstrates the applicant's importance in ensuring an energy-efficient home. The application site is now one of the highest EPC ratings on the Chalcots Estate.

5.12 These findings align with Policies CC1 and CC2 of the Camden Local Plan, supporting climate change mitigation and adaptation measures.

Health Benefits

5.13 The air conditioning units provide significant health benefits to the applicants, who suffer from hay fever. By allowing windows to remain closed during high pollen periods while maintaining a comfortable indoor environment, the units contribute to the applicants' well-being and quality of life by filtering out the pollen.

6 CONCLUSION

6.1 The proposed development would be in keeping with the character and appearance of the host property and surroundings, as the units will barely be visible from the public domain.

6.2 The proposed development would protect the amenity of neighbouring occupants as the units are demonstrably capable of avoiding harmful noise levels, as shown by the supporting Plant Noise Assessment.

6.3 It is considered that given the fact that the units are obscured from the public domain, would not cause adverse effects to neighbouring amenities, and contribute to energy efficiency and health benefits, the development would be fully compliant with the relevant policies of the Camden Local Plan (2017).

6.4 The Council are respectfully requested to grant planning permission for the proposed development.

APPENDIX 1

Noise Impact Assessment (RBA Acoustics)

9 BRIARY CLOSE, LONDON, NW3 3JZ

Plant Noise Assessment

Reference: 13663.RP01.PNA.2
Prepared: 19 August 2024
Revision Number: 2

Ashley Donoff
9 Briary Close
London
NW3 3JZ

Plant Noise Assessment

9 BRIARY CLOSE, LONDON, NW3 3JZ

Reference: 13663.RP01.PNA.2
Prepared: 19 August 2024

Revision	Comment	Date	Prepared By	Approved By
0	First issue of report	16 July 2024	Patrick Spiers	Martin Raisborough
1	Minor amendments based on client feedback	30 July 2024	Patrick Spiers	Martin Raisborough
2	Inclusion of updated drawing in Appendix B	19 August 2024	Patrick Spiers	Martin Raisborough

Terms of contract:

RBA Acoustics Ltd has prepared this report in accordance with our Scope of Work 13663.ACB01.0 dated 24 April 2023. RBA Acoustics Ltd shall not be responsible for any use of the report or its contents for any purpose other than that for which it was provided. Should the Client require the distribution of the report to other parties for information, the full report should be copied. No professional liability or warranty shall be extended to other parties by RBA Acoustics Ltd without written agreement from RBA Acoustics Ltd.

The recommendations within this report relate to acoustics performance only and will need to be integrated within the overall design by the lead designer to incorporate all other design disciplines such as fire, structural integrity, setting-out, etc. Similarly, any sketches appended to this report illustrate acoustic principles only and again will need to be developed in to full working drawings by the lead designer to incorporate all other design disciplines.

RBA ACOUSTICS

LONDON
44 Borough Road
London SE1 0AJ
T. +44 (0) 20 7620 1950

MANCHESTER
Lowry House, 17 Marble Street
Manchester, M2 3AW
T. +44 (0) 161 661 4504

Contents

1.0 INTRODUCTION

RBA Acoustics has been appointed by Ashley Donoff to undertake a noise impact assessment in relation to the installation of 3No. new condenser units on the roof of 9 Briary Close, in Swiss Cottage. The assessment is required to support a retrospective planning application for the installation of these units. London Borough of Camden requires consideration be given to atmospheric noise emissions from the proposed equipment at the nearest noise-sensitive property.

RBA Acoustics has undertaken measurements of the prevailing noise conditions at the site and to determine the atmospheric noise emissions in accordance with London Borough of Camden's requirements. This report presents the results of the noise measurements, associated criteria and provides the required assessment.

This report occasionally employs technical acoustic terminology. A glossary of acoustic terminology is presented in Appendix A.

2.0 SITE DESCRIPTION

The property at 9 Briary Close, Swiss Cottage comprises a four-storey terraced residential premises located approximately 430-metres to the east of Swiss Cottage Underground Station. The surrounding area consists of further residential properties.

The adjacencies immediately to the east and west are the adjoining terraced residential properties. To the north is a small common green space, across which are the rear gardens of properties located along Fellows Road. The south is bounded by Adelaide Road, with further residential properties located on the southern side.

The condenser units have been installed in the centre of the roof of the property. The nearest noise sensitive properties to the site are those adjacent to the property on either side.

A plan of the site showing the location, the local environment and the nearby noise sensitive properties is illustrated in Figure 1 in Appendix B, while photographs of the measurement position are shown in Figure 2 in Appendix B.

A layout of the location of the condensing units on the roof of the property is shown in Figure 3 of Appendix B.

3.0 ENVIRONMENTAL NOISE MONITORING

Monitoring of the prevailing noise levels was undertaken between Wednesday, 3rd July and Friday 5th July 2024. Measurements commenced at approximately 11:30 on Wednesday 3rd and concluded at around 14:00 on Friday 5th. The equipment was installed and collected by Patrick Spiers of RBA Acoustics.

3.1 Measurement Location

In order to determine the background noise climate at the nearest affected residential receptors to the site, the equipment was installed on the northern facade of the site, at top floor level.

The sound level meter was secured within the property, with the connecting microphone mounted on an A-frame such that it was 1.5-metres from the façade and approximately 8-metres above the ground. As such, the measurements recorded are to be considered façade reflected. The prevailing noise climate at this location was considered representative of the background noise climate at the adjacent noise sensitive receptors on Briary Close.

Continuous measurements of the L_{A90}, L_{Amax} and L_{Aeq} noise levels were made over sample periods of 15 minutes duration throughout the survey period.

The measurement location is illustrated on the site plan in site plan in Figure 1 and in the photograph in Figure 2 in Appendix B.

3.2 Noise Climate

The noise climate at the measurement position consisted predominantly of noise from the surrounding road network and other general urban noise sources (human activity, etc.).

It was noted that cladding works were ongoing at the Burnham tower block, approximately 55-metres northwest of the site. As the survey was unattended, the exact timing of these works is unknown, and thus recorded levels during standard construction hours (08:00 – 18:00) have been excluded, and daytime noise levels taken from the period between 18:00 – 23:00.

It is understood that the installed units were switched off for the duration of the survey period, and thus the measured noise levels are representation of the current noise climate without any contributions from the new units.

3.3 Instrumentation

For information regarding the equipment used for the measurements please refer to Appendix C.

The sound level meter was calibrated both prior to and on completion of the survey with no calibration drifts observed. The sound level meter and field calibrator have been laboratory calibrated within the last 2 years, while the field calibrator has undergone and additional in-house calibration check within the past year.

3.4 Weather Conditions

Weather conditions throughout the survey were considered to be conducive to the measurement of environmental sound. Wind speeds measured during the beginning of the survey were measured to be an average of 4m/s with a temperature of 16 degrees. At the end of the survey, the wind speed was measured to be an average of 5m/s with a temperature of 18 degrees.

As the survey was unattended, detailed records of weather conditions throughout the survey were not able to be recorded, however, it is understood from weather reports from nearby stations that weather conditions remained mostly dry and still throughout the survey.

3.5 Location of the Nearest Noise-Sensitive Receptors

We understand the nearest noise-sensitive receptors (NSR) to the proposed plant to be as follows:

NSR 1 – 8 Briary Close (Top Floor Windows)

This receptor is adjacent to the site, with the windows located approximately 7m east of the proposed plant location.

NSR 2 – 10 Briary Close (Top Floor Windows)

This receptor is also adjacent to the site, with the windows located approximately 7m west of the proposed plant location.

As the NSR are equidistant from the proposed plant, satisfying the criteria at NSR 1 will automatically satisfy the criteria at NSR 2.

3.6 Results

The full results of the measured sound levels are shown as time-histories on the Graphs presented in Appendix D.

The lowest measured $L_{A90,\,15min}$ periods over the entire survey period are summarised in Table 1 below.

Table 1 – Measured Sound Levels

Measurement Period	Position 1 – Site Rooftop	
	Typical Lowest Background Noise $L_{A90,15min}$ (dB)	Period Averaged Noise Levels L_{Aeq} (dB)
Daytime (07:00 – 23:00)	44	56
Daytime with Construction Excluded (18:00 – 23:00)	41	46
Night-time (23:00 – 07:00)	35	50

The results of the above measurements will be used in the subsequent analysis of plant noise.

4.0 ASSESSMENT CRITERIA

4.1 Local Authority Criteria

The requirements of London Borough of Camden's Environmental Health Department regarding new building services plant are understood to be as follows.

> *Industrial and Commercial Noise Sources*
>
> *A relevant standard or guidance document should be referenced when determining values for LOAEL and SOAEL for non-anonymous noise. Where appropriate and within the scope of the document it is expected that British Standard 4142:2014 'Methods for rating and assessing industrial and commercial sound' (BS 4142) will be used. For such cases a 'Rating Level' of 10 dB below background (15dB if tonal components are present) should be considered as the design criterion).*

4.2 National Planning Policy Framework (NPPF)

The National Planning Policy Framework (NPPF) states that, with respect to noise, planning policies and decisions should aim to:

- Avoid noise from giving rise to significant adverse impacts on health and quality of life as a result of new development;
- Mitigate and reduce to a minimum, other adverse impacts on health and quality of life arising from noise from a new development, including through the use of conditions;
- Recognise that development will often create some noise and existing business wanting to develop in continuance of their business should not have unreasonable restrictions put upon them because of changes in nearby land uses since they were established; and
- Identify and protect areas of tranquillity which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason.

The guidance contained within the NPPF further determines that consideration should be given to the Noise Policy Statement for England (DEFRA, March 2010).

4.3 Noise Policy Statement for England (NPSE, March 2010)

The NPSE attends to three types of noise;

- "Environmental noise" which includes noise from transportation sources;
- "Neighbour noise" which includes noise from inside and outside people's homes; and
- "Neighbourhood noise", which includes noise arising from within the community such as industrial and entertainment premises, trade and business premises, construction sites and noise in the street.

In line with the aims determined in the NPPF, the NPSE determines three aims;

1. Avoid significant adverse impacts on health and quality of life from environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development;
2. Mitigate and minimise adverse impacts on health and quality of life from environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development; and,
3. Where possible, contribute to the improvement of health and quality of life through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development.

The guidance detailed within the NPSE relates a number of key phrases with regards to adverse effects which can be applied to noise impacts as used by the World Health Organisation.

- **NOEL – No Observed Effect Level** - The level below which no health effect or detrimental impact on the quality of life is observed.
- **LOAEL – Lowest Observed Adverse Effect Level** - The level at which adverse effects on health and quality of life can be detected
- **SOAEL – Significant Observed Adverse Effect Level** - The level above which significant adverse effects on health and quality of life occur.

The guidance indicates that it is not possible to have a single objective noise-based measure that defines SOAEL, and as such the SOAEL is likely to be different for different noise sources and receptors. The document indicates that further research is required to establish what may constitute a significant adverse impact on health and quality of life from noise.

While the NPSE determines the NOEL, LOAEL and SOAEL descriptions, the document indicates that, unlike other environmental disciplines, there are currently no European or national noise limits which have to be met, although the NPSE states that "there can be specific local limits for specific developments" allowing for negotiation.

4.4 Planning Practice Guidance - Noise

The Planning Practice Guidance for noise 2014 (updated July 2019) broadly considers the same issues as demonstrated within both the NPPF and the NPSE with regards to noise within the planning realm. The information detailed within the PPG indicates that noise should be considered when:

- New developments may create additional noise; and/ or,
- New developments would be sensitive to the prevailing acoustic environment.

The guidance indicates that Local Planning Authorities should take account of the acoustic environment and in doing so consider:

- Whether or not a significant adverse effect is occurring or likely to occur;
- Whether or not an adverse effect is occurring or likely to occur; and,
- Whether or not a good standard of amenity can be achieved.

The impact of noise is rated within the policy document in terms of the relative 'Observed Effect Level', defined in line with the guidance within the NPSE. Based upon this, the Planning Practice Guidance provides the following matrix of likely average response.

Table 2 - PPG Observed Effect Levels

Perception	Example of Outcomes	Increasing Effect Level	Action
Not noticeable	No Effect	No Observed Effect	No specific measures required
Noticeable and not intrusive	Noise can be heard but does not cause any change in behaviour or attitude. Can slightly affect the acoustic character of the area but not such that there is a perceived change in the quality of life.	No Observed Adverse Effect	No specific measures required
Lowest Observed Adverse Effect Level			
Noticeable and Intrusive	Noise can be heard and causes small changes in behaviour and/ or attitude, e.g. turning up volume of television; speaking more loudly; where there is no alternative ventilation, having to close windows for some of the time because of the noise. Potential for some reported sleep disturbance. Affects the acoustic character of the area such that there is a perceived change in the quality of life.	Observed Adverse Effect	Mitigate and reduce to a minimum
Significant Observed Adverse Effect Level			
Noticeable and disruptive	The noise causes a material change in behaviour and/ or attitude, e.g. avoiding certain activities during periods of intrusion: where there is no alternative ventilation, having to keep windows closed most of the time because of the noise. Potential for sleep disturbance resulting in difficulty in getting to sleep, premature awakening and difficulty in getting back to sleep. Quality of life diminished due to change in character of the area.	Significant Observed Adverse Effect	Avoid
Noticeable and very disruptive	Extensive and regular changes in behaviour and/ or an ability to mitigate effect of noise leading to psychological stress or physiological effects, e.g. regular sleep deprivation/ awakening; loss of appetite, significant, medically definable harm, e.g. auditory and non-auditory.	Unacceptable Adverse Effect	Prevent

4.5 BS 4142:2014 'Method for Rating and Assessing Industrial & Commercial Sound'

BS4142:2014 *Methods for rating and assessing industrial and commercial sound* describes methods for rating and assessing sound of an industrial and/or commercial nature, which includes:

- sound from industrial and manufacturing processes
- sound from fixed installations which comprise mechanical and electrical plant and equipment
- sound from the loading and unloading of goods and materials at industrial and/or commercial premises
- sound from mobile plant and vehicles that is an intrinsic part of the overall sound emanating from premises or processes, such as that from forklift trucks, or that from train or ship movements on or around an industrial and/or commercial site.

The methods described within BS4142:2014 use outdoor sound levels to assess the likely effects of sound on people who might be inside or outside a dwelling or premises used for residential purposes upon which sound is incident.

The standard is also applicable to determine rating levels for sound of an industrial or commercial nature at proposed new dwellings or premises used for residential premises. The standard is only appropriate for the assessment of external sound levels.

The assessment method described in BS4142:2014 is based on the continuous sound pressure level produced by a specific source ($L_{Aeq,Tr}$) at the assessment location. Appropriate corrections allowing for any tonality, impulsivity, other characteristics or intermittency of the specific sound source are then applied to derive the rating level ($L_{Ar,Tr}$). The rating level is then compared to the background sound level ($L_{A90,T}$) to produce the relative difference, or excess of rating level over background sound level. BS4142:2014 quantifies the estimated impact from the excess as:

a) *Typically the greater this difference, the greater the magnitude of impact.*
b) *A difference of around +10dB or more is likely to be an indication of a significant adverse impact, depending on the context.*
c) *A difference of around +5dB is likely to be an indication of an adverse impact, depending on the context.*
d) *The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context.*

For the purposes of this assessment, it is considered that these response levels may be correlated to the effect levels within NPSE and PPG, as presented in Table 3.

Table 3 – BS 4142 Correlated Effect Levels with NPSE and PPG

BS4142 Rating Level	NPSE	PPG
> +8dB	SOAEL	Unacceptable Adverse Effect / Significant Observed Adverse Effect
> 0dB < +8dB	LOAEL / SOAEL	Observed Adverse Effect
>-5dB < 0dB	LOAEL	No Observed Adverse Effect
< -5dB	NOEL	No Observed Adverse Effect

4.6 Plant Noise Emission Limits

Based on the above guidance, the requirements of the London Borough of Camden, and the typically lowest noise levels representative of those at the nearest affected noise sensitive properties in Table 1, the following plant noise emission limits are recommended.

Table 4 – Recommended Plant Noise Emission Limits

Period	Typical lowest $L_{A90,15min}$ (dB)
Daytime (07:00 – 23:00)	34dB $L_{Ar,T}$
Night-time (23:00 – 07:00)	30dB $L_{Ar,T}$

These limits are to be achieved at 1 metre from the façade of the nearest noise sensitive due to operation of the extract fan at representative worst-case duty. The limits are based on meeting the requirements of the London Borough of Camden, which in turn will achieve a rating noise level 10dB below the current background sound level, and will be in line with "NOEL", with reference to NPSE guidance and "No Observed Adverse Effect", with reference to PPG.

5.0 PLANT NOISE IMPACT ASSESSMENT

This assessment has been based on the information provided to RBA by the Client, and is described in the following sections.

5.1 Plant Noise Emission Limits

Based on the guidance and adopted assessment criteria in Section 4.0, and the typically lowest noise levels representative of those at the nearest affected noise sensitive properties in Table 1, the following plant noise emission limits are recommended.

Table 5 – Recommended Plant Noise Emission Limits

Period	Typical lowest $L_{A90,15min}$ (dB)
Daytime (07:00 – 23:00)	34dB $L_{Ar,T}$
Night-time (23:00 – 07:00)	30dB $L_{Ar,T}$

These limits are to be achieved at 1 metre from the façade of the nearest noise sensitive due to operation of the extract fan at representative worst-case duty. The limits are based on achieving a rating noise level 10dB below the current background sound level, which will be in line with "NOEL", with reference to NPSE guidance and "No Observed Adverse Effect", with reference to PPG.

5.2 Proposed Plant Items

The following items of plant have been installed in the centre of the roof of the demise:

Table 6 – Proposed Extract Fan

Ref.	Manufacturer/Model/Duty	Plant Type
CON 1 – 2	Daikin 5MXS90E	Condenser
CON 3	Daikin RXM60R	Condenser

5.3 Noise Levels

Information regarding the noise levels of the installed plant has been provided by the Client. The associated plant noise levels are detailed as follows:

Table 7 – Plant Noise Levels

Unit	Parameter	Sound Level (dB) at Octave Band Centre Frequency (Hz)							dBA
		125	250	500	1k	2k	4k	8k	
CON 1 – 2	L_p	57	53	52	50	48	42	38	32
CON 3	L_p	52	53	51	47	46	40	34	26

Review of the octave band data provides no indication of any tonal characteristics associated with the proposed plant.

5.4 Calculation of Noise Levels at Nearest Residential Window

Our calculation method for predicting noise levels from the installed plant at the nearest residential windows, based on the information stated above, is summarised below.

- Source Term SPL
- 20LogR Distance Attenuation
- Directivity
- Reflections
- Screening

The results of the calculations indicate the following noise levels at the nearest affected residential windows:

Table 8 – Predicted Noise Levels

Plant Details	Predicted Noise Level @ Nearest Noise-Sensitive Receptor		
	Specific Noise Level	Rating Corrections	BS 4142 Rating Noise Level
CON 1	20dBA	0	20dB $L_{Ar,T}$
CON 2	20dBA	0	20dB $L_{Ar,T}$
CON 3	20dBA	0	20dB $L_{Ar,T}$
Total Noise Level @ Receptor Location 1			**25dB $L_{Ar,T}$**

Noise levels from the installed plant is within the assessment and Local Authority criteria.

5.5 Control of Vibration

In addition to the control of airborne noise transfer, it is also important to consider the transfer of noise as vibration to adjacent properties (as well as to any sensitive areas of the same building).

We would typically advise that fans be isolated from the supporting structure by means of either steel spring isolators or rubber footings. For particularly sensitive locations, or when on lightweight structures the mounts should ideally be caged and be of the restrained type.

It is important the isolation is not "short-circuited" by associated pipework, ductwork or conduits. To this end, any conduits should be looped and flexible connectors should be introduced between the condenser and any associated pipework. Pipework should be supported by brackets containing neoprene inserts.

5.6 Uncertainty

Uncertainty is an unavoidable feature of measurements in the field, which can be subject to many factors; the weather typically being the most significant of which with respect to the measurement of sound. Uncertainty is also unavoidable in the prediction of sound levels, where naturally, before the scenario being considered becomes a reality, a number of assumptions need to be relied upon. There is also the uncertainty of people's reactions, which can be influenced by a number of factors, not just the magnitude or character of the sound in question.

In keeping with the scale of each project, therefore, it is the aim of RBA Acoustics to minimise uncertainty at each stage as far as reasonably practicable. With this in mind, RBA Acoustics follow the best practise methodologies based on the guidance within BS 4142:2014 and our experience in undertaking assessments of these nature.

Crucially, it has been determined that environmental noise measurements have been undertaken by suitably qualified staff, using in calibration equipment and avoiding adverse weather conditions.

The predictions have also been undertaken by suitably qualified staff, whilst using the best available information, an industry standard calculation method, and the most applicable calculation procedures.

Notwithstanding this, naturally some uncertainty remains. Given the sheer number of factors involved, however, it is not feasible to place a value on the level of uncertainty, without resulting in an unhelpful range of possible outcomes. It is the professional position of RBA Acoustics that uncertainty has been kept to a realistic minimum and that the outcome of this assessment is sufficiently representative.

6.0 CONCLUSIONS

RBA Acoustics has been appointed by Ashley Donoff to undertake a noise impact assessment in relation to the installation of 3No. new condenser units on the roof of 9 Briary Close, in Swiss Cottage. London Borough of Camden requires consideration be given to atmospheric noise emissions from the proposed equipment at the nearest noise-sensitive property.

Baseline environmental sound monitoring was undertaken at the site between Wednesday, 3rd July and Friday, 5th July 2024 to ascertain current prevailing sound levels close to the nearest existing noise sensitive receptors to the installed new external noise generating plant items. The closest residential receptors have been identified to be the top floor window of the adjacent 8 Briary Close and 10 Briary Close – located equidistant from the plant location.

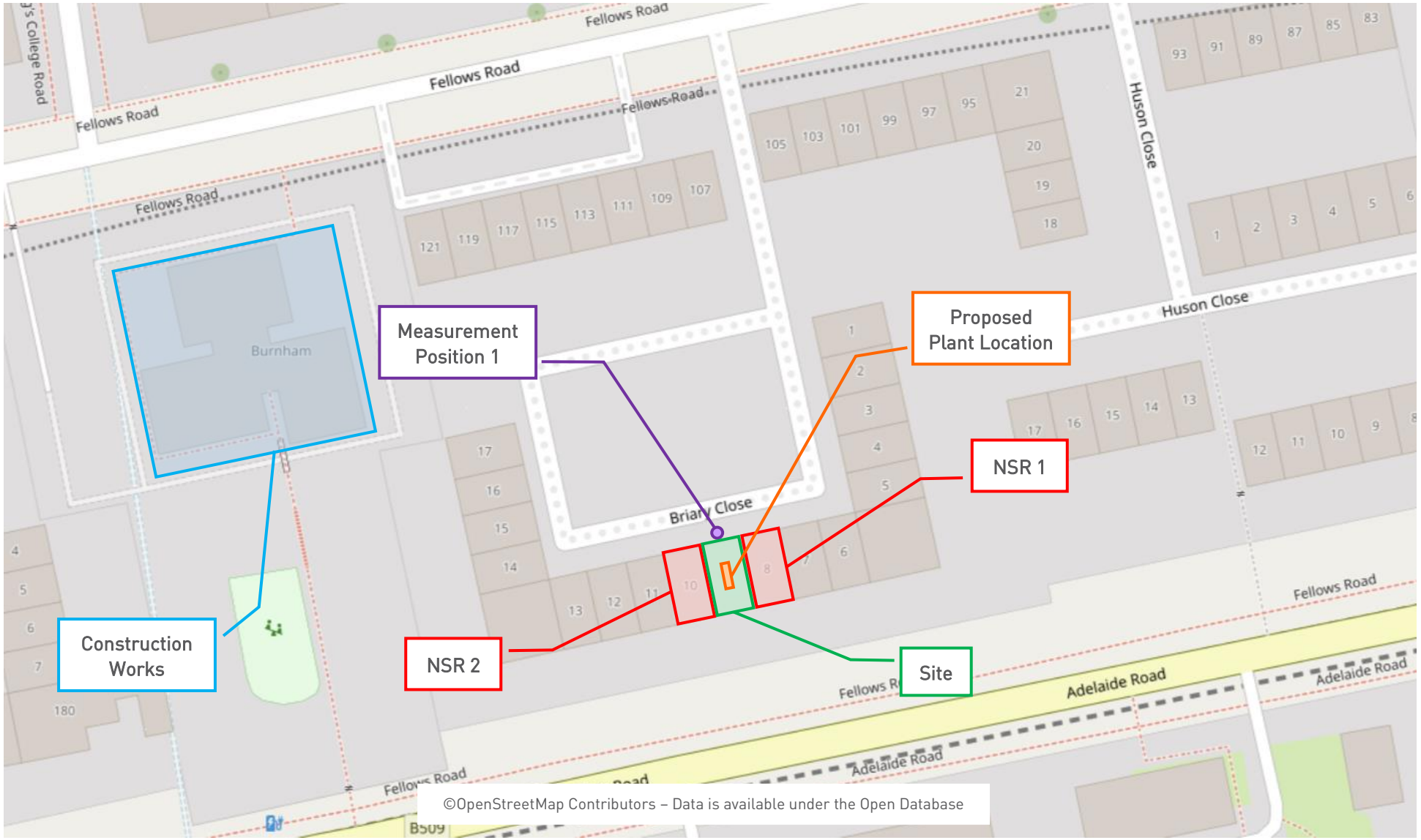
The baseline environmental noise levels have been used to set noise emission limits for the new plant items based on Local Authority criteria, national noise policy guidelines, and British Standard 4142 in order that there may be no significant impact on the nearby noise sensitive properties.

Based on the details of the plant installed at the property and noise impact assessment has been undertaken, the results of our assessment suggest that noise from the operation of the installed plant is expected to be at least 10dB below the otherwise prevailing background sound level, meeting the requirements of London Borough of Camden, and in line with “NOEL”, with reference to NPSE guidance and “No Observed Adverse Effect”, with reference to PPG.

Appendix A - Acoustic Terminology

dB	Decibel - Used as a measurement of sound pressure level. It is the logarithmic ratio of the noise being assessed to a standard reference level.
dB(A)	The human ear is more susceptible to mid-frequency noise than the high and low frequencies. To take account of this when measuring noise, the 'A' weighting scale is used so that the measured noise corresponds roughly to the overall level of noise that is discerned by the average human. It is also possible to calculate the 'A' weighted noise level by applying certain corrections to an un-weighted spectrum. The measured or calculated 'A' weighted noise level is known as the dB(A) level. Because of being a logarithmic scale noise levels in dB(A) do not have a linear relationship to each other. For similar noises, a change in noise level of 10dB(A) represents a doubling or halving of subjective loudness. A change of 3dB(A) is just perceptible.
L_{eq}	L_{eq} is defined as a notional steady sound level which, over a stated period of time, would contain the same amount of acoustical energy as the actual, fluctuating sound measured over that period (1 hour).
L_{Aeq}	The level of notional steady sound which, over a stated period of time, would have the same A-weighted acoustic energy as the A-weighted fluctuating noise measured over that period.
L_{An} (e.g L_{A10}, L_{A90})	If a non-steady noise is to be described it is necessary to know both its level and the degree of fluctuation. The L_n indices are used for this purpose, and the term refers to the level exceeded for n% of the time, hence L_{10} is the level exceeded for 10% of the time and as such can be regarded as the 'average maximum level'. Similarly, L_{90} is the average minimum level and is often used to describe the background noise.
$L_{max,T}$	The instantaneous maximum sound pressure level which occurred during the measurement period, T. It is commonly used to measure the effect of very short duration bursts of noise, such as for example sudden bangs, shouts, car horns, emergency sirens etc. which audibly stand out from the general level of, say, traffic noise, but because of their very short duration, maybe only a very small fraction of a second, may not have any effect on the L_{eq} value.

Appendix B – Site Plans



9 Briary Close, London, NW3 3JZ

Location of Site, Proposed Plant, Nearest Noise-Sensitive Receptors, & Construction Noise

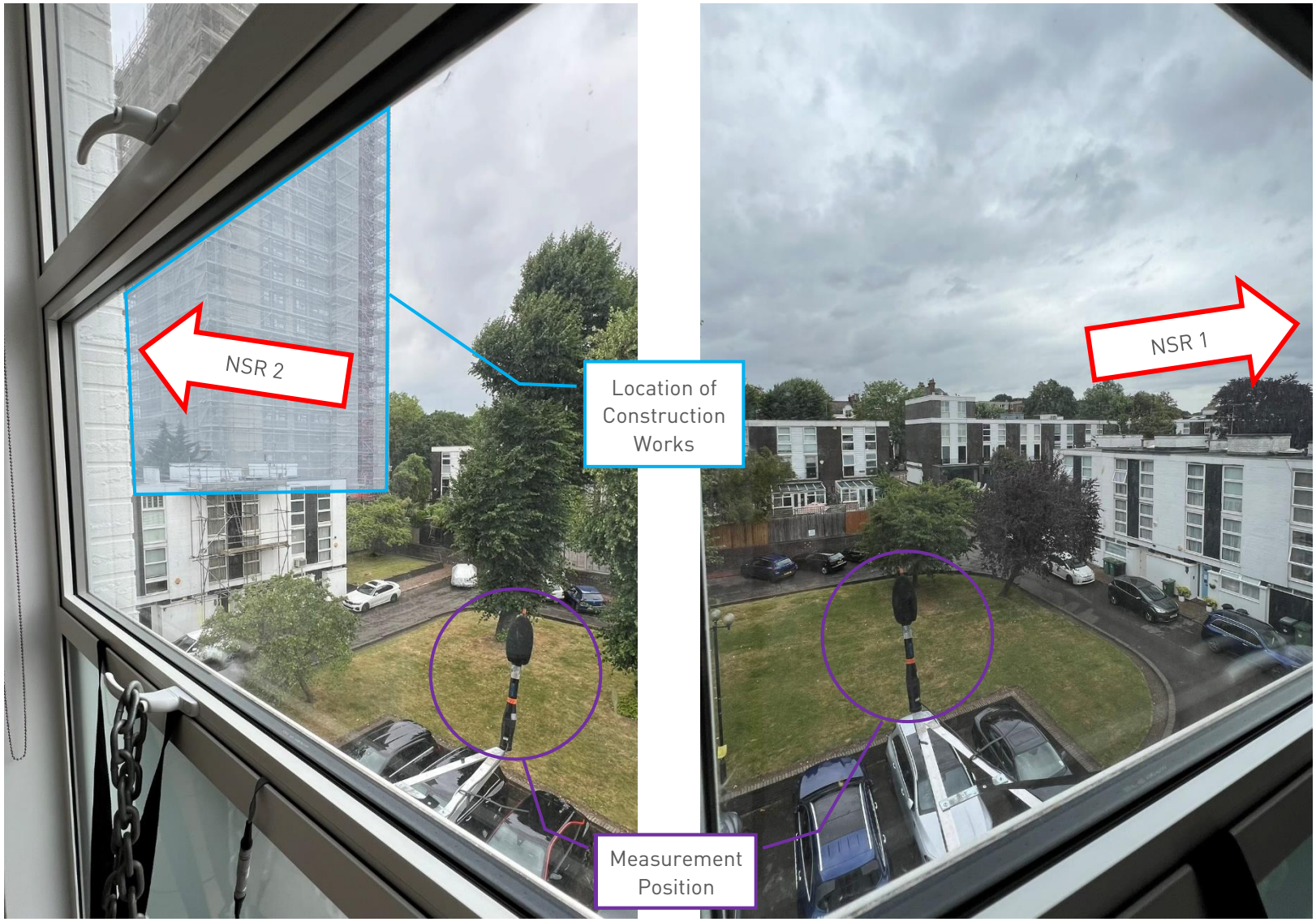
Project 13663

Figure 1

19 August 2024

Not to Scale

RBA ACOUSTICS



9 Briary Close, London, NW3 3JZ

Monitoring Location

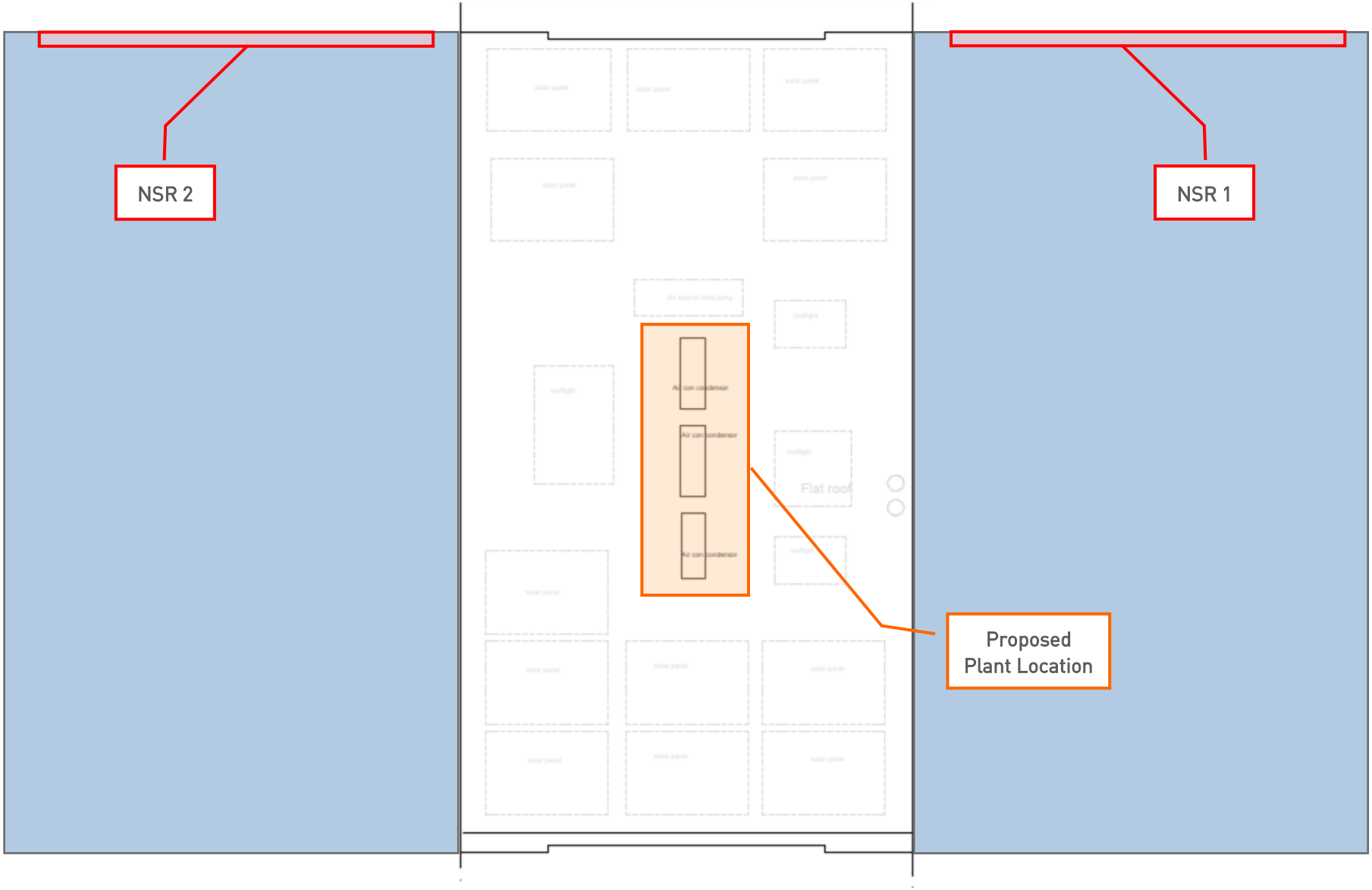
Project 13663

Figure 2

19 August 2024

Not to Scale

RBA ACOUSTICS



9 Briary Close, London, NW3 3JZ

Proposed Plant Layout (based on drawing "Proposed Roof Layout", Drawing No 134, Rev 10, 23/02/2022)

Project 13663

Figure C

19 August 2024

Not to Scale

RBA ACOUSTICS

Appendix C –Instrumentation

The following equipment was used for the measurements

Table C1 – Equipment Calibration Details

Manufacturer	Model Type	Serial No.	Calibration	
			Certificate No.	Valid Until
Norsonic Type 1 Sound Level Meter	Nor140	1403226	U42991	18 January 2025
Norsonic Pre Amplifier	1209A	12066		
Norsonic ½“ Microphone	1225	168180	42990	18 January 2025
Norsonic Sound Calibrator	1251	31988	U42989	18 January 2025

Appendix D – Results of Noise Monitoring Survey

9 Briary Close, London NW3

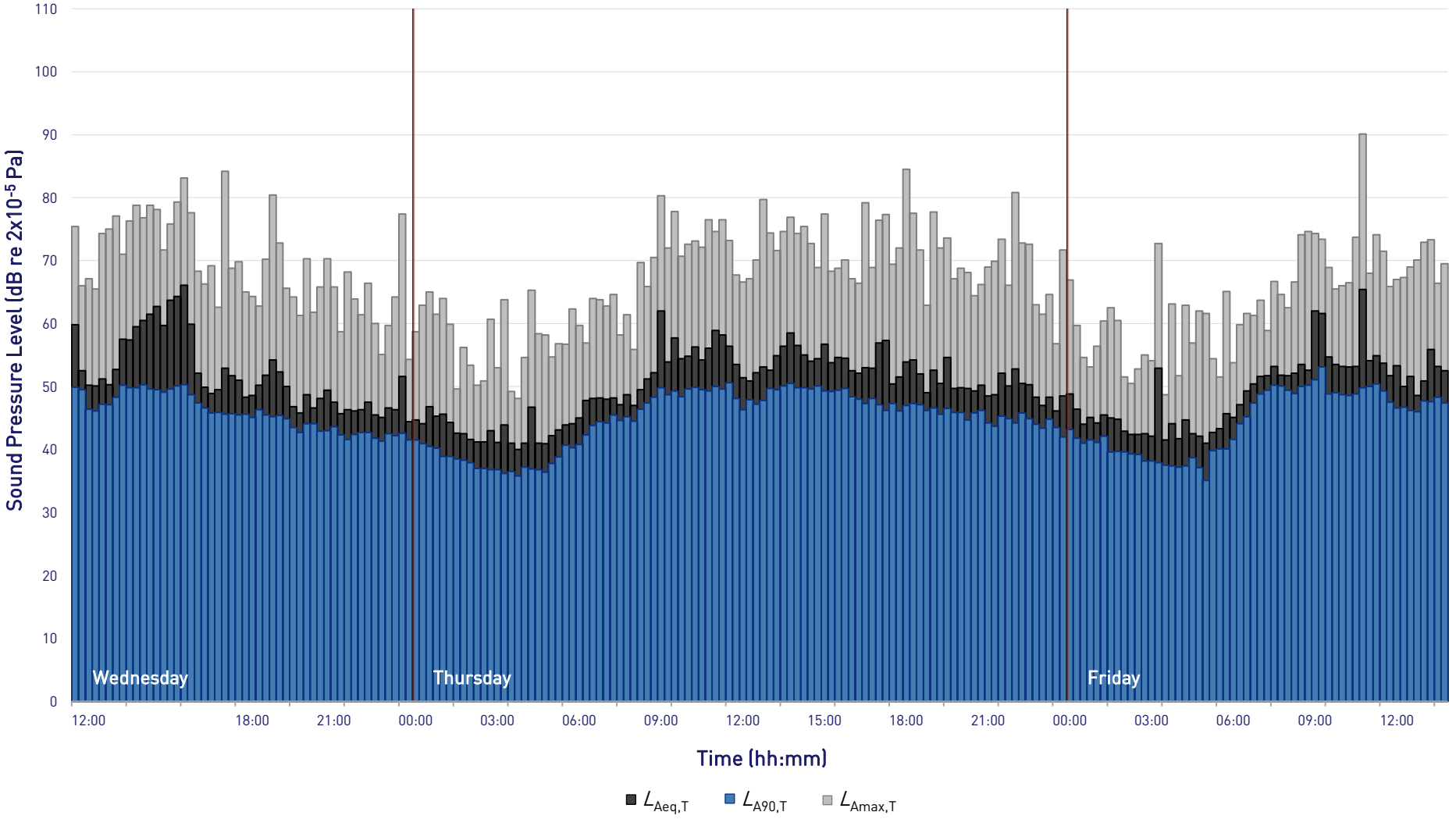
Measured Levels (15min Sample Periods)

Measurement Position 1, Third Floor Window - Wednesday 3 July to Friday 5 July, 2024

RBA ACOUSTICS

Project: 13663

Graph 1



9 Briary Close, London NW3

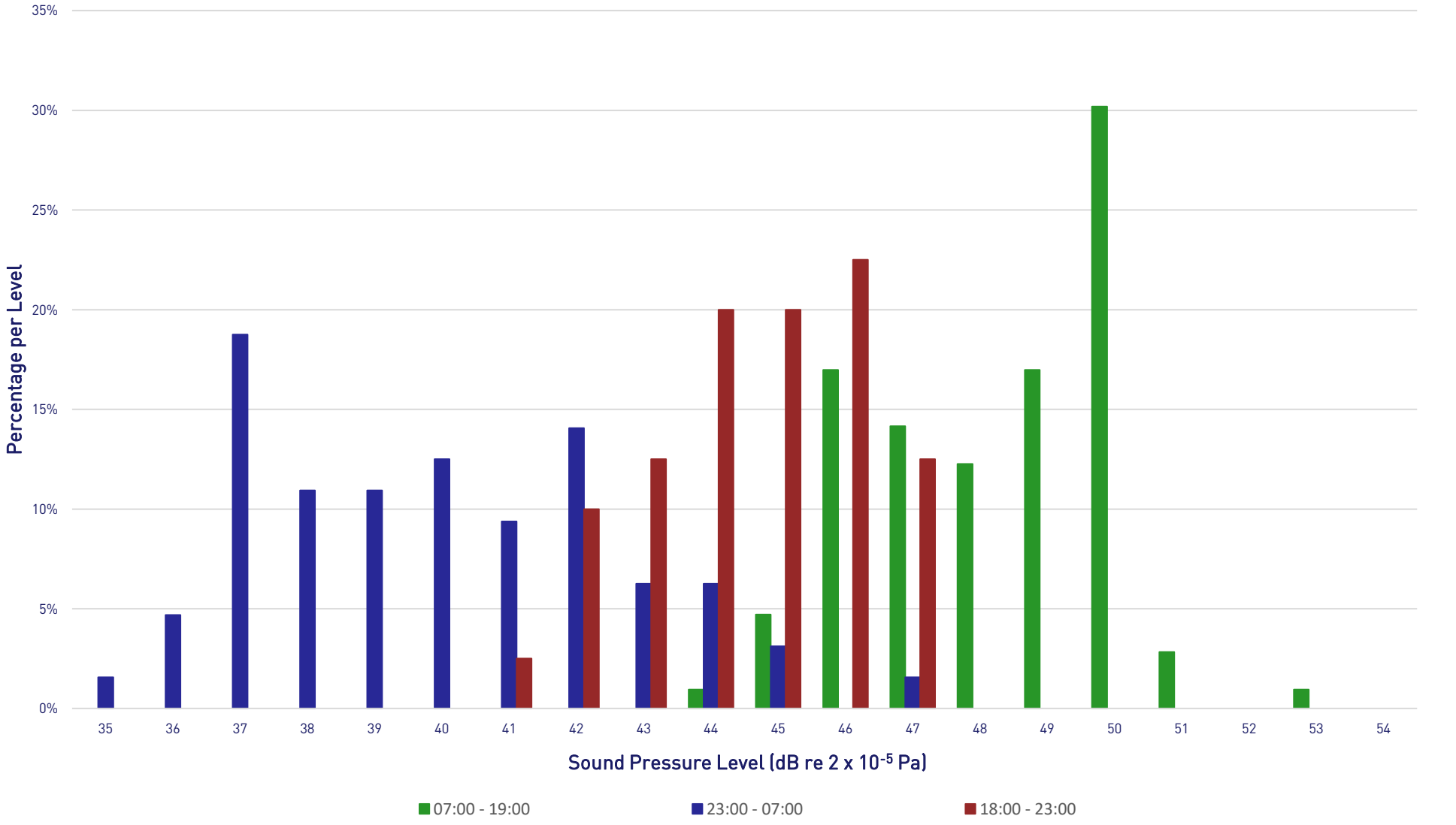
$L_{A90,\,15\,min}$ Histogram

Measurement Position 1, Third Floor Window - Wednesday 3 July to Friday 5 July, 2024

RBA ACOUSTICS

Project: 13663

Graph 2

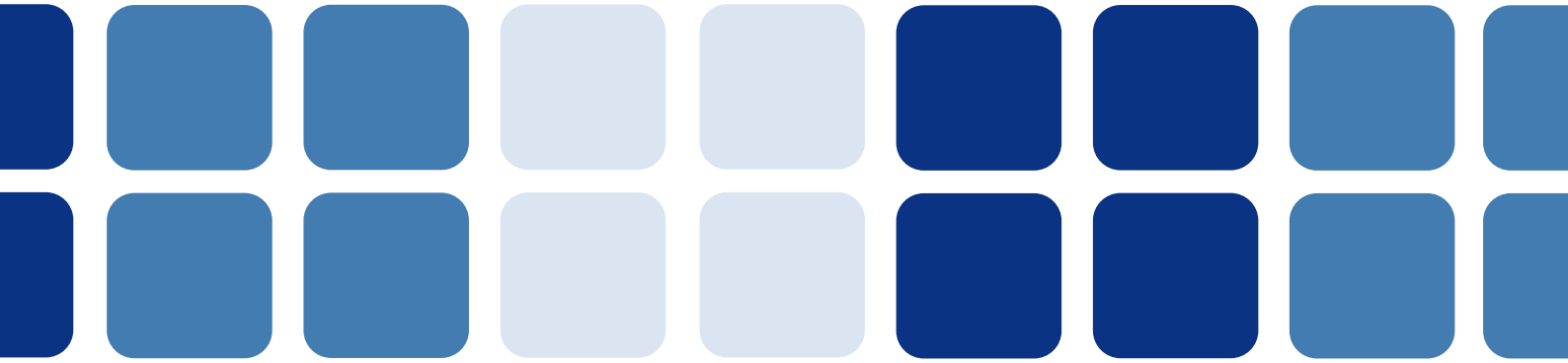


RBA ACOUSTICS

W. www.rba-acoustics.co.uk
E. info@rba-acoustics.co.uk

London:
44 Borough Road
London SE1 0AJ
T. +44 (0) 20 7620 1950

Manchester:
Lowry House, 17 Marble Street
Manchester M2 3AW
T. +44 (0) 16 1661 4504



APPENDIX 2

Overheating Risk & Energy Assessment (L2 Energy Consulting)

L2 ENERGY Consulting
Established 2008

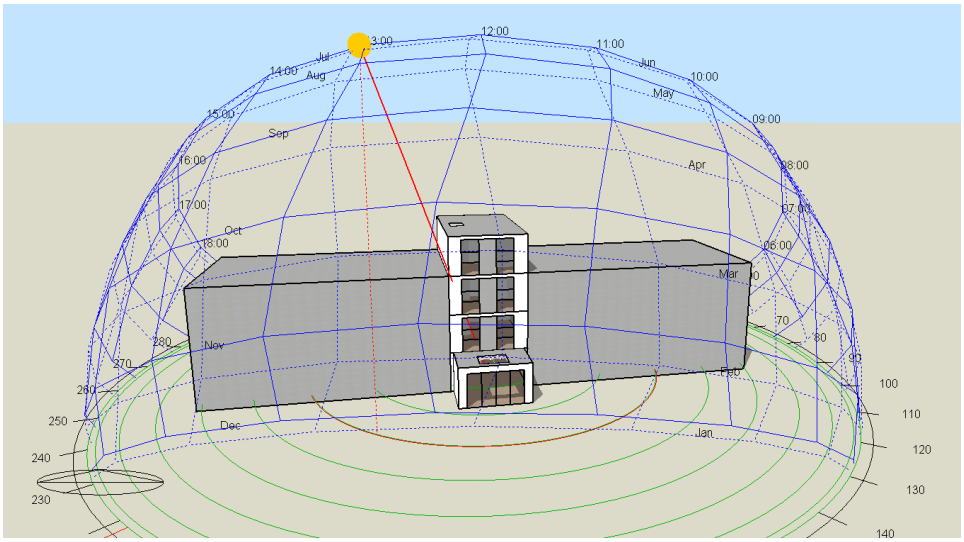
Overheating Risk & Energy Assessment
Revision 1

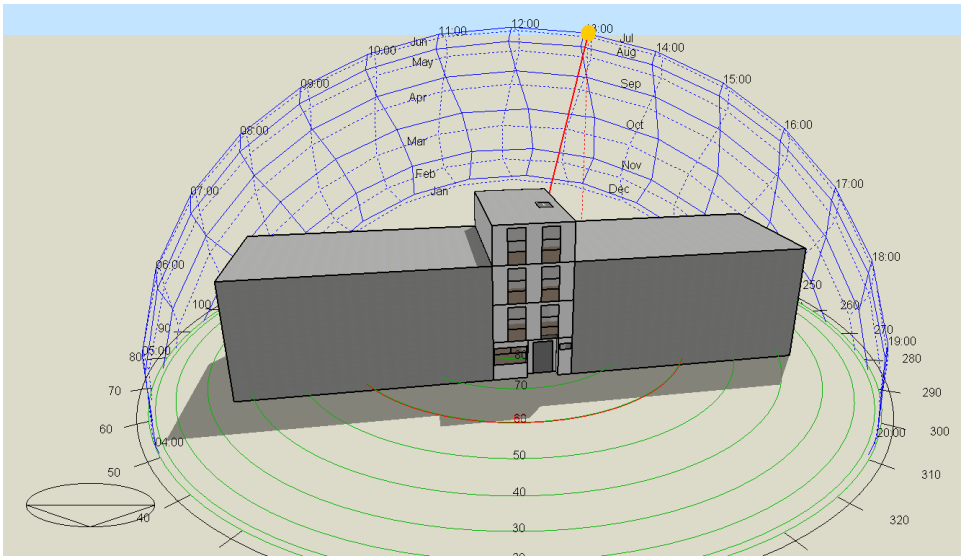
For

9 Briary Close
London
NW3 3JZ

Date: 22 July 2024

EXISTING DWELLING
9 BRIARY CLOSE, NW3 3JZ





Modelled in DesignBuilder 7.2.0.032 Utilizing Energyplus Version 9.4.0.002 in accordance with CIBSE AM11 using guidance outlined in CIBSE TM59.

CONTENTS

EXECUTIVE SUMMARY

This report seeks to demonstrate whether the existing dwelling at 9 Briary Close, London meets the requirements of TM59: Design methodology for the assessment of overheating risk in homes. If the requirements of TM59 are shown not to be met, installing Air Conditioning is an option which may be sought providing the requirements of the Cooling Hierarchy within the Camden Local Plan are investigated and other methods of achieving acceptable comfort levels cannot be introduced as an alternative. As Air Conditioning has already been installed and extended as part of a recent extensive refurbishment and extension works this report is in support of a retrospective planning application for its justification for installation.

Furthermore, the report will also demonstrate that as a result of the refurbishment and extensions, energy use has been vastly reduced and therefore carbon emissions have also been reduced.

Compliance Criteria for Overheating

Homes that are predominantly naturally ventilated, including homes that have mechanical ventilation with heat recovery (mvhr), with good opportunities for natural ventilation in the summer should assess overheating using the adaptive method based on CIBSE TM52 (2013).

In order to allow the occupants to 'adapt', each habitable room needs operable windows with a minimum free area that satisfies the purge ventilation criteria set in Part F of the Building Regulations for England (NBS, 2010), i.e. the window opening area should be at least 1/20th of the floor area of the room (different conditions exist for windows with restricted openings, and the same requirement applies for external doors). Control of overheating may require accessible, secure, quiet ventilation with a significant openable area.

Homes that are predominantly mechanically ventilated because they have either no opportunity or extremely limited opportunities for opening windows (e.g. due to noise levels or air quality) should be assessed for overheating using the fixed temperature method based on CIBSE Guide A (2015a).

Criteria for homes predominantly naturally ventilated

Compliance is based on passing *both* of the following two criteria:

(*a*) *For living rooms, kitchens and bedrooms*: the number of hours during which D*T* is greater than or equal to one degree (K) during the period May to September inclusive shall not be more than 3 per cent of occupied hours. (CIBSE TM52 Criterion 1: *Hours of exceedance*).

(*b*) *For bedrooms only*: to guarantee comfort during the sleeping hours the operative temperature in the bedroom from 10 pm to 7 am shall not exceed 26 °C for more than 1% of annual hours. (*Note*: 1% of the annual hours between 22:00 and 07:00 for bedrooms is 32 hours, so 33 or more hours above 26 °C will be recorded as a fail).

Criteria for homes predominantly mechanically ventilated

For homes with restricted window openings, the CIBSE fixed temperature test must be followed, i.e. all occupied rooms should not exceed an operative temperature of 26 ˚C for more than 3% of the annual occupied annual hours (CIBSE Guide A (2015a)).

Basis of Methodology for this Assessment

There is reasonable opportunity for natural ventilation in the summer within the property and therefore the adaptive method for homes predominately naturally ventilated is to be used.

Assessments are based upon occupied hours between May and September, this equates to 3,672 hours per year for bedrooms and 1,989 hours per year for Living rooms.

Results Overview

The results obtained from the thermal model demonstrate that all rooms of the property do not pass the requirements of TM59, it can be seen that this is exacerbated at second and third floor levels, indicating significant overheating will occur.

CALCULATION PARAMETERS

U-Values

External Walls, clear cavity with 50mm PIR to internal face	0.29 W/m²K
Flat Roofs, built to current regulations	0.18 W/m²K
Ground Floor	0.30 W/m²K
Windows, Rooflights & Glazed Doors	1.40 W/m²K

Glazing

Windows and glazed doors with an anticipated g-value of 0.50 and light transmission of 0.80 has been allowed for.

Room and Glazing Sizes

Taken from plan drawings and elevations, produced by ZED Architect.

Thermal Mass

Medium-weight construction to ground, first and second floor elements.
Light-weight construction to third floor elements largely built within timber structures.

Ventilation Strategy

Openable windows available to all occupied areas however middle windows are restricted to 100mm for safety reasons, high level windows have been modelled as fully open. Free Areas calculated accordingly.

Ground floor windows modelled as closed from 11pm. Upper Floor Windows open at all times day and night.

In accordance with TM59 windows to be open when the internal dry bulb temperature exceeds 22°C and the room is occupied.

As part of the refurbishment , MVHR has been added throughout the property to improve internal air quality and reduce the cooling load of the air conditioning. This has been included within the calculations for overheating. The unit exchanges air at the rate of 75 l/s.

Lighting

In accordance with TM59, lighting gains are set at 2 W/m² and on between 6pm and 11pm.

Air Permeability

Air permeability set at 15.0 m³/(h.m²) at 50 Pa.

Internal Gains

In accordance with TM59

Room Ref:	Occupancy Gains	Lighting Gains W/m²	Equipment Gains W/m²
Bedrooms	2*	2.0	80W Peak Load*
Kitchen	4*	2.0	450W Peak Load*
Living	4*	2.0	150W Peak Load*

*Adjusted in accordance with TM59 for differing time periods of the day.

Occupied Times

In accordance with TM59

Room Ref	Occupancy
Single Bedrooms	1 person at 70% gains from 11pm to 8am 1 person at full gains from 8am to 11pm
Double Bedrooms	2 people at 70% gains from 11pm to 8am 2 people at full gains from 8am to 9am and from 10pm to 11pm 1 person at full gain in the bedroom from 9am to 10pm
Living	4 people at 5% gains from 9 am to 10 pm; room is unoccupied for the rest of the day
Kitchen	4 people at 25% gains from 9 am to 10 pm; room is unoccupied for the rest of the day

Weather File

London Central DSY1 2020s, high emissions, 50% percentile scenario in accordance with TM59

OVERHEATING

Compliance is based on passing *both* of the following two criteria:

(*a*) *For living rooms, kitchens and bedrooms*: the number of hours during which D*T* is greater than or equal to one degree (K) during the period May to September inclusive shall not be more than 3 per cent of occupied hours. (CIBSE TM52 Criterion 1: *Hours of exceedance*).

(*b*) *For bedrooms only*: to guarantee comfort during the sleeping hours the operative temperature in the bedroom from 10 pm to 7 am shall not exceed 26 °C for more than 1% of annual hours. (*Note*: 1% of the annual hours between 22:00 and 07:00 for bedrooms is 32 hours, so 33 or more hours above 26 °C will be recorded as a fail).

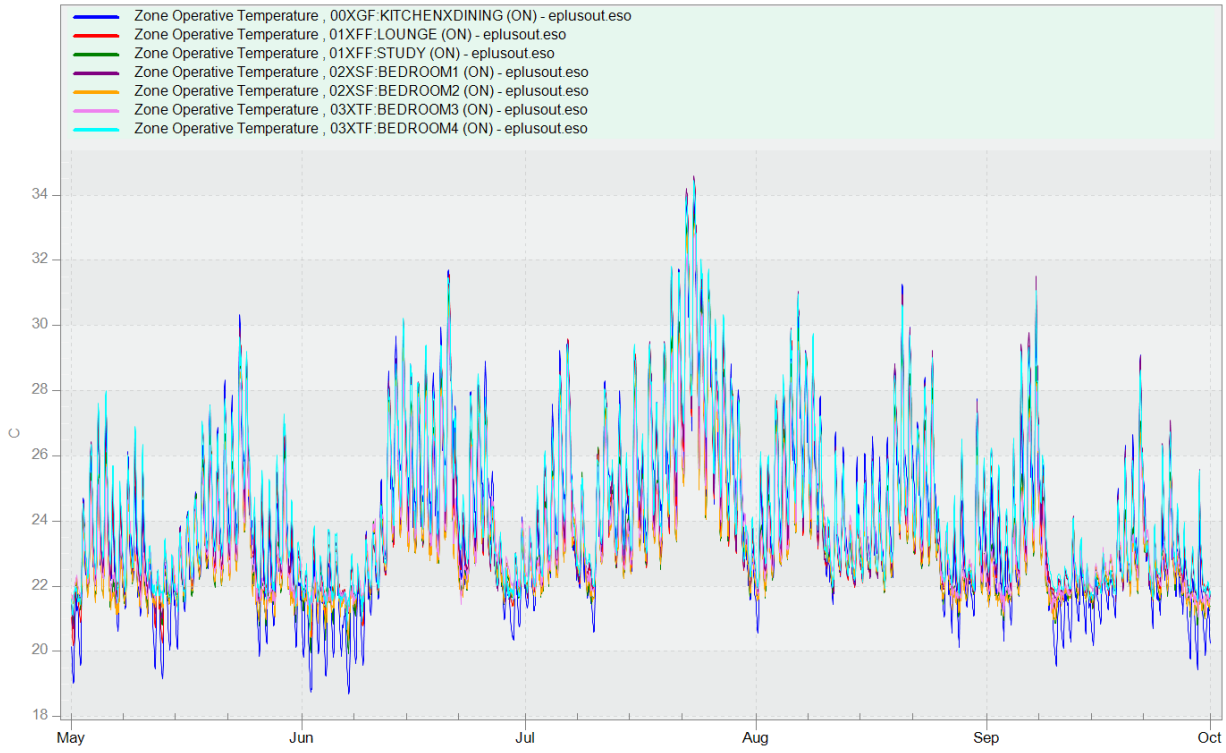
Results of the above calculations can be viewed below and can be seen that all occupied space fails the required benchmark of CIBSE TM59.

Results

Dwelling	Level	Zone	Criterion A (%)	Criterion B (hr)	Pass / Fail
9 Briary Close	Grd Flr	Kitchen Diner	3.86	N/A	Fail
	First Flr	Lounge	4.05	N/A	Fail
	First Flr	Study / Bedroom	1.43	75.67	Fail
	Second Flr	Bedroom 1	3.24	104.00	Fail
	Second Flr	Bedroom 2	0.92	71.17	Fail
	Third Flr	Bedroom 3	0.77	80.67	Fail
	Third Flr	Bedroom 4	3.37	112.83	Fail

Indoor Temperature Distribution

01 May – 30 September



COOLING HIERARCHY

In accordance with Camden Local Plan air conditioning will only be permitted where dynamic thermal modelling demonstrates there is a clear need for it after all of the preferred measures are incorporated in line with the cooling hierarchy.

The cooling hierarchy includes:

- Minimise internal heat generation through energy efficient design;
- Reduce the amount of heat entering a building in summer through orientation, shading, albedo, fenestration, insulation and green roofs and walls;
- Manage the heat within the building through exposed internal mass and high ceilings;
- Passive ventilation;
- Mechanical ventilation;
- Active cooling.

As the property has been completely refurbished, thermal quality has been improved to current regulations. Orientation and window sizes could not have been changed as the refurbishment needed to be in keeping with the surrounding buildings. Windows with a reasonably low g-value have been installed in an attempt to reduce solar gains.

Windows were designed to allow adequate passive ventilation with openable windows at all levels, however these need to be restricted in the middle panes for safety reasons but allowing top level windows out of reach from children to be fully opened.

Passive shading could not be introduced without changing the look of the existing building or at great expense.

A Mechanical Ventilation Heat Recovery (MVHR) system has been added throughout to reduce the cooling load. The chosen system comes with summertime bypass to allow cool outside air to bypass the heat recovery unit to prevent incoming air being pre-heated by internal warm air.

ENERGY REDUCTION

This section will provide an overview of the energy reduction and CO2 emission reduction achieved by the extensive refurbishment undertaken, improved thermal quality of the structure, efficient LED lighting and including the introduction of a highly efficient Air Source Heat Pump in lieu of a non-condensing gas fired boiler to heat the property along with domestic hot water.

Comfort cooling was included prior to the refurbishment, however this has been extended into newly formed areas.

Results have been created using SAP 10

Energy Use

	Pre-Refurbishment KWh/year	Post Refurbishment KWh/year
Space heating	20,801.52	6,729.25
Water heating	5,404.15	1,800.15
Space cooling	34.91	8.03
Fans & Pumps	86.00	719.07
Lighting	461.59	391.73
PV electricity used	-1,282.49	-3,383.68
	25,505.57	6,264.55

The above results represent a 75% reduction in energy use as a result of the refurbishment works undertaken.

It can also be seen that the energy used from comfort cooling is less than 1%, this has been almost halved following refurbishment, however the introduction of MVHR has increased power used by fans as could be expected.

3.94KWp of PV was installed pre-refurbishment and has been re-installed on the new roof on completion. A new 20KW battery has been added which allows for greater use of the installed PV, allowing energy to be collected and used when required.

CO2 Emissions

	Pre-Refurbishment	Post Refurbishment
Total Kg CO2/year	5,412.81	1003.59

The above results represent an 81% reduction in CO2 emissions as a result of the refurbishment works undertaken.

CONCLUSION

It can be viewed from the results within this report that overheating is expected within the building even following extensive refurbishment. When considering the cooling hierarchy of the Camden Local Plan much of the recommendations to mitigate the need for mechanical cooling have been introduced, however overheating is still expected and therefore it is believed that retrospective planning permission for comfort cooling should not be withheld.

The report demonstrates that the inclusion of comfort cooling does not adversely affect energy use or therefore CO2 emissions. The extensive refurbishment and extensions have vastly reduced the energy consumption as a whole and further adding weight for the inclusion of comfort cooling being permitted.

SAP 10 CALCULATION PRINTOUTS

Full SAP Calculation Printout

Property Reference	9 Briary Close	**Issued on Date**	19/07/2024
Assessment Reference	Post Refurbishment	**Prop Type Ref**	9 Briary Close
Property			

SAP Rating	78 C	**DER**	4.43	**TER**	
Environmental	95 A	**% DER < TER**			N/A
CO_2 Emissions (t/year)	0.81	**DFEE**	102.52	**TFEE**	
Compliance Check	See BREL	**% DFEE < TFEE**			
% DPER < TPER		**DPER**	44.11	**TPER**	

Assessor Details	Mr. Jason Cook	**Assessor ID**	V572-0001
Client	MZA Planning, Charlotte Hirst		

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

---

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	67.5600	(1b)	x 2.8500	(2b) =	192.5460	(1b) - (3b)
First floor	53.9800	(1c)	x 2.7500	(2c) =	148.4450	(1c) - (3c)
Second floor	53.9800	(1d)	x 2.7500	(2d) =	148.4450	(1d) - (3d)
Third floor	53.9800	(1e)	x 2.7500	(2e) =	148.4450	(1e) - (3e)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	229.5000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		637.8810	(5)

---

2. Ventilation rate

---

		m3 per hour	
Number of open chimneys		0 * 80 =	0.0000 (6a)
Number of open flues		0 * 20 =	0.0000 (6b)
Number of chimneys / flues attached to closed fire		0 * 10 =	0.0000 (6c)
Number of flues attached to solid fuel boiler		0 * 20 =	0.0000 (6d)
Number of flues attached to other heater		0 * 35 =	0.0000 (6e)
Number of blocked chimneys		0 * 20 =	0.0000 (6f)
Number of intermittent extract fans		0 * 10 =	0.0000 (7a)
Number of passive vents		0 * 10 =	0.0000 (7b)
Number of flueless gas fires		0 * 40 =	0.0000 (7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =		0.0000 / (5) =	0.0000 (8)
Number of storeys in the dwelling (ns)			4 (9)
Additional infiltration		[(9) - 1] x 0.1 =	0.3000 (10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction			0.3500 (11)
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0.0000 (12)
If no draught lobby, enter 0.05, else enter 0			0.0500 (13)
Percentage of windows and doors draught stripped			100.0000 (14)
Window infiltration	0.25 - [0.2 * (14) / 100] =		0.0500 (15)

Pressure test		No
Pressure Test Method		Blower Door
Measured/design AP50		15.0000 (17)
Infiltration rate		0.7500 (18)
Number of sides sheltered		2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.6375 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.8128	0.7969	0.7809	0.7013	0.6853	0.6056	0.6056	0.5897	0.6375	0.6853	0.7172	0.7491	(22b)

Balanced mechanical ventilation with heat recovery	
If mechanical ventilation	0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)	0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	83.7000 (23c)

Effective ac	0.8943	0.8784	0.8624	0.7828	0.7668	0.6871	0.6871	0.6712	0.7190	0.7668	0.7987	0.8306	(25)

---

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
New Windows (Uw = 1.40)			40.7200	1.3258	53.9848			(27)
Solid Door (New)			2.7600	1.4000	3.8640			(26)
Heatloss Floor 1			53.3000	0.3000	15.9900	110.0000	5863.0000	(28a)

External Wall 1	177.1600	43.4800	133.6800	0.2900	38.7672	190.0000	25399.2000 (29a)
External Wall 2	115.1400		115.1400	0.2600	29.9364	190.0000	21876.6000 (29a)
External Roof 1	53.9800		53.9800	1.6000	86.3680	9.0000	485.8200 (30)
Total net area of external elements Aum(A, m2)			399.5800				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		228.9104		(33)
Party Wall 1			163.1600	0.0000	0.0000	70.0000	11421.2000 (32)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	65045.8200 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		283.4241 (35)
Thermal bridges (Default value 0.200 * total exposed area)		79.9160 (36)
Point Thermal bridges	(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =	308.8264 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	188.2534	184.8986	181.5437	164.7694	161.4146	144.6403	144.6403	141.2855	151.3500	161.4146	168.1243	174.8340	(38)
Heat transfer coeff	497.0799	493.7250	490.3702	473.5959	470.2410	453.4668	453.4668	450.1119	460.1765	470.2410	476.9508	483.6605	(39)
Average = Sum(39)m / 12 =												472.7572	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	2.1659	2.1513	2.1367	2.0636	2.0490	1.9759	1.9759	1.9613	2.0051	2.0490	2.0782	2.1075	(40)
HLP (average)												2.0599	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

---

4. Water heating energy requirements (kWh/year)

Assumed occupancy												3.0403	(42)
Hot water usage for mixer showers	65.7960	64.8072	63.3663	60.6095	58.5750	56.3062	55.0166	56.4466	58.0141	60.4501	63.2661	65.5439	(42a)
Hot water usage for baths	34.1681	33.6607	32.9461	31.6285	30.6419	29.5479	28.9570	29.6666	30.4392	31.6098	32.9545	34.0526	(42b)
Hot water usage for other uses	48.1742	46.4224	44.6706	42.9188	41.1671	39.4153	39.4153	41.1671	42.9188	44.6706	46.4224	48.1742	(42c)
Average daily hot water use (litres/day)												136.1356	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	148.1383	144.8902	140.9830	135.1568	130.3840	125.2694	123.3889	127.2803	131.3722	136.7305	142.6431	147.7707	(44)
Energy conte	234.6148	206.3218	216.6856	185.0230	175.5219	154.0334	149.2282	157.5996	161.9950	185.5421	203.2212	231.3731	(45)
Energy content (annual)										Total = Sum(45)m =		2261.1597	
Distribution loss (46)m = 0.15 x (45)m	35.1922	30.9483	32.5028	27.7534	26.3283	23.1050	22.3842	23.6399	24.2993	27.8313	30.4832	34.7060	(46)
Water storage loss:													
Store volume												300.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.6000	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.8640	(55)
Total storage loss	26.7840	24.1920	26.7840	25.9200	26.7840	25.9200	26.7840	26.7840	25.9200	26.7840	25.9200	26.7840	(56)
If cylinder contains dedicated solar storage	26.7840	24.1920	26.7840	25.9200	26.7840	25.9200	26.7840	26.7840	25.9200	26.7840	25.9200	26.7840	(57)
Primary loss	37.2980	33.6885	37.2980	36.0948	37.2980	36.0948	37.2980	37.2980	36.0948	37.2980	36.0948	37.2980	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	298.6968	264.2023	280.7676	247.0378	239.6039	216.0482	213.3102	221.6815	224.0098	249.6240	265.2360	295.4551	(62)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	298.6968	264.2023	280.7676	247.0378	239.6039	216.0482	213.3102	221.6815	224.0098	249.6240	265.2360	295.4551	(64)
										Total per year (kWh/year) = Sum(64)m =		3015.6731	(64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
										Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =		0.0000	(64a)
Heat gains from water heating, kWh/month	129.2750	114.9064	123.3135	111.1320	109.6266	100.8279	100.8840	103.6674	103.4752	112.9583	117.1829	128.1971	(65)

---

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	182.4168	182.4168	182.4168	182.4168	182.4168	182.4168	182.4168	182.4168	182.4168	182.4168	182.4168	182.4168	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	55.4531	49.2530	40.0552	30.3244	22.6678	19.1371	20.6783	26.8785	36.0763	45.8071	53.4637	56.9943	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	594.4551	600.6237	585.0791	551.9864	510.2128	470.9516	444.7226	438.5540	454.0987	487.1914	528.9649	568.2262	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	56.2820	56.2820	56.2820	56.2820	56.2820	56.2820	56.2820	56.2820	56.2820	56.2820	56.2820	56.2820	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-121.6112	-121.6112	-121.6112	-121.6112	-121.6112	-121.6112	-121.6112	-121.6112	-121.6112	-121.6112	-121.6112	-121.6112	(71)
Water heating gains (Table 5)	173.7567	170.9916	165.7440	154.3500	147.3476	140.0388	135.5967	139.3379	143.7155	151.8257	162.7540	172.3080	(72)
Total internal gains	940.7525	937.9559	907.9659	853.7483	797.3158	747.2151	718.0852	721.8580	750.9780	801.9117	862.2702	914.6161	(73)

---

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	21.7300	10.6334	0.5000	0.7000	0.7700	56.0445	(74)
South	18.9900	46.7521	0.5000	0.7000	0.7700	215.3412	(78)

Solar gains	271.3856	459.7772	631.2389	800.0741	922.8965	930.7577	891.0968	795.4112	688.1054	507.8844	324.3908	232.7960	(83)
Total gains	1212.1382	1397.7331	1539.2048	1653.8224	1720.2123	1677.9728	1609.1820	1517.2693	1439.0834	1309.7961	1186.6609	1147.4121	(84)

---

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	36.3489	36.5958	36.8462	38.1513	38.4235	39.8448	39.8448	40.1418	39.2638	38.4235	37.8829	37.3574	
alpha	3.4233	3.4397	3.4564	3.5434	3.5616	3.6563	3.6563	3.6761	3.6176	3.5616	3.5255	3.4905	
util living area													
	0.9988	0.9979	0.9960	0.9913	0.9778	0.9383	0.8607	0.8888	0.9679	0.9933	0.9981	0.9991	(86)
Living	18.4341	18.6233	18.9733	19.4978	20.0098	20.5063	20.7731	20.7310	20.3401	19.6792	19.0048	18.4534	
Non living	16.9782	17.1733	17.5289	18.0830	18.5935	19.0920	19.2904	19.2769	18.9349	18.2716	17.5863	17.0225	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	24	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	7	28	31	0	0	0	0	0	0	0	4	31	
MIT	20.6718	19.6539	19.8522	19.4978	20.0098	20.5063	20.7731	20.7310	20.3401	19.6792	19.1202	19.5577	(87)
Th 2	19.2250	19.2344	19.2438	19.2913	19.3009	19.3495	19.3495	19.3593	19.3299	19.3009	19.2817	19.2627	(88)
util rest of house													
	0.9983	0.9970	0.9940	0.9860	0.9602	0.8710	0.6761	0.7323	0.9310	0.9882	0.9971	0.9987	(89)
MIT 2	18.9377	18.0670	18.2725	18.0830	18.5935	19.0920	19.2904	19.2769	18.9349	18.2716	17.6844	17.9939	(90)
Living area fraction										fLA = Living area / (4) =		0.3697	(91)
MIT	19.5787	18.6537	18.8565	18.6060	19.1171	19.6148	19.8385	19.8145	19.4543	18.7920	18.2151	18.5720	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.5787	18.6537	18.8565	18.6060	19.1171	19.6148	19.8385	19.8145	19.4543	18.7920	18.2151	18.5720	(93)

---

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9984	0.9965	0.9934	0.9827	0.9574	0.8861	0.7480	0.7912	0.9351	0.9857	0.9960	0.9984	(94)
Useful gains	1210.2329	1392.8977	1529.1122	1625.2547	1646.9722	1486.8126	1203.6285	1200.4150	1345.7339	1291.1193	1181.9515	1145.6307	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	7594.7550	6790.5225	6059.2492	4596.7325	3487.8103	2274.0614	1468.5446	1536.8877	2463.9380	3852.2095	5301.3698	6951.1551	(97)
Space heating kWh													
	4750.0845	3627.2038	3370.4219	2139.4640	1369.5835	0.0000	0.0000	0.0000	0.0000	1905.4511	2965.9811	4319.3102	(98a)
Space heating requirement - total per year (kWh/year)												24447.5002	
Solar heating kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh													
	4750.0845	3627.2038	3370.4219	2139.4640	1369.5835	0.0000	0.0000	0.0000	0.0000	1905.4511	2965.9811	4319.3102	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												24447.5002	
Space heating per m2											(98c) / (4) =	106.5251	(99)

8c. Space cooling requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	4262.5876	3355.6540	3420.8505	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.4190	0.4996	0.4650	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1786.1854	1676.5163	1590.7892	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1835.1137	1759.6269	1651.5595	0.0000	0.0000	0.0000	0.0000	(103)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	35.2284	61.8343	45.2131	0.0000	0.0000	0.0000	0.0000	(104)
Cooled fraction										fC = cooled area / (4) =		0.7451	(105)
Intermittency factor (Table 10b)													
	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	6.5622	11.5182	8.4220	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling requirement												26.5024	(107)

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

Fraction of space heat from secondary/supplementary system (Table 11) 0.0000 (201)

Fraction of space heat from main system(s) 1.0000 (202)

Efficiency of main space heating system 1 (in %) 363.3018 (206)

Efficiency of main space heating system 2 (in %) 0.0000 (207)

Efficiency of secondary/supplementary heating system, % 0.0000 (208)

Cooling System Energy Efficiency Ratio (see Table 10c) 3.3000 (209)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	4750.0845	3627.2038	3370.4219	2139.4640	1369.5835	0.0000	0.0000	0.0000	0.0000	1905.4511	2965.9811	4319.3102	(98)
Space heating efficiency (main heating system 1)													
	363.3018	363.3018	363.3018	363.3018	363.3018	0.0000	0.0000	0.0000	0.0000	363.3018	363.3018	363.3018	(210)
Space heating fuel (main heating system)													
	1307.4762	998.3996	927.7196	588.8944	376.9823	0.0000	0.0000	0.0000	0.0000	524.4816	816.3959	1188.9042	(211)
Space heating efficiency (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	298.6968	264.2023	280.7676	247.0378	239.6039	216.0482	213.3102	221.6815	224.0098	249.6240	265.2360	295.4551	(64)
Efficiency of water heater												167.5228	(216)
(217)m	167.5228	167.5228	167.5228	167.5228	167.5228	167.5228	167.5228	167.5228	167.5228	167.5228	167.5228	167.5228	(217)
Fuel for water heating, kWh/month													
	178.3021	157.7112	167.5996	147.4651	143.0276	128.9664	127.3320	132.3291	133.7190	149.0089	158.3283	176.3670	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	1.9885	3.4904	2.5521	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	61.0717	55.1616	61.0717	59.1017	61.0717	59.1017	61.0717	61.0717	59.1017	61.0717	59.1017	61.0717	(231)
Lighting	48.5378	38.9388	35.0601	25.6865	19.8410	16.2103	18.0996	23.5266	30.5587	40.0947	45.2869	49.8868	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-98.6636	-164.6106	-280.2298	-375.0871	-462.3423	-451.2123	-445.2837	-390.0854	-306.5196	-210.3236	-117.0173	-82.5656	(233a)

Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)

Annual totals kWh/year		
Space heating fuel - main system 1	6729.2539	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	167.5228	
Water heating fuel used	1800.1563	(219)
Space cooling fuel	8.0310	(221)
Electricity for pumps and fans:		
(BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.9240)		
mechanical ventilation fans (SFP = 0.9240)	719.0705	(230a)
Total electricity for the above, kWh/year	719.0705	(231)
Electricity for lighting (calculated in Appendix L)	391.7278	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-3383.9410	(233)
Wind generation	0.0000	(234)
Hydro-electric generation (Appendix N)	0.0000	(235a)
Electricity generated - Micro CHP (Appendix N)	0.0000	(235)
Appendix Q - special features		
Energy saved or generated	-0.0000	(236)
Energy used	0.0000	(237)
Total delivered energy for all uses	6264.2986	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	6729.2539	16.4900	1109.6540	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1800.1563	16.4900	296.8458	(247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000	(247a)
Space cooling	8.0310	16.4900	1.3243	(248)
Pumps, fans and electric keep-hot	719.0705	16.4900	118.5747	(249)
Energy for lighting	391.7278	16.4900	64.5959	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-3383.9410	16.4900	-558.0119	
PV Unit electricity exported	0.0000	5.5900	0.0000	
Total			-558.0119	(252)
Total energy cost			1032.9828	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):	0.3600	(256)
Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] =	1.3547	(257)
SAP value	78.0398	
SAP rating (Section 12)	78	(258)
SAP band	C	

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	6729.2539	0.1541	1037.1739	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1800.1563	0.1409	253.5719	(264)
Space and water heating			1290.7458	(265)
Space cooling	8.0310	0.1135	0.9119	(266)
Pumps, fans and electric keep-hot	719.0705	0.1387	99.7439	(267)
Energy for lighting	391.7278	0.1443	56.5384	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-3383.9410	0.1313	-444.3504	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-444.3504	(269)
Total CO2, kg/year			1003.5897	(272)
CO2 emissions per m2			4.3700	(273)
EI value			95.1009	
EI rating			95	(274)
EI band			A	

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

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	67.5600 (1b)	x	2.8500 (2b)	=	192.5460	(1b) - (3b)
First floor	53.9800 (1c)	x	2.7500 (2c)	=	148.4450	(1c) - (3c)
Second floor	53.9800 (1d)	x	2.7500 (2d)	=	148.4450	(1d) - (3d)
Third floor	53.9800 (1e)	x	2.7500 (2e)	=	148.4450	(1e) - (3e)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	229.5000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	637.8810	(5)

2. Ventilation rate

		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	0 * 10 =	0.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)
	Air changes per hour		
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Number of storeys in the dwelling (ns)		4	(9)
Additional infiltration	[(9) - 1] x 0.1 =	0.3000	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0.3500	(11)
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0.0000	(12)
If no draught lobby, enter 0.05, else enter 0		0.0500	(13)
Percentage of windows and doors draught stripped		100.0000	(14)
Window infiltration	0.25 - [0.2 * (14) / 100] =	0.0500	(15)
Pressure test		No	
Pressure Test Method		Blower Door	
Measured/design AP50		15.0000	(17)
Infiltration rate		0.7500	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.6375	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.6694	0.6375	0.6375	0.5897	0.5897	0.5259	0.5419	0.5100	0.5259	0.5578	0.5578	0.6056	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation	0.5000	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)	0.5000	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	83.7000	(23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.7509	0.7190	0.7190	0.6712	0.6712	0.6074	0.6234	0.5915	0.6074	0.6393	0.6393	0.6871	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
New Windows (Uw = 1.40)			40.7200	1.3258	53.9848			(27)
Solid Door (New)			2.7600	1.4000	3.8640			(26)
Heatloss Floor 1			53.3000	0.3000	15.9900	110.0000	5863.0000	(28a)
External Wall 1	177.1600	43.4800	133.6800	0.2900	38.7672	190.0000	25399.2000	(29a)
External Wall 2	115.1400		115.1400	0.2600	29.9364	190.0000	21876.6000	(29a)
External Roof 1	53.9800		53.9800	1.6000	86.3680	9.0000	485.8200	(30)
Total net area of external elements Aum(A, m2)			399.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	228.9104			(33)
Party Wall 1			163.1600	0.0000	0.0000	70.0000	11421.2000	(32)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 65045.8200	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	283.4241	(35)
Thermal bridges (Default value 0.200 * total exposed area)	79.9160	(36)
Point Thermal bridges	(36a) = 0.0000	
Total fabric heat loss	(33) + (36) + (36a) = 308.8264	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	158.0597	151.3500	151.3500	141.2855	141.2855	127.8660	131.2209	124.5112	127.8660	134.5757	134.5757	144.6403	(38)
Heat transfer coeff	466.8862	460.1765	460.1765	450.1119	450.1119	436.6925	440.0473	433.3376	436.6925	443.4022	443.4022	453.4668	(39)
Average = Sum(39)m / 12 =												447.8753	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	2.0344	2.0051	2.0051	1.9613	1.9613	1.9028	1.9174	1.8882	1.9028	1.9320	1.9320	1.9759	(40)
HLP (average)												1.9515	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy	3.0403	(42)

Hot water usage for mixer showers

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
65.7960	64.8072	63.3663	60.6095	58.5750	56.3062	55.0166	56.4466	58.0141	60.4501	63.2661	65.5439	(42a)

Hot water usage for baths

34.1681	33.6607	32.9461	31.6285	30.6419	29.5479	28.9570	29.6666	30.4392	31.6098	32.9545	34.0526	(42b)

Hot water usage for other uses

48.1742	46.4224	44.6706	42.9188	41.1671	39.4153	39.4153	41.1671	42.9188	44.6706	46.4224	48.1742	(42c)

Average daily hot water use (litres/day)	136.1356	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	148.1383	144.8902	140.9830	135.1568	130.3840	125.2694	123.3889	127.2803	131.3722	136.7305	142.6431	147.7707	(44)
Energy conte	234.6148	206.3218	216.6856	185.0230	175.5219	154.0334	149.2282	157.5996	161.9950	185.5421	203.2212	231.3731	(45)
Energy content (annual)											Total = Sum(45)m =	2261.1597	
Distribution loss (46)m = 0.15 x (45)m													
	35.1922	30.9483	32.5028	27.7534	26.3283	23.1050	22.3842	23.6399	24.2993	27.8313	30.4832	34.7060	(46)
Water storage loss:													
Store volume												300.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.6000	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.8640	(55)
Total storage loss													
	26.7840	24.1920	26.7840	25.9200	26.7840	25.9200	26.7840	26.7840	25.9200	26.7840	25.9200	26.7840	(56)
If cylinder contains dedicated solar storage													
	26.7840	24.1920	26.7840	25.9200	26.7840	25.9200	26.7840	26.7840	25.9200	26.7840	25.9200	26.7840	(57)
Primary loss	37.2980	33.6885	37.2980	36.0948	37.2980	36.0948	37.2980	37.2980	36.0948	37.2980	36.0948	37.2980	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month													
	298.6968	264.2023	280.7676	247.0378	239.6039	216.0482	213.3102	221.6815	224.0098	249.6240	265.2360	295.4551	(62)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h													
	298.6968	264.2023	280.7676	247.0378	239.6039	216.0482	213.3102	221.6815	224.0098	249.6240	265.2360	295.4551	(64)
										Total per year (kWh/year) = Sum(64)m =		3015.6731	(64)
Electric shower(s)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
						Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =						0.0000	(64a)
Heat gains from water heating, kWh/month													
	129.2750	114.9064	123.3135	111.1320	109.6266	100.8279	100.8840	103.6674	103.4752	112.9583	117.1829	128.1971	(65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	182.4168	182.4168	182.4168	182.4168	182.4168	182.4168	182.4168	182.4168	182.4168	182.4168	182.4168	182.4168	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	55.4531	49.2530	40.0552	30.3244	22.6678	19.1371	20.6783	26.8785	36.0763	45.8071	53.4637	56.9943	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	594.4551	600.6237	585.0791	551.9864	510.2128	470.9516	444.7226	438.5540	454.0987	487.1914	528.9649	568.2262	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	56.2820	56.2820	56.2820	56.2820	56.2820	56.2820	56.2820	56.2820	56.2820	56.2820	56.2820	56.2820	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-121.6112	-121.6112	-121.6112	-121.6112	-121.6112	-121.6112	-121.6112	-121.6112	-121.6112	-121.6112	-121.6112	-121.6112	(71)
Water heating gains (Table 5)													
	173.7567	170.9916	165.7440	154.3500	147.3476	140.0388	135.5967	139.3379	143.7155	151.8257	162.7540	172.3080	(72)
Total internal gains													
	940.7525	937.9559	907.9659	853.7483	797.3158	747.2151	718.0852	721.8580	750.9780	801.9117	862.2702	914.6161	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	21.7300	11.9814	0.5000	0.7000	0.7700	63.1495	(74)
South	18.9900	50.9848	0.5000	0.7000	0.7700	234.8373	(78)

Solar gains	297.9869	454.7181	619.3986	815.6684	922.8430	998.6586	944.7191	857.8302	734.0672	536.9413	364.9498	253.1444	(83)
Total gains	1238.7394	1392.6740	1527.3645	1669.4167	1720.1588	1745.8737	1662.8043	1579.6882	1485.0452	1338.8530	1227.2200	1167.7604	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	38.6995	39.2638	39.2638	40.1418	40.1418	41.3753	41.0599	41.6956	41.3753	40.7492	40.7492	39.8448	
alpha	3.5800	3.6176	3.6176	3.6761	3.6761	3.7584	3.7373	3.7797	3.7584	3.7166	3.7166	3.6563	
util living area													
	0.9986	0.9978	0.9954	0.9881	0.9643	0.8680	0.7049	0.7364	0.9396	0.9900	0.9975	0.9989	(86)
Living	18.7189	18.8904	19.2456	19.7529	20.2763	20.7489	20.9279	20.9159	20.5725	19.9362	19.3010	18.7527	
Non living	17.3200	17.5044	17.8587	18.3825	18.8903	19.3145	19.3843	19.4021	19.1921	18.5801	17.9483	17.3802	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	18	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	13	28	24	0	0	0	0	0	0	0	0	31	
MIT	20.4582	19.8052	19.8346	19.7529	20.2763	20.7489	20.9279	20.9159	20.5725	19.9362	19.3010	19.7272	(87)
Th 2	19.3105	19.3299	19.3299	19.3593	19.3593	19.3989	19.3890	19.4089	19.3989	19.3790	19.3790	19.3495	(88)
util rest of house													
	0.9980	0.9967	0.9929	0.9803	0.9324	0.7215	0.3866	0.4299	0.8641	0.9816	0.9960	0.9984	(89)
MIT 2	18.8377	18.2960	18.3526	18.3825	18.8903	19.3145	19.3843	19.4021	19.1921	18.5801	17.9483	18.2341	(90)
Living area fraction										fLA = Living area / (4) =		0.3697	(91)
MIT	19.4368	18.8539	18.9004	18.8891	19.4027	19.8448	19.9550	19.9617	19.7024	19.0814	18.4483	18.7861	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.4368	18.8539	18.9004	18.8891	19.4027	19.8448	19.9550	19.9617	19.7024	19.0814	18.4483	18.7861	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9981	0.9963	0.9920	0.9770	0.9336	0.7741	0.5169	0.5565	0.8844	0.9792	0.9947	0.9982	(94)
Useful gains	1236.3333	1387.5293	1515.2010	1630.9479	1605.9027	1351.5621	859.4335	879.1148	1313.3035	1311.0684	1220.7351	1165.6496	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W													

	6693.6501	6099.1384	5292.2297	4046.0994	2881.9109	1678.9876	904.2779	936.7542	1966.1542	3317.2671	4632.8167	6206.1812	(97)
Space heating kWh													
	4060.2437	3166.2014	2810.1093	1738.9091	949.3501	0.0000	0.0000	0.0000	0.0000	1492.6119	2456.6987	3750.1555	(98a)
Space heating requirement - total per year (kWh/year)												20424.2798	
Solar heating kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh													
	4060.2437	3166.2014	2810.1093	1738.9091	949.3501	0.0000	0.0000	0.0000	0.0000	1492.6119	2456.6987	3750.1555	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												20424.2798	
Space heating per m2											(98c) / (4) =	88.9947	(99)

8c. Space cooling requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	3493.5399	2684.2888	2686.6933	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.5206	0.6179	0.5930	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1818.7581	1658.5547	1593.1450	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1914.4784	1822.3024	1724.5167	0.0000	0.0000	0.0000	0.0000	(103)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	68.9186	121.8283	97.7405	0.0000	0.0000	0.0000	0.0000	(104)
Cooled fraction											fC = cooled area / (4) =	0.7451	(105)
Intermittency factor (Table 10b)													
	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	12.8378	22.6935	18.2066	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling requirement												53.7379	(107)

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	363.8602	(206)
Efficiency of main space heating system 2 (in %)	0.0000	(207)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Cooling System Energy Efficiency Ratio (see Table 10c)	3.3000	(209)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	4060.2437	3166.2014	2810.1093	1738.9091	949.3501	0.0000	0.0000	0.0000	0.0000	1492.6119	2456.6987	3750.1555	(98)
Space heating efficiency (main heating system 1)													
	363.8602	363.8602	363.8602	363.8602	363.8602	0.0000	0.0000	0.0000	0.0000	363.8602	363.8602	363.8602	(210)
Space heating fuel (main heating system)													
	1115.8800	870.1697	772.3046	477.9058	260.9107	0.0000	0.0000	0.0000	0.0000	410.2157	675.1765	1030.6582	(211)
Space heating efficiency (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	298.6968	264.2023	280.7676	247.0378	239.6039	216.0482	213.3102	221.6815	224.0098	249.6240	265.2360	295.4551	(64)
Efficiency of water heater												167.3727	(216)
(217)m	167.3727	167.3727	167.3727	167.3727	167.3727	167.3727	167.3727	167.3727	167.3727	167.3727	167.3727	167.3727	(217)
Fuel for water heating, kWh/month													
	178.4621	157.8527	167.7500	147.5974	143.1559	129.0821	127.4463	132.4479	133.8390	149.1426	158.4703	176.5253	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	3.8902	6.8768	5.5171	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	61.0717	55.1616	61.0717	59.1017	61.0717	59.1017	61.0717	61.0717	59.1017	61.0717	59.1017	61.0717	(231)
Lighting	48.5378	38.9388	35.0601	25.6865	19.8410	16.2103	18.0996	23.5266	30.5587	40.0947	45.2869	49.8868	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-110.5978	-166.1954	-279.7489	-386.0709	-463.6301	-484.1101	-472.6494	-423.1683	-331.5591	-226.7657	-134.4127	-91.6329	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)

Annual totals kWh/year		
Space heating fuel - main system 1	5613.2211	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	167.3727	
Water heating fuel used	1801.7716	(219)
Space cooling fuel	16.2842	(221)
Electricity for pumps and fans:		
(BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.9240)		
mechanical ventilation fans (SFP = 0.9240)	719.0705	(230a)
Total electricity for the above, kWh/year	719.0705	(231)
Electricity for lighting (calculated in Appendix L)	391.7278	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-3570.5413	(233)
Wind generation	0.0000	(234)
Hydro-electric generation (Appendix N)	0.0000	(235a)
Electricity generated - Micro CHP (Appendix N)	0.0000	(235)
Appendix Q - special features		
Energy saved or generated	-0.0000	(236)
Energy used	0.0000	(237)
Total delivered energy for all uses	4971.5340	(238)

10a. Fuel costs - using BEDF prices (550)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	5613.2211	26.0600	1462.8054	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1801.7716	26.0600	469.5417	(247)
Energy for instantaneous electric shower(s)	0.0000	26.0600	0.0000	(247a)
Space cooling	16.2842	26.0600	4.2437	(248)
Pumps, fans and electric keep-hot	719.0705	26.0600	187.3898	(249)
Energy for lighting	391.7278	26.0600	102.0843	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-3570.5413	26.0600	-930.4831	
PV Unit electricity exported	0.0000	5.8100	0.0000	
Total			-930.4831	(252)
Total energy cost			1295.5818	(255)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	5613.2211	0.1546	867.7972	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1801.7716	0.1409	253.7995	(264)
Space and water heating			1121.5967	(265)
Space cooling	16.2842	0.1135	1.8481	(266)
Pumps, fans and electric keep-hot	719.0705	0.1387	99.7439	(267)
Energy for lighting	391.7278	0.1443	56.5384	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-3570.5413	0.1312	-468.3026	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-468.3026	(269)
Total CO2, kg/year			811.4245	(272)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	5613.2211	1.5724	8826.0288	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1801.7716	1.5209	2740.2264	(278)
Space and water heating			11566.2553	(279)
Space cooling	16.2842	1.4184	23.0979	(280)
Pumps, fans and electric keep-hot	719.0705	1.5128	1087.8098	(281)
Energy for lighting	391.7278	1.5338	600.8452	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-3570.5413	1.4845	-5300.5336	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-5300.5336	(283)
Total Primary energy kWh/year			7977.4746	(286)

SAP 10 EPC IMPROVEMENTS

Post Refurbishment

Current energy efficiency rating: C 78
Current environmental impact rating: A 95

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

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.2	-£ 101	-48 kg (5.9%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£101	0.21 kg/m²	C 79	A 95
Total Savings	£101	0.21 kg/m²		

Potential energy efficiency rating: C 79
Potential environmental impact rating: A 95

Fuel prices for cost data on this page from database revision number 550 TEST (28 Jun 2024)
Recommendation texts revision number 6.1 (11 Jun 2019)

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

	Current	Potential	Saving
Electricity	£2226	£2124	£102
Space heating	£1650	£1672	-£22
Space cooling	£4	£4	£0
Water heating	£470	£346	£124
Lighting	£102	£102	£0
Generated (PV)	-£930	-£929	-£1
Total cost of fuels	£1296	£1195	£101
Total cost of uses	£1296	£1195	£101
Delivered energy	22 kWh/m²	20 kWh/m²	2 kWh/m²
Carbon dioxide emissions	0.8 tonnes	0.8 tonnes	0.0 tonnes

CO2 emissions per m²	4 kg/m²	3 kg/m²	0 kg/m²
Primary energy	35 kWh/m²	32 kWh/m²	2 kWh/m²

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

---

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	67.5600 (1b)	x	2.8500 (2b)	=	192.5460	(1b) - (3b)
First floor	53.9800 (1c)	x	2.7500 (2c)	=	148.4450	(1c) - (3c)
Second floor	53.9800 (1d)	x	2.7500 (2d)	=	148.4450	(1d) - (3d)
Third floor	53.9800 (1e)	x	2.7500 (2e)	=	148.4450	(1e) - (3e)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	229.5000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	637.8810	(5)

2. Ventilation rate

		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	0 * 10 =	0.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Number of storeys in the dwelling (ns)		4	(9)
Additional infiltration	[(9) - 1] x 0.1 =	0.3000	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0.3500	(11)
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0.0000	(12)
If no draught lobby, enter 0.05, else enter 0		0.0500	(13)
Percentage of windows and doors draught stripped		100.0000	(14)
Window infiltration	0.25 - [0.2 * (14) / 100] =	0.0500	(15)

Pressure test		No
Pressure Test Method		Blower Door
Measured/design AP50		15.0000 (17)
Infiltration rate		0.7500 (18)
Number of sides sheltered		2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.6375 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.8128	0.7969	0.7809	0.7013	0.6853	0.6056	0.6056	0.5897	0.6375	0.6853	0.7172	0.7491	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation	0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)	0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	83.7000 (23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.8943	0.8784	0.8624	0.7828	0.7668	0.6871	0.6871	0.6712	0.7190	0.7668	0.7987	0.8306	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
New Windows (Uw = 1.40)			40.7200	1.3258	53.9848			(27)
Solid Door (New)			2.7600	1.4000	3.8640			(26)
Heatloss Floor 1			53.3000	0.3000	15.9900	110.0000	5863.0000	(28a)
External Wall 1	177.1600	43.4800	133.6800	0.2900	38.7672	190.0000	25399.2000	(29a)
External Wall 2	115.1400		115.1400	0.2600	29.9364	190.0000	21876.6000	(29a)
External Roof 1	53.9800		53.9800	1.6000	86.3680	9.0000	485.8200	(30)
Total net area of external elements Aum(A, m2)			399.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	228.9104			(33)
Party Wall 1			163.1600	0.0000	0.0000	70.0000	11421.2000	(32)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 65045.8200 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	283.4241 (35)
Thermal bridges (Default value 0.200 * total exposed area)	79.9160 (36)
Point Thermal bridges	(36a) = 0.0000
Total fabric heat loss	(33) + (36) + (36a) = 308.8264 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	188.2534	184.8986	181.5437	164.7694	161.4146	144.6403	144.6403	141.2855	151.3500	161.4146	168.1243	174.8340	(38)
Heat transfer coeff	497.0799	493.7250	490.3702	473.5959	470.2410	453.4668	453.4668	450.1119	460.1765	470.2410	476.9508	483.6605	(39)

Average = Sum(39)m / 12 = 472.7572

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	2.1659	2.1513	2.1367	2.0636	2.0490	1.9759	1.9759	1.9613	2.0051	2.0490	2.0782	2.1075	(40)
HLP (average)												2.0599	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

---

4. Water heating energy requirements (kWh/year)

Assumed occupancy												3.0403	(42)
Hot water usage for mixer showers													
	65.7960	64.8072	63.3663	60.6095	58.5750	56.3062	55.0166	56.4466	58.0141	60.4501	63.2661	65.5439	(42a)
Hot water usage for baths													
	34.1681	33.6607	32.9461	31.6285	30.6419	29.5479	28.9570	29.6666	30.4392	31.6098	32.9545	34.0526	(42b)
Hot water usage for other uses													
	48.1742	46.4224	44.6706	42.9188	41.1671	39.4153	39.4153	41.1671	42.9188	44.6706	46.4224	48.1742	(42c)
Average daily hot water use (litres/day)												136.1356	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	148.1383	144.8902	140.9830	135.1568	130.3840	125.2694	123.3889	127.2803	131.3722	136.7305	142.6431	147.7707	(44)
Energy conte	234.6148	206.3218	216.6856	185.0230	175.5219	154.0334	149.2282	157.5996	161.9950	185.5421	203.2212	231.3731	(45)
Energy content (annual)										Total = Sum(45)m =		2261.1597	
Distribution loss (46)m = 0.15 x (45)m													
	35.1922	30.9483	32.5028	27.7534	26.3283	23.1050	22.3842	23.6399	24.2993	27.8313	30.4832	34.7060	(46)
Water storage loss:													
Store volume												300.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.6000	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.8640	(55)
Total storage loss													
	26.7840	24.1920	26.7840	25.9200	26.7840	25.9200	26.7840	26.7840	25.9200	26.7840	25.9200	26.7840	(56)
If cylinder contains dedicated solar storage													
	26.7840	24.1920	26.7840	25.9200	26.7840	25.9200	26.7840	26.7840	25.9200	26.7840	25.9200	26.7840	(57)
Primary loss	37.2980	33.6885	35.0601	25.2664	16.7841	15.8817	16.4111	17.9030	27.4320	35.0601	36.0948	37.2980	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month													
	298.6968	264.2023	278.5297	236.2093	219.0900	195.8351	192.4233	202.2866	215.3471	247.3861	265.2360	295.4551	(62)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.8000	(H2)
Collector linear heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0000	(H4)
Collector loop efficiency												0.9000	(H5)
Incidence angle modifier												1.0000	(H6)
Overshading factor												0.8000	(H8)
Overall heat loss coefficient of system												6.5000	(H10)
Heat loss coefficient of collector loop												3.9667	(H11)
Dedicated solar storage volume												75.0000	(H12)
Effective solar volume												75.0000	(H14)
Reference volume												225.0000	(H15)
Storage tank correction coefficient												1.3161	(H16)
Heat delivered to hot water												632.7371	(H24)
Heat delivered to space heating												0.0000	(H29)
Solar input												632.7371	
Solar input	-0.0000	-16.1885	-59.0069	-81.5369	-106.8103	-98.5447	-97.9034	-85.3308	-58.6389	-28.7766	-0.0000	-0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h													
	298.6968	248.0137	219.5228	154.6724	112.2797	97.2904	94.5199	116.9558	156.7082	218.6096	265.2360	295.4551	(64)
										Total per year (kWh/year) = Sum(64)m =		2277.9603	(64)
Electric shower(s)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
										Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =		0.0000	(64a)
Heat gains from water heating, kWh/month													
	129.2750	114.9064	121.5232	102.4692	93.2155	84.6575	84.1745	88.1515	96.5450	111.1680	117.1829	128.1971	(65)

---

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	182.4168	182.4168	182.4168	182.4168	182.4168	182.4168	182.4168	182.4168	182.4168	182.4168	182.4168	182.4168	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	55.4531	49.2530	40.0552	30.3244	22.6678	19.1371	20.6783	26.8785	36.0763	45.8071	53.4637	56.9943	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	594.4551	600.6237	585.0791	551.9864	510.2128	470.9516	444.7226	438.5540	454.0987	487.1914	528.9649	568.2262	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	56.2820	56.2820	56.2820	56.2820	56.2820	56.2820	56.2820	56.2820	56.2820	56.2820	56.2820	56.2820	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-121.6112	-121.6112	-121.6112	-121.6112	-121.6112	-121.6112	-121.6112	-121.6112	-121.6112	-121.6112	-121.6112	-121.6112	(71)
Water heating gains (Table 5)													
	173.7567	170.9916	163.3377	142.3184	125.2897	117.5798	113.1377	118.4832	134.0903	149.4194	162.7540	172.3080	(72)
Total internal gains													
	940.7525	937.9559	905.5595	841.7167	775.2579	724.7561	695.6263	701.0033	741.3528	799.5054	862.2702	914.6161	(73)

---

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	21.7300	10.6334	0.5000	0.7000	0.7700	56.0445	(74)
South	18.9900	46.7521	0.5000	0.7000	0.7700	215.3412	(78)

Solar gains	271.3856	459.7772	631.2389	800.0741	922.8965	930.7577	891.0968	795.4112	688.1054	507.8844	324.3908	232.7960	(83)
Total gains	1212.1382	1397.7331	1536.7984	1641.7908	1698.1544	1655.5138	1586.7230	1496.4145	1429.4581	1307.3898	1186.6609	1147.4121	(84)

---

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	36.3489	36.5958	36.8462	38.1513	38.4235	39.8448	39.8448	40.1418	39.2638	38.4235	37.8829	37.3574	
alpha	3.4233	3.4397	3.4564	3.5434	3.5616	3.6563	3.6563	3.6761	3.6176	3.5616	3.5255	3.4905	
util living area													
	0.9988	0.9979	0.9961	0.9915	0.9787	0.9405	0.8649	0.8924	0.9686	0.9933	0.9981	0.9991	(86)
Living	18.4341	18.6233	18.9725	19.4936	20.0024	20.4998	20.7684	20.7261	20.3369	19.6784	19.0048	18.4534	
Non living	16.9782	17.1733	17.5281	18.0788	18.5866	19.0871	19.2885	19.2746	18.9322	18.2708	17.5863	17.0225	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	24	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	7	28	31	0	0	0	0	0	0	0	4	31	
MIT	20.6718	19.6539	19.8517	19.4936	20.0024	20.4998	20.7684	20.7261	20.3369	19.6784	19.1202	19.5577	(87)
Th 2	19.2250	19.2344	19.2438	19.2913	19.3009	19.3495	19.3495	19.3593	19.3299	19.3009	19.2817	19.2627	(88)
util rest of house													
	0.9983	0.9970	0.9941	0.9863	0.9616	0.8748	0.6824	0.7382	0.9322	0.9882	0.9971	0.9987	(89)
MIT 2	18.9377	18.0670	18.2721	18.0788	18.5866	19.0871	19.2885	19.2746	18.9322	18.2708	17.6844	17.9939	(90)
Living area fraction										fLA = Living area / (4) =		0.3697	(91)
MIT	19.5787	18.6537	18.8560	18.6018	19.1100	19.6094	19.8356	19.8111	19.4515	18.7911	18.2151	18.5720	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.5787	18.6537	18.8560	18.6018	19.1100	19.6094	19.8356	19.8111	19.4515	18.7911	18.2151	18.5720	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9984	0.9965	0.9935	0.9831	0.9588	0.8893	0.7535	0.7961	0.9362	0.9858	0.9960	0.9984	(94)
Useful gains	1210.2329	1392.8977	1526.7696	1614.0146	1628.2185	1472.3076	1195.5800	1191.3533	1338.2322	1288.8466	1181.9515	1145.6307	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	7594.7550	6790.5225	6059.0116	4594.7426	3484.4738	2271.5762	1467.2184	1535.3987	2462.6284	3851.8102	5301.3698	6951.1551	(97)
Space heating kWh													
	4750.0845	3627.2038	3371.9880	2146.1241	1381.0539	0.0000	0.0000	0.0000	0.0000	1906.8449	2965.9811	4319.3102	(98a)
Space heating requirement - total per year (kWh/year)												24468.5906	
Solar heating kWh													
	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh													
	4750.0845	3627.2038	3371.9880	2146.1241	1381.0539	0.0000	0.0000	0.0000	0.0000	1906.8449	2965.9811	4319.3102	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												24468.5906	
Space heating per m2											(98c) / (4) =	106.6170	(99)

8c. Space cooling requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	4262.5876	3355.6540	3420.8505	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.4143	0.4941	0.4598	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1766.0778	1658.0203	1572.8800	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1812.6547	1737.1680	1630.7047	0.0000	0.0000	0.0000	0.0000	(103)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	33.5354	58.8858	43.0216	0.0000	0.0000	0.0000	0.0000	(104)
Cooled fraction										fC = cooled area / (4) =		0.7451	(105)
Intermittency factor (Table 10b)													
	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	6.2468	10.9689	8.0138	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling requirement												25.2295	(107)

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												363.3018	(206)
Efficiency of main space heating system 2 (in %)												0.0000	(207)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Cooling System Energy Efficiency Ratio (see Table 10c)												3.3000	(209)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	4750.0845	3627.2038	3371.9880	2146.1241	1381.0539	0.0000	0.0000	0.0000	0.0000	1906.8449	2965.9811	4319.3102	(98)
Space heating efficiency (main heating system 1)													
	363.3018	363.3018	363.3018	363.3018	363.3018	0.0000	0.0000	0.0000	0.0000	363.3018	363.3018	363.3018	(210)
Space heating fuel (main heating system)													
	1307.4762	998.3996	928.1507	590.7276	380.1396	0.0000	0.0000	0.0000	0.0000	524.8653	816.3959	1188.9042	(211)
Space heating efficiency (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	298.6968	248.0137	219.5228	154.6724	112.2797	97.2904	94.5199	116.9558	156.7082	218.6096	265.2360	295.4551	(64)
Efficiency of water heater												167.5228	(216)
(217)m	167.5228	167.5228	167.5228	167.5228	167.5228	167.5228	167.5228	167.5228	167.5228	167.5228	167.5228	167.5228	(217)
Fuel for water heating, kWh/month													
	178.3021	148.0477	131.0405	92.3291	67.0235	58.0759	56.4221	69.8148	93.5444	130.4954	158.3283	176.3670	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	1.8930	3.3239	2.4284	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	67.8663	61.2986	67.8663	65.6770	67.8663	65.6770	67.8663	67.8663	65.6770	67.8663	65.6770	67.8663	(231)
Lighting	48.5378	38.9388	35.0601	25.6865	19.8410	16.2103	18.0996	23.5266	30.5587	40.0947	45.2869	49.8868	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-98.6636	-164.6105	-280.2234	-375.0342	-462.0857	-449.9257	-444.0127	-389.3678	-306.3206	-210.3207	-117.0174	-82.5656	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)

Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)

Annual totals kWh/year		
Space heating fuel - main system 1	6735.0591	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	167.5228	
Water heating fuel used	1359.7908	(219)
Space cooling fuel	7.6453	(221)
Electricity for pumps and fans:		
(BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.9240)		
mechanical ventilation fans (SFP = 0.9240)	719.0705	(230a)
pump for solar water heating	80.0000	(230g)
Total electricity for the above, kWh/year	799.0705	(231)
Electricity for lighting (calculated in Appendix L)	391.7278	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-3380.1480	(233)
Wind generation	0.0000	(234)
Hydro-electric generation (Appendix N)	0.0000	(235a)
Electricity generated - Micro CHP (Appendix N)	0.0000	(235)
Appendix Q - special features		
Energy saved or generated	-0.0000	(236)
Energy used	0.0000	(237)
Total delivered energy for all uses	5913.1455	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	6735.0591	16.4900	1110.6112	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1359.7908	16.4900	224.2295	(247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000	(247a)
Space cooling	7.6453	16.4900	1.2607	(248)
Pumps, fans and electric keep-hot	719.0705	16.4900	118.5747	(249)
Pump for solar water heating	80.0000	16.4900	13.1920	(249)
Energy for lighting	391.7278	16.4900	64.5959	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-3380.1480	16.4900	-557.3864	
PV Unit electricity exported	0.0000	5.5900	0.0000	
Total			-557.3864	(252)
Total energy cost			975.0777	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):	0.3600	(256)
Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] =	1.2788	(257)
SAP value	79.2708	
SAP rating (Section 12)	79	(258)
SAP band	C	

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	6735.0591	0.1541	1037.9709	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1359.7908	0.1454	197.7166	(264)
Space and water heating			1235.6876	(265)
Space cooling	7.6453	0.1135	0.8681	(266)
Pumps, fans and electric keep-hot	799.0705	0.1387	110.8409	(267)
Energy for lighting	391.7278	0.1443	56.5384	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-3380.1480	0.1313	-443.9075	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-443.9075	(269)
Total CO2, kg/year			960.0276	(272)
CO2 emissions per m2			4.1800	(273)
EI value			95.3135	
EI rating			95	(274)
EI band			A	

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

---

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	67.5600 (1b)	x	2.8500 (2b)	=	192.5460	(1b) - (3b)
First floor	53.9800 (1c)	x	2.7500 (2c)	=	148.4450	(1c) - (3c)
Second floor	53.9800 (1d)	x	2.7500 (2d)	=	148.4450	(1d) - (3d)
Third floor	53.9800 (1e)	x	2.7500 (2e)	=	148.4450	(1e) - (3e)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	229.5000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	637.8810	(5)

2. Ventilation rate

		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	0 * 10 =	0.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)
		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Number of storeys in the dwelling (ns)		4	(9)
Additional infiltration	[(9) - 1] x 0.1 =	0.3000	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0.3500	(11)
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0.0000	(12)
If no draught lobby, enter 0.05, else enter 0		0.0500	(13)
Percentage of windows and doors draught stripped		100.0000	(14)
Window infiltration	0.25 - [0.2 * (14) / 100] =	0.0500	(15)
Pressure test		No	
Pressure Test Method		Blower Door	
Measured/design AP50		15.0000	(17)
Infiltration rate		0.7500	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.6375	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.6694	0.6375	0.6375	0.5897	0.5897	0.5259	0.5419	0.5100	0.5259	0.5578	0.5578	0.6056	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation	0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)	0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	83.7000 (23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.7509	0.7190	0.7190	0.6712	0.6712	0.6074	0.6234	0.5915	0.6074	0.6393	0.6393	0.6871	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
New Windows (Uw = 1.40)			40.7200	1.3258	53.9848			(27)
Solid Door (New)			2.7600	1.4000	3.8640			(26)
Heatloss Floor 1			53.3000	0.3000	15.9900	110.0000	5863.0000	(28a)
External Wall 1	177.1600	43.4800	133.6800	0.2900	38.7672	190.0000	25399.2000	(29a)
External Wall 2	115.1400		115.1400	0.2600	29.9364	190.0000	21876.6000	(29a)
External Roof 1	53.9800		53.9800	1.6000	86.3680	9.0000	485.8200	(30)
Total net area of external elements Aum(A, m2)			399.5800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		228.9104			(33)
Party Wall 1			163.1600	0.0000	0.0000	70.0000	11421.2000	(32)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 65045.8200 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	283.4241 (35)
Thermal bridges (Default value 0.200 * total exposed area)	79.9160 (36)
Point Thermal bridges	(36a) = 0.0000
Total fabric heat loss	(33) + (36) + (36a) = 308.8264 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	158.0597	151.3500	151.3500	141.2855	141.2855	127.8660	131.2209	124.5112	127.8660	134.5757	134.5757	144.6403	(38)
Heat transfer coeff	466.8862	460.1765	460.1765	450.1119	450.1119	436.6925	440.0473	433.3376	436.6925	443.4022	443.4022	453.4668	(39)
Average = Sum(39)m / 12 =												447.8753	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	2.0344	2.0051	2.0051	1.9613	1.9613	1.9028	1.9174	1.8882	1.9028	1.9320	1.9320	1.9759	(40)
HLP (average)												1.9515	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy	3.0403 (42)

Hot water usage for mixer showers

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
65.7960	64.8072	63.3663	60.6095	58.5750	56.3062	55.0166	56.4466	58.0141	60.4501	63.2661	65.5439	(42a)

Hot water usage for baths

34.1681	33.6607	32.9461	31.6285	30.6419	29.5479	28.9570	29.6666	30.4392	31.6098	32.9545	34.0526	(42b)

Hot water usage for other uses

48.1742	46.4224	44.6706	42.9188	41.1671	39.4153	39.4153	41.1671	42.9188	44.6706	46.4224	48.1742	(42c)

Average daily hot water use (litres/day)	136.1356 (43)

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

Daily hot water use

	148.1383	144.8902	140.9830	135.1568	130.3840	125.2694	123.3889	127.2803	131.3722	136.7305	142.6431	147.7707	(44)
Energy conte	234.6148	206.3218	216.6856	185.0230	175.5219	154.0334	149.2282	157.5996	161.9950	185.5421	203.2212	231.3731	(45)
Energy content (annual)										Total = Sum(45)m =		2261.1597	

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

	35.1922	30.9483	32.5028	27.7534	26.3283	23.1050	22.3842	23.6399	24.2993	27.8313	30.4832	34.7060	(46)

Water storage loss:

Store volume	300.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):	1.6000	(48)
Temperature factor from Table 2b	0.5400	(49)
Enter (49) or (54) in (55)	0.8640	(55)

Total storage loss

	26.7840	24.1920	26.7840	25.9200	26.7840	25.9200	26.7840	26.7840	25.9200	26.7840	25.9200	26.7840	(56)

If cylinder contains dedicated solar storage

	26.7840	24.1920	26.7840	25.9200	26.7840	25.9200	26.7840	26.7840	25.9200	26.7840	25.9200	26.7840	(57)
Primary loss	37.2980	33.6885	35.0601	25.2664	16.7841	15.8817	16.4111	17.9030	27.4320	35.0601	36.0948	37.2980	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)

Total heat required for water heating calculated for each month

	298.6968	264.2023	278.5297	236.2093	219.0900	195.8351	192.4233	202.2866	215.3471	247.3861	265.2360	295.4551	(62)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.8000	(H2)
Collector linear heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0000	(H4)
Collector loop efficiency												0.9000	(H5)
Incidence angle modifier												1.0000	(H6)
Overshading factor												0.8000	(H8)
Overall heat loss coefficient of system												6.5000	(H10)
Heat loss coefficient of collector loop												3.9667	(H11)
Dedicated solar storage volume												75.0000	(H12)
Effective solar volume												75.0000	(H14)
Reference volume												225.0000	(H15)
Storage tank correction coefficient												1.3161	(H16)
Heat delivered to hot water												691.4323	(H24)
Heat delivered to space heating												0.0000	(H29)
Solar input												691.4323	

Solar input	-0.0000	-17.5800	-60.0563	-86.0505	-108.8952	-108.5105	-106.4613	-96.2702	-67.6186	-35.8446	-4.1452	-0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)

Output from w/h

	298.6968	246.6223	218.4734	150.1589	110.1948	87.3246	85.9621	106.0163	147.7284	211.5416	261.0908	295.4551	(64)
									Total per year (kWh/year) = Sum(64)m =			2219.2651	(64)

Electric shower(s)

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

Heat gains from water heating, kWh/month

	129.2750	114.9064	121.5232	102.4692	93.2155	84.6575	84.1745	88.1515	96.5450	111.1680	117.1829	128.1971	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	182.4168	182.4168	182.4168	182.4168	182.4168	182.4168	182.4168	182.4168	182.4168	182.4168	182.4168	182.4168	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	55.4531	49.2530	40.0552	30.3244	22.6678	19.1371	20.6783	26.8785	36.0763	45.8071	53.4637	56.9943	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	594.4551	600.6237	585.0791	551.9864	510.2128	470.9516	444.7226	438.5540	454.0987	487.1914	528.9649	568.2262	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	56.2820	56.2820	56.2820	56.2820	56.2820	56.2820	56.2820	56.2820	56.2820	56.2820	56.2820	56.2820	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-121.6112	-121.6112	-121.6112	-121.6112	-121.6112	-121.6112	-121.6112	-121.6112	-121.6112	-121.6112	-121.6112	-121.6112	(71)
Water heating gains (Table 5)													
	173.7567	170.9916	163.3377	142.3184	125.2897	117.5798	113.1377	118.4832	134.0903	149.4194	162.7540	172.3080	(72)
Total internal gains													
	940.7525	937.9559	905.5595	841.7167	775.2579	724.7561	695.6263	701.0033	741.3528	799.5054	862.2702	914.6161	(73)

6. Solar gains

[Jan]

	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	21.7300	11.9814	0.5000	0.7000	0.7700	63.1495	(74)
South	18.9900	50.9848	0.5000	0.7000	0.7700	234.8373	(78)

Solar gains	297.9869	454.7181	619.3986	815.6684	922.8430	998.6586	944.7191	857.8302	734.0672	536.9413	364.9498	253.1444	(83)
Total gains	1238.7394	1392.6740	1524.9581	1657.3851	1698.1009	1723.4147	1640.3454	1558.8335	1475.4199	1336.4466	1227.2200	1167.7604	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)	21.0000	(85)

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	38.6995	39.2638	39.2638	40.1418	40.1418	41.3753	41.0599	41.6956	41.3753	40.7492	40.7492	39.8448	
alpha	3.5800	3.6176	3.6176	3.6761	3.6761	3.7584	3.7373	3.7797	3.7584	3.7166	3.7166	3.6563	
util living area													
	0.9986	0.9978	0.9954	0.9884	0.9656	0.8718	0.7109	0.7422	0.9407	0.9900	0.9975	0.9989	(86)
Living	18.7189	18.8904	19.2447	19.7486	20.2692	20.7441	20.9258	20.9135	20.5697	19.9354	19.3010	18.7527	
Non living	17.3200	17.5044	17.8578	18.3784	18.8841	19.3121	19.3841	19.4018	19.1900	18.5792	17.9483	17.3802	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	18	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	13	28	24	0	0	0	0	0	0	0	0	31	
MIT	20.4582	19.8052	19.8340	19.7486	20.2692	20.7441	20.9258	20.9135	20.5697	19.9354	19.3010	19.7272	(87)
Th 2	19.3105	19.3299	19.3299	19.3593	19.3593	19.3989	19.3890	19.4089	19.3989	19.3790	19.3790	19.3495	(88)
util rest of house													
	0.9980	0.9967	0.9930	0.9807	0.9346	0.7273	0.3916	0.4352	0.8661	0.9817	0.9960	0.9984	(89)
MIT 2	18.8377	18.2960	18.3520	18.3784	18.8841	19.3121	19.3841	19.4018	19.1900	18.5792	17.9483	18.2341	(90)
Living area fraction									fLA = Living area / (4) =			0.3697	(91)
MIT	19.4368	18.8539	18.8999	18.8849	19.3961	19.8415	19.9540	19.9607	19.7001	19.0806	18.4483	18.7861	(92)

Temperature adjustment												0.0000	
adjusted MIT	19.4368	18.8539	18.8999	18.8849	19.3961	19.8415	19.9540	19.9607	19.7001	19.0806	18.4483	18.7861	(93)

---

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9981	0.9963	0.9921	0.9774	0.9356	0.7791	0.5227	0.5624	0.8860	0.9794	0.9947	0.9982	(94)
Useful gains	1236.3333	1387.5293	1512.8735	1619.9744	1588.8235	1342.6455	857.3503	876.6239	1307.2011	1308.8569	1220.7351	1165.6496	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	6693.6501	6099.1384	5291.9644	4044.2198	2878.9656	1677.5493	903.8649	936.2927	1965.1433	3316.8932	4632.8167	6206.1812	(97)
Space heating kWh	4060.2437	3166.2014	2811.6436	1745.4567	959.8657	0.0000	0.0000	0.0000	0.0000	1493.9790	2456.6987	3750.1555	(98a)
Space heating requirement - total per year (kWh/year)												20444.2444	
Solar heating kWh	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh	4060.2437	3166.2014	2811.6436	1745.4567	959.8657	0.0000	0.0000	0.0000	0.0000	1493.9790	2456.6987	3750.1555	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												20444.2444	
Space heating per m2											(98c) / (4) =	89.0817	(99)

8c. Space cooling requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	3493.5399	2684.2888	2686.6933	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.5154	0.6121	0.5873	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1800.5415	1643.1141	1577.9949	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1892.0194	1799.8434	1703.6619	0.0000	0.0000	0.0000	0.0000	(103)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	65.8641	116.6066	93.4963	0.0000	0.0000	0.0000	0.0000	(104)
Cooled fraction											fC = cooled area / (4) =	0.7451	(105)
Intermittency factor (Table 10b)	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	(106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	12.2688	21.7208	17.4160	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling requirement												51.4056	(107)

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												363.8602	(206)
Efficiency of main space heating system 2 (in %)												0.0000	(207)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Cooling System Energy Efficiency Ratio (see Table 10c)												3.3000	(209)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	4060.2437	3166.2014	2811.6436	1745.4567	959.8657	0.0000	0.0000	0.0000	0.0000	1493.9790	2456.6987	3750.1555	(98)
Space heating efficiency (main heating system 1)	363.8602	363.8602	363.8602	363.8602	363.8602	0.0000	0.0000	0.0000	0.0000	363.8602	363.8602	363.8602	(210)
Space heating fuel (main heating system)	1115.8800	870.1697	772.7263	479.7052	263.8007	0.0000	0.0000	0.0000	0.0000	410.5914	675.1765	1030.6582	(211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	298.6968	246.6223	218.4734	150.1589	110.1948	87.3246	85.9621	106.0163	147.7284	211.5416	261.0908	295.4551	(64)
Efficiency of water heater												167.3727	(216)
(217)m	167.3727	167.3727	167.3727	167.3727	167.3727	167.3727	167.3727	167.3727	167.3727	167.3727	167.3727	167.3727	(217)
Fuel for water heating, kWh/month	178.4621	147.3492	130.5311	89.7153	65.8380	52.1738	51.3597	63.3415	88.2632	126.3896	155.9937	176.5253	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	3.7178	6.5821	5.2776	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	67.8663	61.2986	67.8663	65.6770	67.8663	65.6770	67.8663	67.8663	65.6770	67.8663	65.6770	67.8663	(231)
Lighting	48.5378	38.9388	35.0601	25.6865	19.8410	16.2103	18.0996	23.5266	30.5587	40.0947	45.2869	49.8868	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-110.5979	-166.1952	-279.7403	-385.9910	-463.2488	-482.3620	-470.9980	-422.1388	-331.2667	-226.7590	-134.4129	-91.6330	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)

Annual totals kWh/year		
Space heating fuel - main system 1	5618.7080	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	167.3727	
Water heating fuel used	1325.9424	(219)
Space cooling fuel	15.5775	(221)

Electricity for pumps and fans:
(BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.9240)
mechanical ventilation fans (SFP = 0.9240) 719.0705 (230a)

pump for solar water heating	80.0000	(230g)
Total electricity for the above, kWh/year	799.0705	(231)
Electricity for lighting (calculated in Appendix L)	391.7278	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-3565.3435	(233)
Wind generation	0.0000	(234)
Hydro-electric generation (Appendix N)	0.0000	(235a)
Electricity generated - Micro CHP (Appendix N)	0.0000	(235)
Appendix Q - special features		
Energy saved or generated	-0.0000	(236)
Energy used	0.0000	(237)
Total delivered energy for all uses	4585.6827	(238)

10a. Fuel costs - using BEDF prices (550)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	5618.7080	26.0600	1464.2353	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1325.9424	26.0600	345.5406	(247)
Energy for instantaneous electric shower(s)	0.0000	26.0600	0.0000	(247a)
Space cooling	15.5775	26.0600	4.0595	(248)
Pumps, fans and electric keep-hot	719.0705	26.0600	187.3898	(249)
Pump for solar water heating	80.0000	26.0600	20.8480	(249)
Energy for lighting	391.7278	26.0600	102.0843	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-3565.3435	26.0600	-929.1285	
PV Unit electricity exported	0.0000	5.8100	0.0000	
Total			-929.1285	(252)
Total energy cost			1195.0289	(255)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	5618.7080	0.1546	868.5516	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1325.9424	0.1459	193.4981	(264)
Space and water heating			1062.0498	(265)
Space cooling	15.5775	0.1135	1.7678	(266)
Pumps, fans and electric keep-hot	799.0705	0.1387	110.8409	(267)
Energy for lighting	391.7278	0.1443	56.5384	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-3565.3435	0.1312	-467.6945	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-467.6945	(269)
Total CO2, kg/year			763.5024	(272)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	5618.7080	1.5723	8834.3057	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1325.9424	1.5398	2041.7309	(278)
Space and water heating			10876.0366	(279)
Space cooling	15.5775	1.4184	22.0953	(280)
Pumps, fans and electric keep-hot	799.0705	1.5128	1208.8338	(281)
Energy for lighting	391.7278	1.5338	600.8452	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-3565.3435	1.4846	-5293.0951	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-5293.0951	(283)
Total Primary energy kWh/year			7414.7159	(286)

Full SAP Calculation Printout

Property Reference	9 Briary Close	**Issued on Date**	18/07/2024
Assessment Reference	Pre Refurbishment	**Prop Type Ref**	9 Briary Close
Property			

SAP Rating	74 C	**DER**	34.04	**TER**	
Environmental	65 D	**% DER < TER**			N/A
CO_2 Emissions (t/year)	4.83	**DFEE**	102.66	**TFEE**	
Compliance Check	See BREL	**% DFEE < TFEE**			
% DPER < TPER		**DPER**	179.78	**TPER**	

Assessor Details	Mr. Jason Cook	**Assessor ID**	V572-0001
Client	MZA Planning, Charlotte Hirst		

SAP 10 WORKSHEET FOR Existing dwelling (SAP) (Version 10.2, February 2022)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE

---

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	53.3000 (1b)	x	2.8500 (2b)	=	151.9050	(1b) - (3b)
First floor	53.9800 (1c)	x	2.7500 (2c)	=	148.4450	(1c) - (3c)
Second floor	53.9800 (1d)	x	2.7500 (2d)	=	148.4450	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	161.2600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	448.7950	(5)

---

2. Ventilation rate

---

		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	3 * 10 =	30.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.0668	(8)
Number of storeys in the dwelling (ns)		3	(9)
Additional infiltration	[(9) - 1] x 0.1 =	0.2000	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0.3500	(11)
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0.0000	(12)
If no draught lobby, enter 0.05, else enter 0		0.0500	(13)
Percentage of windows and doors draught stripped		100.0000	(14)
Window infiltration	0.25 - [0.2 * (14) / 100] =	0.0500	(15)

Pressure test		No	
Pressure Test Method		Blower Door	
Measured/design AP50		15.0000	(17)
Infiltration rate		0.7168	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.6093	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.7769	0.7616	0.7464	0.6703	0.6550	0.5789	0.5789	0.5636	0.6093	0.6550	0.6855	0.7159	(22b)
Effective ac	0.8018	0.7901	0.7786	0.7246	0.7145	0.6675	0.6675	0.6588	0.6856	0.7145	0.7349	0.7563	(25)

---

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Original Windows (Uw = 2.80)			37.6000	2.5180	94.6763			(27)
Solid Door (Old)			2.7600	2.8000	7.7280			(26)
Heatloss Floor 1			53.3000	0.4000	21.3200	110.0000	5863.0000	(28a)
External Wall 1	92.1800	40.3600	51.8200	0.8200	42.4924	190.0000	9845.8000	(29a)
External Roof 1	53.9800		53.9800	1.6000	86.3680	9.0000	485.8200	(30)
Total net area of external elements Aum(A, m2)			199.4600					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		252.5847			(33)
Party Wall 1			163.1600	0.0000	0.0000	70.0000	11421.2000	(32)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 27615.8200 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 171.2503 (35)
Thermal bridges (Default value 0.200 * total exposed area) 39.8920 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 292.4767 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	118.7444	117.0089	115.3078	107.3176	105.8227	98.8636	98.8636	97.5748	101.5441	105.8227	108.8469	112.0086	(38)
Heat transfer coeff	411.2210	409.4855	407.7844	399.7943	398.2994	391.3402	391.3402	390.0515	394.0208	398.2994	401.3236	404.4853	(39)

Average = Sum(39)m / 12 = 399.7871

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	2.5500	2.5393	2.5287	2.4792	2.4699	2.4268	2.4268	2.4188	2.4434	2.4699	2.4887	2.5083	(40)
HLP (average)												2.4791	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.9507 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	64.4812	63.5122	62.1002	59.3984	57.4046	55.1811	53.9173	55.3187	56.8549	59.2422	62.0020	64.2342	(42a)
Hot water usage for baths	33.4880	32.9906	32.2902	30.9989	30.0320	28.9598	28.3806	29.0761	29.8333	30.9806	32.2985	33.3747	(42b)
Hot water usage for other uses	47.2082	45.4915	43.7749	42.0582	40.3416	38.6249	38.6249	40.3416	42.0582	43.7749	45.4915	47.2082	(42c)

Average daily hot water use (litres/day) 133.4147 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	145.1774	141.9944	138.1653	132.4555	127.7781	122.7658	120.9228	124.7363	128.7464	133.9977	139.7920	144.8171	(44)
Energy conte	229.9255	202.1981	212.3549	181.3250	172.0139	150.9549	146.2457	154.4497	158.7572	181.8336	199.1594	226.7486	(45)
Energy content (annual)										Total = Sum(45)m =		2215.9665	
Distribution loss (46)m = 0.15 x (45)m	34.4888	30.3297	31.8532	27.1988	25.8021	22.6432	21.9369	23.1674	23.8136	27.2750	29.8739	34.0123	(46)

Water storage loss:
Store volume 250.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): 2.0900 (48)
Temperature factor from Table 2b 0.7800 (49)
Enter (49) or (54) in (55) 1.6302 (55)

Total storage loss	50.5362	45.6456	50.5362	48.9060	50.5362	48.9060	50.5362	50.5362	48.9060	50.5362	48.9060	50.5362	(56)
If cylinder contains dedicated solar storage	50.5362	45.6456	50.5362	48.9060	50.5362	48.9060	50.5362	50.5362	48.9060	50.5362	48.9060	50.5362	(57)
Primary loss	106.3213	96.0322	106.3213	102.8916	106.3213	36.0948	37.2980	37.2980	36.0948	106.3213	102.8916	106.3213	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	386.7830	343.8759	369.2124	333.1226	328.8714	235.9557	234.0799	242.2838	243.7580	338.6911	350.9570	383.6062	(62)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	386.7830	343.8759	369.2124	333.1226	328.8714	235.9557	234.0799	242.2838	243.7580	338.6911	350.9570	383.6062	(64)

Total per year (kWh/year) = Sum(64)m = 3791.1970 (64)
12Total per year (kWh/year) 3791 (64)

Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)

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

Heat gains from water heating, kWh/month	161.5073	144.0566	155.6651	142.6039	142.2517	79.0683	78.4651	81.1929	81.6626	145.5167	148.5338	160.4510	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	147.5334	147.5334	147.5334	147.5334	147.5334	147.5334	147.5334	147.5334	147.5334	147.5334	147.5334	147.5334	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	167.7206	185.6906	167.7206	173.3112	167.7206	173.3112	167.7206	167.7206	173.3112	167.7206	173.3112	167.7206	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	332.5248	335.9753	327.2800	308.7687	285.4015	263.4397	248.7678	245.3172	254.0125	272.5238	295.8910	317.8529	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.7533	37.7533	37.7533	37.7533	37.7533	37.7533	37.7533	37.7533	37.7533	37.7533	37.7533	37.7533	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-118.0267	-118.0267	-118.0267	-118.0267	-118.0267	-118.0267	-118.0267	-118.0267	-118.0267	-118.0267	-118.0267	-118.0267	(71)
Water heating gains (Table 5)	217.0797	214.3699	209.2272	198.0609	191.1985	109.8171	105.4638	109.1302	113.4203	195.5870	206.2969	215.6599	(72)
Total internal gains	787.5850	806.2959	774.4878	750.4009	714.5806	613.8281	589.2122	589.4280	608.0041	706.0914	745.7592	771.4934	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	15.4400	10.6334	0.7600	0.7000	0.7700	60.5291	(74)
South	22.1600	46.7521	0.7600	0.7000	0.7700	381.9578	(78)

Solar gains	442.4869	741.2227	993.3965	1216.3233	1363.7892	1358.4654	1307.5280	1194.2250	1068.7184	812.4077	527.4207	380.5067	(83)
Total gains	1230.0719	1547.5186	1767.8843	1966.7242	2078.3698	1972.2934	1896.7402	1783.6530	1676.7225	1518.4991	1273.1799	1152.0001	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	18.6543	18.7334	18.8116	19.1875	19.2595	19.6020	19.6020	19.6668	19.4687	19.2595	19.1144	18.9650	
alpha	2.2436	2.2489	2.2541	2.2792	2.2840	2.3068	2.3068	2.3111	2.2979	2.2840	2.2743	2.2643	
util living area	0.9826	0.9703	0.9530	0.9195	0.8621	0.7758	0.6632	0.7000	0.8416	0.9335	0.9730	0.9850	(86)
MIT	17.2608	17.6293	18.1953	18.9724	19.7176	20.3413	20.6864	20.6307	20.1189	19.1730	18.1002	17.2310	(87)
Th 2	18.9918	18.9980	19.0041	19.0330	19.0385	19.0640	19.0640	19.0688	19.0541	19.0385	19.0275	19.0160	(88)
util rest of house	0.9775	0.9616	0.9380	0.8907	0.8032	0.6543	0.4496	0.4995	0.7478	0.9036	0.9634	0.9806	(89)
MIT 2	15.7941	16.1611	16.7218	17.4938	18.1979	18.7555	18.9887	18.9672	18.5837	17.7049	16.6485	15.7780	(90)
Living area fraction										fLA = Living area / (4) =		0.4379	(91)
MIT	16.4363	16.8040	17.3670	18.1412	18.8633	19.4499	19.7321	19.6956	19.2559	18.3477	17.2841	16.4142	(92)
Temperature adjustment												0.0000	
adjusted MIT	16.4363	16.8040	17.3670	18.1412	18.8633	19.4499	19.7321	19.6956	19.2559	18.3477	17.2841	16.4142	(93)

---

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9671	0.9470	0.9202	0.8728	0.7964	0.6841	0.5369	0.5780	0.7604	0.8886	0.9504	0.9714	(94)
Useful gains	1189.6111	1465.5367	1626.8940	1716.4961	1655.1319	1349.2094	1018.3901	1031.0242	1275.0412	1349.3236	1210.0214	1119.0286	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	4990.7089	4874.4982	4431.3759	3694.5888	2853.1416	1897.9419	1225.6997	1285.4428	2031.5320	3085.9057	4087.1339	4940.4662	(97)
Space heating kWh	2828.0167	2290.8221	2086.5346	1424.2268	891.3192	0.0000	0.0000	0.0000	0.0000	1292.0171	2071.5210	2843.1496	(98a)
Space heating requirement - total per year (kWh/year)												15727.6070	
Solar heating kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh	2828.0167	2290.8221	2086.5346	1424.2268	891.3192	0.0000	0.0000	0.0000	0.0000	1292.0171	2071.5210	2843.1496	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												15727.6070	
Space heating per m2											(98c) / (4) =	97.5295	(99)

8c. Space cooling requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	3678.5980	2895.9175	2964.3912	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.5129	0.5878	0.5566	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1886.6656	1702.3418	1649.8548	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	2228.0459	2144.0732	2017.4635	0.0000	0.0000	0.0000	0.0000	(103)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	245.7938	328.6482	273.5009	0.0000	0.0000	0.0000	0.0000	(104)
Cooled fraction										fC = cooled area / (4) =		0.5271	(105)
Intermittency factor (Table 10b)	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	(106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	32.3894	43.3075	36.0405	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling requirement												111.7375	(107)

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	74.3000	(206)
Efficiency of main space heating system 2 (in %)	0.0000	(207)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Cooling System Energy Efficiency Ratio (see Table 10c)	3.2000	(209)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	2828.0167	2290.8221	2086.5346	1424.2268	891.3192	0.0000	0.0000	0.0000	0.0000	1292.0171	2071.5210	2843.1496	(98)
Space heating efficiency (main heating system 1)	74.3000	74.3000	74.3000	74.3000	74.3000	0.0000	0.0000	0.0000	0.0000	74.3000	74.3000	74.3000	(210)
Space heating fuel (main heating system)	3806.2136	3083.2060	2808.2565	1916.8597	1199.6220	0.0000	0.0000	0.0000	0.0000	1738.9194	2788.0498	3826.5808	(211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	386.7830	343.8759	369.2124	333.1226	328.8714	235.9557	234.0799	242.2838	243.7580	338.6911	350.9570	383.6062	(64)
Efficiency of water heater												69.2000	(216)
(217)m	72.9315	72.8176	72.5972	72.1651	71.2986	64.2000	64.2000	64.2000	64.2000	71.9668	72.6579	72.9475	(217)
Fuel for water heating, kWh/month	530.3374	472.2427	508.5764	461.6120	461.2596	367.5322	364.6104	377.3891	379.6854	470.6211	483.0265	525.8661	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	10.1217	13.5336	11.2627	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting	57.1954	45.8842	41.3137	30.2682	23.3800	19.1017	21.3280	27.7230	36.0094	47.2463	53.3646	58.7850	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-61.5647	-86.1831	-122.9093	-136.6707	-145.6379	-135.1274	-133.4795	-127.0508	-115.0342	-98.0696	-67.4840	-53.2854	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													

(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)

Annual totals kWh/year		
Space heating fuel - main system 1	21167.7079	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	69.2000	
Water heating fuel used	5402.7588	(219)
Space cooling fuel	34.9180	(221)
Electricity for pumps and fans:		
central heating pump	41.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	86.0000	(231)
Electricity for lighting (calculated in Appendix L)	461.5993	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-1282.4966	(233)
Wind generation	0.0000	(234)
Hydro-electric generation (Appendix N)	0.0000	(235a)
Electricity generated - Micro CHP (Appendix N)	0.0000	(235)
Appendix Q - special features		
Energy saved or generated	-0.0000	(236)
Energy used	0.0000	(237)
Total delivered energy for all uses	25870.4875	(238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	21167.7079	0.2100	4445.2187	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	5402.7588	0.2100	1134.5794	(264)
Space and water heating			5579.7980	(265)
Space cooling	34.9180	0.1139	3.9783	(266)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	461.5993	0.1443	66.6230	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1282.4966	0.1348	-172.9060	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-172.9060	(269)
Total CO2, kg/year			5489.4226	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			34.0400	(273)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	21167.7079	1.1300	23919.5099	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	5402.7588	1.1300	6105.1175	(278)
Space and water heating			30024.6274	(279)
Space cooling	34.9180	1.4200	49.5819	(280)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	461.5993	1.5338	708.0165	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1282.4966	1.4983	-1921.5463	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-1921.5463	(283)
Total Primary energy kWh/year			28990.7802	(286)
Dwelling Primary energy Rate (DPER)			179.7800	(287)

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

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)			Volume (m3)	
Ground floor	53.3000	(1b)	x 2.8500	(2b)	=	151.9050	(1b) - (3b)
First floor	53.9800	(1c)	x 2.7500	(2c)	=	148.4450	(1c) - (3c)
Second floor	53.9800	(1d)	x 2.7500	(2d)	=	148.4450	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	161.2600						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)		=	448.7950	(5)

2. Ventilation rate

		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	3 * 10 =	30.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)

Number of flueless gas fires	0 * 40 =	0.0000	(7c)
	Air changes per hour		
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.0668	(8)
Number of storeys in the dwelling (ns)		3	(9)
Additional infiltration	[(9) - 1] x 0.1 =	0.2000	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0.3500	(11)
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0.0000	(12)
If no draught lobby, enter 0.05, else enter 0		0.0500	(13)
Percentage of windows and doors draught stripped		100.0000	(14)
Window infiltration	0.25 - [0.2 * (14) / 100] =	0.0500	(15)
Pressure test		No	
Pressure Test Method		Blower Door	
Measured/design AP50		15.0000	(17)
Infiltration rate		0.7168	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.6093	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.7769	0.7616	0.7464	0.6703	0.6550	0.5789	0.5789	0.5636	0.6093	0.6550	0.6855	0.7159	(22b)
Effective ac	0.8018	0.7901	0.7786	0.7246	0.7145	0.6675	0.6675	0.6588	0.6856	0.7145	0.7349	0.7563	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Original Windows (Uw = 2.80)			37.6000	2.5180	94.6763			(27)
Solid Door (Old)			2.7600	2.8000	7.7280			(26)
Heatloss Floor 1			53.3000	0.4000	21.3200	110.0000	5863.0000	(28a)
External Wall 1	92.1800	40.3600	51.8200	0.8200	42.4924	190.0000	9845.8000	(29a)
External Roof 1	53.9800		53.9800	1.6000	86.3680	9.0000	485.8200	(30)
Total net area of external elements Aum(A, m2)			199.4600					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		252.5847			(33)
Party Wall 1			163.1600	0.0000	0.0000	70.0000	11421.2000	(32)
Heat capacity Cm = Sum(A x k)				(28)...(30) + (32) + (32a)...(32e) =			27615.8200	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							171.2503	(35)
Thermal bridges (Default value 0.200 * total exposed area)							39.8920	(36)
Point Thermal bridges						(36a) =	0.0000	
Total fabric heat loss					(33) + (36) + (36a) =		292.4767	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	118.7444	117.0089	115.3078	107.3176	105.8227	98.8636	98.8636	97.5748	101.5441	105.8227	108.8469	112.0086	(38)
Heat transfer coeff	411.2210	409.4855	407.7844	399.7943	398.2994	391.3402	391.3402	390.0515	394.0208	398.2994	401.3236	404.4853	(39)
Average = Sum(39)m / 12 =												399.7871	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	2.5500	2.5393	2.5287	2.4792	2.4699	2.4268	2.4268	2.4188	2.4434	2.4699	2.4887	2.5083	(40)
HLP (average)												2.4791	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.9507	(42)
Hot water usage for mixer showers	64.4812	63.5122	62.1002	59.3984	57.4046	55.1811	53.9173	55.3187	56.8549	59.2422	62.0020	64.2342	(42a)
Hot water usage for baths	33.4880	32.9906	32.2902	30.9989	30.0320	28.9598	28.3806	29.0761	29.8333	30.9806	32.2985	33.3747	(42b)
Hot water usage for other uses	47.2082	45.4915	43.7749	42.0582	40.3416	38.6249	38.6249	40.3416	42.0582	43.7749	45.4915	47.2082	(42c)
Average daily hot water use (litres/day)												133.4147	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	145.1774	141.9944	138.1653	132.4555	127.7781	122.7658	120.9228	124.7363	128.7464	133.9977	139.7920	144.8171	(44)
Energy conte	229.9255	202.1981	212.3549	181.3250	172.0139	150.9549	146.2457	154.4497	158.7572	181.8336	199.1594	226.7486	(45)
Energy content (annual)										Total = Sum(45)m =		2215.9665	
Distribution loss (46)m = 0.15 x (45)m	34.4888	30.3297	31.8532	27.1988	25.8021	22.6432	21.9369	23.1674	23.8136	27.2750	29.8739	34.0123	(46)
Water storage loss:													
Store volume												250.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												2.0900	(48)
Temperature factor from Table 2b												0.7800	(49)
Enter (49) or (54) in (55)												1.6302	(55)
Total storage loss	50.5362	45.6456	50.5362	48.9060	50.5362	48.9060	50.5362	50.5362	48.9060	50.5362	48.9060	50.5362	(56)
If cylinder contains dedicated solar storage	50.5362	45.6456	50.5362	48.9060	50.5362	48.9060	50.5362	50.5362	48.9060	50.5362	48.9060	50.5362	(57)
Primary loss	106.3213	96.0322	106.3213	102.8916	106.3213	36.0948	37.2980	37.2980	36.0948	106.3213	102.8916	106.3213	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	386.7830	343.8759	369.2124	333.1226	328.8714	235.9557	234.0799	242.2838	243.7580	338.6911	350.9570	383.6062	(62)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	386.7830	343.8759	369.2124	333.1226	328.8714	235.9557	234.0799	242.2838	243.7580	338.6911	350.9570	383.6062	(64)
									Total per year (kWh/year) = Sum(64)m =			3791.1970	(64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
									Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =			0.0000	(64a)
Heat gains from water heating, kWh/month	161.5073	144.0566	155.6651	142.6039	142.2517	79.0683	78.4651	81.1929	81.6626	145.5167	148.5338	160.4510	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	177.0401	177.0401	177.0401	177.0401	177.0401	177.0401	177.0401	177.0401	177.0401	177.0401	177.0401	177.0401	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	65.3442	58.0381	47.1998	35.7333	26.7110	22.5506	24.3667	31.6727	42.5111	53.9776	62.9998	67.1603	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	496.3056	501.4557	488.4776	460.8488	425.9724	393.1935	371.2952	366.1451	379.1232	406.7520	441.6284	474.4073	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.6547	55.6547	55.6547	55.6547	55.6547	55.6547	55.6547	55.6547	55.6547	55.6547	55.6547	55.6547	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-118.0267	-118.0267	-118.0267	-118.0267	-118.0267	-118.0267	-118.0267	-118.0267	-118.0267	-118.0267	-118.0267	-118.0267	(71)
Water heating gains (Table 5)													
	217.0797	214.3699	209.2272	198.0609	191.1985	109.8171	105.4638	109.1302	113.4203	195.5870	206.2969	215.6599	(72)
Total internal gains													
	896.3975	891.5318	862.5727	812.3110	761.5500	640.2293	615.7937	621.6161	649.7226	773.9846	828.5932	874.8955	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	15.4400	10.6334	0.7600	0.7000	0.7700	60.5291	(74)
South	22.1600	46.7521	0.7600	0.7000	0.7700	381.9578	(78)

Solar gains	442.4869	741.2227	993.3965	1216.3233	1363.7892	1358.4654	1307.5280	1194.2250	1068.7184	812.4077	527.4207	380.5067	(83)
Total gains	1338.8844	1632.7544	1855.9691	2028.6344	2125.3392	1998.6946	1923.3218	1815.8411	1718.4410	1586.3924	1356.0139	1255.4023	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	18.6543	18.7334	18.8116	19.1875	19.2595	19.6020	19.6020	19.6668	19.4687	19.2595	19.1144	18.9650	
alpha	2.2436	2.2489	2.2541	2.2792	2.2840	2.3068	2.3068	2.3111	2.2979	2.2840	2.2743	2.2643	
util living area													
	0.9794	0.9670	0.9485	0.9150	0.8571	0.7717	0.6582	0.6938	0.8356	0.9280	0.9694	0.9821	(86)
MIT	17.3285	17.6805	18.2454	19.0043	19.7377	20.3497	20.6918	20.6383	20.1356	19.2096	18.1508	17.2964	(87)
Th 2	18.9918	18.9980	19.0041	19.0330	19.0385	19.0640	19.0640	19.0688	19.0541	19.0385	19.0275	19.0160	(88)
util rest of house													
	0.9733	0.9574	0.9323	0.8849	0.7969	0.6494	0.4447	0.4929	0.7398	0.8961	0.9586	0.9769	(89)
MIT 2	15.8607	16.2109	16.7695	17.5229	18.2142	18.7606	18.9904	18.9700	18.5955	17.7380	16.6975	15.8424	(90)
Living area fraction										fLA = Living area / (4) =		0.4379	(91)
MIT	16.5034	16.8543	17.4158	18.1715	18.8813	19.4564	19.7354	19.7005	19.2698	18.3824	17.3338	16.4791	(92)
Temperature adjustment												0.0000	
adjusted MIT	16.5034	16.8543	17.4158	18.1715	18.8813	19.4564	19.7354	19.7005	19.2698	18.3824	17.3338	16.4791	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9616	0.9419	0.9138	0.8670	0.7907	0.6798	0.5321	0.5719	0.7535	0.8811	0.9447	0.9664	(94)
Useful gains	1287.5319	1537.9653	1696.0585	1758.7747	1680.4552	1358.7895	1023.4513	1038.4581	1294.9177	1397.7665	1280.9596	1213.2624	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	5018.3084	4895.1327	4451.2733	3706.7110	2860.3061	1900.5050	1226.9996	1287.3583	2037.0243	3099.7245	4107.0762	4966.6955	(97)
Space heating kWh													
	2775.6977	2256.0165	2049.8798	1402.5141	877.8091	0.0000	0.0000	0.0000	0.0000	1266.2567	2034.8039	2792.5542	(98a)
Space heating requirement - total per year (kWh/year)												15455.5321	
Solar heating kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh													
	2775.6977	2256.0165	2049.8798	1402.5141	877.8091	0.0000	0.0000	0.0000	0.0000	1266.2567	2034.8039	2792.5542	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												15455.5321	
Space heating per m2											(98c) / (4) =	95.8423	(99)

8c. Space cooling requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	3678.5980	2895.9175	2964.3912	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.5129	0.5878	0.5566	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1886.6656	1702.3418	1649.8548	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	2228.0459	2144.0732	2017.4635	0.0000	0.0000	0.0000	0.0000	(103)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	245.7938	328.6482	273.5009	0.0000	0.0000	0.0000	0.0000	(104)
Cooled fraction										fC = cooled area / (4) =		0.5271	(105)
Intermittency factor (Table 10b)													
	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	32.3894	43.3075	36.0405	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling requirement												111.7375	(107)

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												74.3000	(206)
Efficiency of main space heating system 2 (in %)												0.0000	(207)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Cooling System Energy Efficiency Ratio (see Table 10c)												3.2000	(209)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	2775.6977	2256.0165	2049.8798	1402.5141	877.8091	0.0000	0.0000	0.0000	0.0000	1266.2567	2034.8039	2792.5542	(98)
Space heating efficiency (main heating system 1)													
	74.3000	74.3000	74.3000	74.3000	74.3000	0.0000	0.0000	0.0000	0.0000	74.3000	74.3000	74.3000	(210)
Space heating fuel (main heating system)													
	3735.7977	3036.3614	2758.9231	1887.6367	1181.4389	0.0000	0.0000	0.0000	0.0000	1704.2486	2738.6325	3758.4848	(211)
Space heating efficiency (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	386.7830	343.8759	369.2124	333.1226	328.8714	235.9557	234.0799	242.2838	243.7580	338.6911	350.9570	383.6062	(64)
Efficiency of water heater												69.2000	(216)
(217)m	72.9093	72.7981	72.5720	72.1391	71.2662	64.2000	64.2000	64.2000	64.2000	71.9305	72.6332	72.9263	(217)
Fuel for water heating, kWh/month													
	530.4991	472.3690	508.7533	461.7782	461.4688	367.5322	364.6104	377.3891	379.6854	470.8588	483.1910	526.0187	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	10.1217	13.5336	11.2627	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting	57.1954	45.8842	41.3137	30.2682	23.3800	19.1017	21.3280	27.7230	36.0094	47.2463	53.3646	58.7850	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-61.5647	-86.1831	-122.9093	-136.6707	-145.6379	-135.1274	-133.4795	-127.0508	-115.0342	-98.0696	-67.4840	-53.2854	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)
Annual totals kWh/year													
Space heating fuel - main system 1												20801.5237	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												69.2000	
Water heating fuel used												5404.1541	(219)
Space cooling fuel												34.9180	(221)
Electricity for pumps and fans:													
central heating pump												41.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												86.0000	(231)
Electricity for lighting (calculated in Appendix L)												461.5993	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-1282.4966	(233)
Wind generation												0.0000	(234)
Hydro-electric generation (Appendix N)												0.0000	(235a)
Electricity generated - Micro CHP (Appendix N)												0.0000	(235)
Appendix Q - special features													
Energy saved or generated												-0.0000	(236)
Energy used												0.0000	(237)
Total delivered energy for all uses												25505.6986	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	20801.5237	3.6400	757.1755	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	5404.1541	3.6400	196.7112	(247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000	(247a)
Space cooling	34.9180	16.4900	5.7580	(248)
Pumps, fans and electric keep-hot	86.0000	16.4900	14.1814	(249)
Energy for lighting	461.5993	16.4900	76.1177	(250)
Additional standing charges			92.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1282.4966	16.4900	-211.4837	
PV Unit electricity exported	0.0000	5.5900	0.0000	
Total			-211.4837	(252)
Total energy cost			930.4601	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.3600	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	1.6240	(257)
SAP value		73.6750	
SAP rating (Section 12)		74	(258)
SAP band		C	

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	20801.5237	0.2100	4368.3200	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	5404.1541	0.2100	1134.8724	(264)
Space and water heating			5503.1924	(265)
Space cooling	34.9180	0.1139	3.9783	(266)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	461.5993	0.1443	66.6230	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1282.4966	0.1348	-172.9060	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-172.9060	(269)
Total CO2, kg/year			5412.8169	(272)
CO2 emissions per m2			33.5700	(273)
EI value			64.8348	
EI rating			65	(274)
EI band			D	

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

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	53.3000 (1b)	x	2.8500 (2b)	=	151.9050	(1b) - (3b)
First floor	53.9800 (1c)	x	2.7500 (2c)	=	148.4450	(1c) - (3c)
Second floor	53.9800 (1d)	x	2.7500 (2d)	=	148.4450	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	161.2600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	448.7950	(5)

2. Ventilation rate

		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	3 * 10 =	30.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)
		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.0668	(8)
Number of storeys in the dwelling (ns)		3	(9)
Additional infiltration	[(9) - 1] x 0.1 =	0.2000	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0.3500	(11)
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0.0000	(12)
If no draught lobby, enter 0.05, else enter 0		0.0500	(13)
Percentage of windows and doors draught stripped		100.0000	(14)
Window infiltration	0.25 - [0.2 * (14) / 100] =	0.0500	(15)
Pressure test		No	
Pressure Test Method		Blower Door	
Measured/design AP50		15.0000	(17)
Infiltration rate		0.7168	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.6093	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.6398	0.6093	0.6093	0.5636	0.5636	0.5027	0.5179	0.4875	0.5027	0.5332	0.5332	0.5789	(22b)
Effective ac	0.7047	0.6856	0.6856	0.6588	0.6588	0.6263	0.6341	0.6188	0.6263	0.6421	0.6421	0.6675	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Original Windows (Uw = 2.80)			37.6000	2.5180	94.6763			(27)
Solid Door (Old)			2.7600	2.8000	7.7280			(26)
Heatloss Floor 1			53.3000	0.4000	21.3200	110.0000	5863.0000	(28a)
External Wall 1	92.1800	40.3600	51.8200	0.8200	42.4924	190.0000	9845.8000	(29a)
External Roof 1	53.9800		53.9800	1.6000	86.3680	9.0000	485.8200	(30)
Total net area of external elements Aum(A, m2)			199.4600					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		252.5847			(33)
Party Wall 1			163.1600	0.0000	0.0000	70.0000	11421.2000	(32)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		27615.8200	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							171.2503	(35)
Thermal bridges (Default value 0.200 * total exposed area)							39.8920	(36)
Point Thermal bridges						(36a) =	0.0000	

Total fabric heat loss (33) + (36) + (36a) = 292.4767 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	104.3621	101.5441	101.5441	97.5748	97.5748	92.7636	93.9148	91.6467	92.7636	95.1005	95.1005	98.8636	(38)
Heat transfer coeff	396.8388	394.0208	394.0208	390.0515	390.0515	385.2402	386.3915	384.1233	385.2402	387.5771	387.5771	391.3402	(39)
Average = Sum(39)m / 12 =												389.3727	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	2.4609	2.4434	2.4434	2.4188	2.4188	2.3889	2.3961	2.3820	2.3889	2.4034	2.4034	2.4268	(40)
HLP (average)												2.4146	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.9507 (42)

Hot water usage for mixer showers

64.4812	63.5122	62.1002	59.3984	57.4046	55.1811	53.9173	55.3187	56.8549	59.2422	62.0020	64.2342	(42a)

Hot water usage for baths

33.4880	32.9906	32.2902	30.9989	30.0320	28.9598	28.3806	29.0761	29.8333	30.9806	32.2985	33.3747	(42b)

Hot water usage for other uses

47.2082	45.4915	43.7749	42.0582	40.3416	38.6249	38.6249	40.3416	42.0582	43.7749	45.4915	47.2082	(42c)

Average daily hot water use (litres/day) 133.4147 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	145.1774	141.9944	138.1653	132.4555	127.7781	122.7658	120.9228	124.7363	128.7464	133.9977	139.7920	144.8171	(44)
Energy conte	229.9255	202.1981	212.3549	181.3250	172.0139	150.9549	146.2457	154.4497	158.7572	181.8336	199.1594	226.7486	(45)
Energy content (annual)											Total = Sum(45)m =	2215.9665	
Distribution loss (46)m = 0.15 x (45)m	34.4888	30.3297	31.8532	27.1988	25.8021	22.6432	21.9369	23.1674	23.8136	27.2750	29.8739	34.0123	(46)

Water storage loss:

Store volume 250.0000 (47)

a) If manufacturer declared loss factor is known (kWh/day): 2.0900 (48)

Temperature factor from Table 2b 0.7800 (49)

Enter (49) or (54) in (55) 1.6302 (55)

Total storage loss

50.5362	45.6456	50.5362	48.9060	50.5362	48.9060	50.5362	50.5362	48.9060	50.5362	48.9060	50.5362	(56)

If cylinder contains dedicated solar storage

50.5362	45.6456	50.5362	48.9060	50.5362	48.9060	50.5362	50.5362	48.9060	50.5362	48.9060	50.5362	(57)

Primary loss	106.3213	96.0322	106.3213	102.8916	106.3213	36.0948	37.2980	37.2980	36.0948	106.3213	102.8916	106.3213	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)

Total heat required for water heating calculated for each month

386.7830	343.8759	369.2124	333.1226	328.8714	235.9557	234.0799	242.2838	243.7580	338.6911	350.9570	383.6062	(62)

WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)

Output from w/h

386.7830	343.8759	369.2124	333.1226	328.8714	235.9557	234.0799	242.2838	243.7580	338.6911	350.9570	383.6062	(64)

Total per year (kWh/year) = Sum(64)m = 3791.1970 (64)

Electric shower(s)

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)

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

Heat gains from water heating, kWh/month

161.5073	144.0566	155.6651	142.6039	142.2517	79.0683	78.4651	81.1929	81.6626	145.5167	148.5338	160.4510	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	177.0401	177.0401	177.0401	177.0401	177.0401	177.0401	177.0401	177.0401	177.0401	177.0401	177.0401	177.0401	(66)

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

65.3442	58.0381	47.1998	35.7333	26.7110	22.5506	24.3667	31.6727	42.5111	53.9776	62.9998	67.1603	(67)

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

496.3056	501.4557	488.4776	460.8488	425.9724	393.1935	371.2952	366.1451	379.1232	406.7520	441.6284	474.4073	(68)

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

55.6547	55.6547	55.6547	55.6547	55.6547	55.6547	55.6547	55.6547	55.6547	55.6547	55.6547	55.6547	(69)

Pumps, fans	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	3.0000	(70)

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

-118.0267	-118.0267	-118.0267	-118.0267	-118.0267	-118.0267	-118.0267	-118.0267	-118.0267	-118.0267	-118.0267	-118.0267	(71)

Water heating gains (Table 5)

217.0797	214.3699	209.2272	198.0609	191.1985	109.8171	105.4638	109.1302	113.4203	195.5870	206.2969	215.6599	(72)

Total internal gains

896.3975	891.5318	862.5727	812.3110	761.5500	640.2293	615.7937	621.6161	649.7226	773.9846	828.5932	874.8955	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	15.4400	11.9814	0.7600	0.7000	0.7700	68.2026	(74)
South	22.1600	50.9848	0.7600	0.7000	0.7700	416.5389	(78)

Solar gains	484.7415	730.5452	969.7604	1232.5036	1356.0656	1450.2136	1378.8424	1280.2094	1133.6186	855.3747	591.8165	412.9324	(83)
Total gains	1381.1390	1622.0770	1832.3331	2044.8146	2117.6156	2090.4429	1994.6361	1901.8255	1783.3412	1629.3593	1420.4096	1287.8280	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	19.3304	19.4687	19.4687	19.6668	19.6668	19.9124	19.8531	19.9703	19.9124	19.7923	19.7923	19.6020
alpha	2.2887	2.2979	2.2979	2.3111	2.3111	2.3275	2.3235	2.3314	2.3275	2.3195	2.3195	2.3068
util living area												

	0.9757	0.9642	0.9424	0.8983	0.8185	0.6704	0.5107	0.5385	0.7737	0.9081	0.9613	0.9789	(86)
MIT	17.6672	17.9652	18.5529	19.3127	20.0611	20.6428	20.8782	20.8602	20.4183	19.5314	18.5067	17.6466	(87)
Th 2	19.0438	19.0541	19.0541	19.0688	19.0688	19.0866	19.0824	19.0908	19.0866	19.0779	19.0779	19.0640	(88)
util rest of house													
	0.9684	0.9534	0.9235	0.8604	0.7358	0.4909	0.2232	0.2522	0.6363	0.8649	0.9472	0.9725	(89)
MIT 2	16.2256	16.5242	17.1003	17.8390	18.5212	18.9758	19.0745	19.0798	18.8399	18.0672	17.0767	16.2170	(90)
Living area fraction										fLA = Living area / (4) =		0.4379	(91)
MIT	16.8568	17.1552	17.7363	18.4843	19.1955	19.7057	19.8643	19.8594	19.5310	18.7083	17.7029	16.8430	(92)
Temperature adjustment												0.0000	
adjusted MIT	16.8568	17.1552	17.7363	18.4843	19.1955	19.7057	19.8643	19.8594	19.5310	18.7083	17.7029	16.8430	(93)

---

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9558	0.9379	0.9054	0.8452	0.7426	0.5589	0.3545	0.3827	0.6759	0.8536	0.9323	0.9612	(94)
Useful gains	1320.0679	1521.2716	1659.0749	1728.3219	1572.5338	1168.4160	707.0848	727.8912	1205.3057	1390.7418	1324.2224	1237.8112	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W													
	4665.5700	4552.9784	4072.7186	3348.3101	2416.5604	1427.5951	758.9753	791.0649	1668.4908	2755.0141	3760.6121	4595.5000	(97)
Space heating kWh													
	2489.0535	2037.3069	1795.7509	1166.3915	627.9558	0.0000	0.0000	0.0000	0.0000	1015.0186	1754.2006	2498.1204	(98a)
Space heating requirement - total per year (kWh/year)												13383.7982	
Solar heating kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh													
	2489.0535	2037.3069	1795.7509	1166.3915	627.9558	0.0000	0.0000	0.0000	0.0000	1015.0186	1754.2006	2498.1204	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												13383.7982	
Space heating per m2											(98c) / (4) =	82.9952	(99)

8c. Space cooling requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	3081.9217	2356.9880	2381.5645	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.5980	0.6791	0.6578	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1843.1404	1600.6750	1566.6453	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	2335.2841	2227.4276	2117.9647	0.0000	0.0000	0.0000	0.0000	(103)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	354.3434	466.3040	410.1817	0.0000	0.0000	0.0000	0.0000	(104)
Cooled fraction										fC = cooled area / (4) =		0.5271	(105)
Intermittency factor (Table 10b)													
	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	46.6935	61.4471	54.0516	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling requirement												162.1922	(107)

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												74.3000	(206)
Efficiency of main space heating system 2 (in %)												0.0000	(207)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Cooling System Energy Efficiency Ratio (see Table 10c)												3.2000	(209)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	2489.0535	2037.3069	1795.7509	1166.3915	627.9558	0.0000	0.0000	0.0000	0.0000	1015.0186	1754.2006	2498.1204	(98)
Space heating efficiency (main heating system 1)													
	74.3000	74.3000	74.3000	74.3000	74.3000	0.0000	0.0000	0.0000	0.0000	74.3000	74.3000	74.3000	(210)
Space heating fuel (main heating system)													
	3350.0048	2742.0012	2416.8922	1569.8405	845.1626	0.0000	0.0000	0.0000	0.0000	1366.1085	2360.9698	3362.2079	(211)
Space heating efficiency (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	386.7830	343.8759	369.2124	333.1226	328.8714	235.9557	234.0799	242.2838	243.7580	338.6911	350.9570	383.6062	(64)
Efficiency of water heater												69.2000	(216)
(217)m	72.7733	72.6630	72.3741	71.8095	70.5119	64.2000	64.2000	64.2000	64.2000	71.5062	72.4163	72.7887	(217)
Fuel for water heating, kWh/month													
	531.4902	473.2473	510.1445	463.8976	466.4057	367.5322	364.6104	377.3891	379.6854	473.6526	484.6383	527.0137	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	14.5917	19.2022	16.8911	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting	57.1954	45.8842	41.3137	30.2682	23.3800	19.1017	21.3280	27.7230	36.0094	47.2463	53.3646	58.7850	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-67.0847	-86.7394	-122.7966	-138.6066	-145.8675	-138.7384	-136.5146	-131.4380	-119.5589	-102.6347	-74.4509	-57.7386	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)
Annual totals kWh/year													
Space heating fuel - main system 1												18013.1874	(211)

Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	69.2000	
Water heating fuel used	5419.7069	(219)
Space cooling fuel	50.6851	(221)
Electricity for pumps and fans:		
central heating pump	41.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	86.0000	(231)
Electricity for lighting (calculated in Appendix L)	461.5993	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-1322.1689	(233)
Wind generation	0.0000	(234)
Hydro-electric generation (Appendix N)	0.0000	(235a)
Electricity generated - Micro CHP (Appendix N)	0.0000	(235)
Appendix Q - special features		
Energy saved or generated	-0.0000	(236)
Energy used	0.0000	(237)
Total delivered energy for all uses	22709.0097	(238)

10a. Fuel costs - using BEDF prices (550)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	18013.1874	5.6000	1008.7385	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	5419.7069	5.6000	303.5036	(247)
Energy for instantaneous electric shower(s)	0.0000	26.0600	0.0000	(247a)
Space cooling	50.6851	26.0600	13.2085	(248)
Pumps, fans and electric keep-hot	86.0000	26.0600	22.4116	(249)
Energy for lighting	461.5993	26.0600	120.2928	(250)
Additional standing charges			99.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1322.1689	26.0600	-344.5572	
PV Unit electricity exported	0.0000	5.8100	0.0000	
Total			-344.5572	(252)
Total energy cost			1222.5978	(255)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	18013.1874	0.2100	3782.7694	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	5419.7069	0.2100	1138.1384	(264)
Space and water heating			4920.9078	(265)
Space cooling	50.6851	0.1139	5.7743	(266)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	461.5993	0.1443	66.6230	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1322.1689	0.1349	-178.3970	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-178.3970	(269)
Total CO2, kg/year			4826.8374	(272)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	18013.1874	1.1300	20354.9018	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	5419.7069	1.1300	6124.2688	(278)
Space and water heating			26479.1705	(279)
Space cooling	50.6851	1.4199	71.9690	(280)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	461.5993	1.5338	708.0165	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1322.1689	1.4987	-1981.5039	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-1981.5039	(283)
Total Primary energy kWh/year			25407.7529	(286)

SAP 10 EPC IMPROVEMENTS

Pre Refurbishment

Current energy efficiency rating:	C 74
Current environmental impact rating:	D 65

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

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.0	-£ 62	-289 kg (6.0%)

Recommended measures	Typical annual savings	Energy efficiency	Environmental impact

Solar water heating	£62	1.79 kg/m²	C 75	D 67
Total Savings	£62	1.79 kg/m²		

Potential energy efficiency rating: C 75
Potential environmental impact rating: D 67

Fuel prices for cost data on this page from database revision number 550 TEST (28 Jun 2024)
Recommendation texts revision number 6.1 (11 Jun 2019)

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

	Current	Potential	Saving
Electricity	£156	£177	-£21
Mains gas	£1411	£1332	£80
Space heating	£1130	£1151	-£21
Space cooling	£13	£13	£0
Water heating	£304	£224	£80
Lighting	£120	£120	£0
Generated (PV)	-£345	-£348	£3
Total cost of fuels	£1222	£1161	£62
Total cost of uses	£1222	£1160	£62
Delivered energy	141 kWh/m²	132 kWh/m²	8 kWh/m²
Carbon dioxide emissions	4.8 tonnes	4.5 tonnes	0.3 tonnes
CO2 emissions per m²	30 kg/m²	28 kg/m²	2 kg/m²
Primary energy	158 kWh/m²	148 kWh/m²	9 kWh/m²

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

---

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	53.3000	(1b)	x 2.8500	(2b) =	151.9050	(1b) - (3b)
First floor	53.9800	(1c)	x 2.7500	(2c) =	148.4450	(1c) - (3c)
Second floor	53.9800	(1d)	x 2.7500	(2d) =	148.4450	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	161.2600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		448.7950	(5)

2. Ventilation rate

		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	3 * 10 =	30.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.0668	(8)
Number of storeys in the dwelling (ns)		3	(9)
Additional infiltration	[(9) - 1] x 0.1 =	0.2000	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0.3500	(11)
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0.0000	(12)
If no draught lobby, enter 0.05, else enter 0		0.0500	(13)
Percentage of windows and doors draught stripped		100.0000	(14)
Window infiltration	0.25 - [0.2 * (14) / 100] =	0.0500	(15)

Pressure test	No	
Pressure Test Method	Blower Door	
Measured/design AP50	15.0000	(17)
Infiltration rate	0.7168	(18)
Number of sides sheltered	2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.6093 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.7769	0.7616	0.7464	0.6703	0.6550	0.5789	0.5789	0.5636	0.6093	0.6550	0.6855	0.7159	(22b)
Effective ac	0.8018	0.7901	0.7786	0.7246	0.7145	0.6675	0.6675	0.6588	0.6856	0.7145	0.7349	0.7563	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Original Windows (Uw = 2.80)			37.6000	2.5180	94.6763			(27)
Solid Door (Old)			2.7600	2.8000	7.7280			(26)
Heatloss Floor 1			53.3000	0.4000	21.3200	110.0000	5863.0000	(28a)
External Wall 1	92.1800	40.3600	51.8200	0.8200	42.4924	190.0000	9845.8000	(29a)
External Roof 1	53.9800		53.9800	1.6000	86.3680	9.0000	485.8200	(30)

Total net area of external elements Aum(A, m2)							199.4600						(31)
Fabric heat loss, W/K = Sum (A x U)							(26)...(30) + (32) =		252.5847				(33)
Party Wall 1							163.1600	0.0000	0.0000	70.0000		11421.2000	(32)
Heat capacity Cm = Sum(A x k)									(28)...(30) + (32) + (32a)...(32e) =			27615.8200	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K												171.2503	(35)
Thermal bridges (Default value 0.200 * total exposed area)												39.8920	(36)
Point Thermal bridges											(36a) =	0.0000	
Total fabric heat loss										(33) + (36) + (36a) =		292.4767	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	118.7444	117.0089	115.3078	107.3176	105.8227	98.8636	98.8636	97.5748	101.5441	105.8227	108.8469	112.0086	(38)
Heat transfer coeff	411.2210	409.4855	407.7844	399.7943	398.2994	391.3402	391.3402	390.0515	394.0208	398.2994	401.3236	404.4853	(39)
Average = Sum(39)m / 12 =												399.7871	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	2.5500	2.5393	2.5287	2.4792	2.4699	2.4268	2.4268	2.4188	2.4434	2.4699	2.4887	2.5083	(40)
HLP (average)												2.4791	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

---

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.9507	(42)
Hot water usage for mixer showers	64.4812	63.5122	62.1002	59.3984	57.4046	55.1811	53.9173	55.3187	56.8549	59.2422	62.0020	64.2342	(42a)
Hot water usage for baths	33.4880	32.9906	32.2902	30.9989	30.0320	28.9598	28.3806	29.0761	29.8333	30.9806	32.2985	33.3747	(42b)
Hot water usage for other uses	47.2082	45.4915	43.7749	42.0582	40.3416	38.6249	38.6249	40.3416	42.0582	43.7749	45.4915	47.2082	(42c)
Average daily hot water use (litres/day)												133.4147	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	145.1774	141.9944	138.1653	132.4555	127.7781	122.7658	120.9228	124.7363	128.7464	133.9977	139.7920	144.8171	(44)
Energy conte	229.9255	202.1981	212.3549	181.3250	172.0139	150.9549	146.2457	154.4497	158.7572	181.8336	199.1594	226.7486	(45)
Energy content (annual)											Total = Sum(45)m =	2215.9665	
Distribution loss (46)m = 0.15 x (45)m	34.4888	30.3297	31.8532	27.1988	25.8021	22.6432	21.9369	23.1674	23.8136	27.2750	29.8739	34.0123	(46)
Water storage loss:													
Store volume												250.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												2.0900	(48)
Temperature factor from Table 2b												0.7800	(49)
Enter (49) or (54) in (55)												1.6302	(55)
Total storage loss	50.5362	45.6456	50.5362	48.9060	50.5362	48.9060	50.5362	50.5362	48.9060	50.5362	48.9060	50.5362	(56)
If cylinder contains dedicated solar storage	35.3753	31.9519	35.3753	34.2342	35.3753	34.2342	35.3753	35.3753	34.2342	35.3753	34.2342	35.3753	(57)
Primary loss	106.3213	96.0322	106.3213	102.8916	106.3213	36.0948	37.2980	37.2980	36.0948	106.3213	102.8916	106.3213	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	371.6222	330.1822	354.0516	318.4508	313.7106	221.2839	218.9190	227.1230	229.0862	323.5303	336.2852	368.4453	(62)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.8000	(H2)
Collector linear heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0000	(H4)
Collector loop efficiency												0.9000	(H5)
Incidence angle modifier												1.0000	(H6)
Overshading factor												0.8000	(H8)
Overall heat loss coefficient of system												6.5000	(H10)
Heat loss coefficient of collector loop												3.9667	(H11)
Dedicated solar storage volume												75.0000	(H12)
If combined cylinder, total volume of cylinder												250.0000	(H13)
Effective solar volume												127.5000	(H14)
Reference volume												225.0000	(H15)
Storage tank correction coefficient												1.1526	(H16)
Heat delivered to hot water												709.7441	(H24)
Heat delivered to space heating												0.0000	(H29)
Solar input												709.7441	
Solar input	-0.0000	-21.2657	-66.1036	-91.3464	-121.5042	-107.2913	-107.1297	-93.2482	-64.8377	-35.2267	-1.7905	-0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	371.6222	308.9165	287.9479	227.1044	192.2064	113.9926	111.7893	133.8748	164.2485	288.3036	334.4947	368.4453	(64)
											Total per year (kWh/year) = Sum(64)m =	2902.9460	(64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
											Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =	0.0000	(64a)
Heat gains from water heating, kWh/month	161.5073	144.0566	155.6651	142.6039	142.2517	79.0683	78.4651	81.1929	81.6626	145.5167	148.5338	160.4510	(65)

---

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	177.0401	177.0401	177.0401	177.0401	177.0401	177.0401	177.0401	177.0401	177.0401	177.0401	177.0401	177.0401	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	65.3442	58.0381	47.1998	35.7333	26.7110	22.5506	24.3667	31.6727	42.5111	53.9776	62.9998	67.1603	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	496.3056	501.4557	488.4776	460.8488	425.9724	393.1935	371.2952	366.1451	379.1232	406.7520	441.6284	474.4073	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.6547	55.6547	55.6547	55.6547	55.6547	55.6547	55.6547	55.6547	55.6547	55.6547	55.6547	55.6547	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-118.0267	-118.0267	-118.0267	-118.0267	-118.0267	-118.0267	-118.0267	-118.0267	-118.0267	-118.0267	-118.0267	-118.0267	(71)
Water heating gains (Table 5)	217.0797	214.3699	209.2272	198.0609	191.1985	109.8171	105.4638	109.1302	113.4203	195.5870	206.2969	215.6599	(72)
Total internal gains	896.3975	891.5318	862.5727	812.3110	761.5500	640.2293	615.7937	621.6161	649.7226	773.9846	828.5932	874.8955	(73)

---

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	15.4400	10.6334	0.7600	0.7000	0.7700	60.5291	(74)
South	22.1600	46.7521	0.7600	0.7000	0.7700	381.9578	(78)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	442.4869	741.2227	993.3965	1216.3233	1363.7892	1358.4654	1307.5280	1194.2250	1068.7184	812.4077	527.4207	380.5067	(83)
Total gains	1338.8844	1632.7544	1855.9691	2028.6344	2125.3392	1998.6946	1923.3218	1815.8411	1718.4410	1586.3924	1356.0139	1255.4023	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	18.6543	18.7334	18.8116	19.1875	19.2595	19.6020	19.6020	19.6668	19.4687	19.2595	19.1144	18.9650	
alpha	2.2436	2.2489	2.2541	2.2792	2.2840	2.3068	2.3068	2.3111	2.2979	2.2840	2.2743	2.2643	
util living area	0.9794	0.9670	0.9485	0.9150	0.8571	0.7717	0.6582	0.6938	0.8356	0.9280	0.9694	0.9821	(86)
MIT	17.3285	17.6805	18.2454	19.0043	19.7377	20.3497	20.6918	20.6383	20.1356	19.2096	18.1508	17.2964	(87)
Th 2	18.9918	18.9980	19.0041	19.0330	19.0385	19.0640	19.0640	19.0688	19.0541	19.0385	19.0275	19.0160	(88)
util rest of house	0.9733	0.9574	0.9323	0.8849	0.7969	0.6494	0.4447	0.4929	0.7398	0.8961	0.9586	0.9769	(89)
MIT 2	15.8607	16.2109	16.7695	17.5229	18.2142	18.7606	18.9904	18.9700	18.5955	17.7380	16.6975	15.8424	(90)
Living area fraction									fLA = Living area / (4) =			0.4379	(91)
MIT	16.5034	16.8543	17.4158	18.1715	18.8813	19.4564	19.7354	19.7005	19.2698	18.3824	17.3338	16.4791	(92)
Temperature adjustment												0.0000	
adjusted MIT	16.5034	16.8543	17.4158	18.1715	18.8813	19.4564	19.7354	19.7005	19.2698	18.3824	17.3338	16.4791	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9616	0.9419	0.9138	0.8670	0.7907	0.6798	0.5321	0.5719	0.7535	0.8811	0.9447	0.9664	(94)
Useful gains	1287.5319	1537.9653	1696.0585	1758.7747	1680.4552	1358.7895	1023.4513	1038.4581	1294.9177	1397.7665	1280.9596	1213.2624	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	5018.3084	4895.1327	4451.2733	3706.7110	2860.3061	1900.5050	1226.9996	1287.3583	2037.0243	3099.7245	4107.0762	4966.6955	(97)
Space heating kWh	2775.6977	2256.0165	2049.8798	1402.5141	877.8091	0.0000	0.0000	0.0000	0.0000	1266.2567	2034.8039	2792.5542	(98a)
Space heating requirement - total per year (kWh/year)												15455.5321	
Solar heating kWh	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh	2775.6977	2256.0165	2049.8798	1402.5141	877.8091	0.0000	0.0000	0.0000	0.0000	1266.2567	2034.8039	2792.5542	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												15455.5321	
Space heating per m2											(98c) / (4) =	95.8423	(99)

8c. Space cooling requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	3678.5980	2895.9175	2964.3912	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.5129	0.5878	0.5566	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1886.6656	1702.3418	1649.8548	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	2228.0459	2144.0732	2017.4635	0.0000	0.0000	0.0000	0.0000	(103)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	245.7938	328.6482	273.5009	0.0000	0.0000	0.0000	0.0000	(104)
Cooled fraction									fC = cooled area / (4) =			0.5271	(105)
Intermittency factor (Table 10b)	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	(106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	32.3894	43.3075	36.0405	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling requirement												111.7375	(107)

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	74.3000	(206)
Efficiency of main space heating system 2 (in %)	0.0000	(207)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Cooling System Energy Efficiency Ratio (see Table 10c)	3.2000	(209)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	2775.6977	2256.0165	2049.8798	1402.5141	877.8091	0.0000	0.0000	0.0000	0.0000	1266.2567	2034.8039	2792.5542	(98)
Space heating efficiency (main heating system 1)	74.3000	74.3000	74.3000	74.3000	74.3000	0.0000	0.0000	0.0000	0.0000	74.3000	74.3000	74.3000	(210)
Space heating fuel (main heating system)	3735.7977	3036.3614	2758.9231	1887.6367	1181.4389	0.0000	0.0000	0.0000	0.0000	1704.2486	2738.6325	3758.4848	(211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	371.6222	308.9165	287.9479	227.1044	192.2064	113.9926	111.7893	133.8748	164.2485	288.3036	334.4947	368.4453	(64)
Efficiency of water heater												69.2000	(216)

(217)m	72.9565	72.9301	72.8996	72.7192	72.2741	64.2000	64.2000	64.2000	64.2000	72.2101	72.6990	72.9735	(217)
Fuel for water heating, kWh/month													
	509.3748	423.5788	394.9925	312.3033	265.9410	177.5585	174.1266	208.5277	255.8387	399.2568	460.1092	504.9030	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	10.1217	13.5336	11.2627	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	14.0986	12.7342	14.0986	13.6438	14.0986	13.6438	14.0986	14.0986	13.6438	14.0986	13.6438	14.0986	(231)
Lighting	57.1954	45.8842	41.3137	30.2682	23.3800	19.1017	21.3280	27.7230	36.0094	47.2463	53.3646	58.7850	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-61.7854	-86.6098	-123.7195	-137.8601	-147.2246	-136.8006	-135.2052	-128.5652	-116.1630	-98.7545	-67.7956	-53.4687	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)

Annual totals kWh/year		
Space heating fuel - main system 1	20801.5237	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	69.2000	
Water heating fuel used	4086.5109	(219)
Space cooling fuel	34.9180	(221)
Electricity for pumps and fans:		
central heating pump	41.0000	(230c)
main heating flue fan	45.0000	(230e)
pump for solar water heating	80.0000	(230g)
Total electricity for the above, kWh/year	166.0000	(231)
Electricity for lighting (calculated in Appendix L)	461.5993	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-1293.9523	(233)
Wind generation	0.0000	(234)
Hydro-electric generation (Appendix N)	0.0000	(235a)
Electricity generated - Micro CHP (Appendix N)	0.0000	(235)
Appendix Q - special features		
Energy saved or generated	-0.0000	(236)
Energy used	0.0000	(237)
Total delivered energy for all uses	24256.5996	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	20801.5237	3.6400	757.1755	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	4086.5109	3.6400	148.7490	(247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000	(247a)
Space cooling	34.9180	16.4900	5.7580	(248)
Pumps, fans and electric keep-hot	86.0000	16.4900	14.1814	(249)
Pump for solar water heating	80.0000	16.4900	13.1920	(249)
Energy for lighting	461.5993	16.4900	76.1177	(250)
Additional standing charges			92.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1293.9523	16.4900	-213.3727	
PV Unit electricity exported	0.0000	5.5900	0.0000	
Total			-213.3727	(252)
Total energy cost			893.8008	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.3600 (256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	1.5600 (257)
SAP value		74.7122
SAP rating (Section 12)		75 (258)
SAP band		C

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	20801.5237	0.2100	4368.3200	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	4086.5109	0.2100	858.1673	(264)
Space and water heating			5226.4873	(265)
Space cooling	34.9180	0.1139	3.9783	(266)
Pumps, fans and electric keep-hot	166.0000	0.1387	23.0262	(267)
Energy for lighting	461.5993	0.1443	66.6230	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1293.9523	0.1348	-174.3835	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-174.3835	(269)
Total CO2, kg/year			5145.7313	(272)
CO2 emissions per m2			31.9100	(273)
EI value			66.5700	
EI rating			67	(274)
EI band			D	

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

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	53.3000	(1b)	x 2.8500	(2b) =	151.9050	(1b) - (3b)
First floor	53.9800	(1c)	x 2.7500	(2c) =	148.4450	(1c) - (3c)
Second floor	53.9800	(1d)	x 2.7500	(2d) =	148.4450	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	161.2600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		448.7950	(5)

2. Ventilation rate

		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	3 * 10 =	30.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)
	Air changes per hour		
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.0668	(8)
Number of storeys in the dwelling (ns)		3	(9)
Additional infiltration	[(9) - 1] x 0.1 =	0.2000	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0.3500	(11)
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0.0000	(12)
If no draught lobby, enter 0.05, else enter 0		0.0500	(13)
Percentage of windows and doors draught stripped		100.0000	(14)
Window infiltration	0.25 - [0.2 * (14) / 100] =	0.0500	(15)
Pressure test		No	
Pressure Test Method		Blower Door	
Measured/design AP50		15.0000	(17)
Infiltration rate		0.7168	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.6093	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.6398	0.6093	0.6093	0.5636	0.5636	0.5027	0.5179	0.4875	0.5027	0.5332	0.5332	0.5789	(22b)
Effective ac	0.7047	0.6856	0.6856	0.6588	0.6588	0.6263	0.6341	0.6188	0.6263	0.6421	0.6421	0.6675	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Original Windows (Uw = 2.80)			37.6000	2.5180	94.6763			(27)
Solid Door (Old)			2.7600	2.8000	7.7280			(26)
Heatloss Floor 1			53.3000	0.4000	21.3200	110.0000	5863.0000	(28a)
External Wall 1	92.1800	40.3600	51.8200	0.8200	42.4924	190.0000	9845.8000	(29a)
External Roof 1	53.9800		53.9800	1.6000	86.3680	9.0000	485.8200	(30)
Total net area of external elements Aum(A, m2)			199.4600					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		252.5847			(33)
Party Wall 1			163.1600	0.0000	0.0000	70.0000	11421.2000	(32)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		27615.8200	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							171.2503	(35)
Thermal bridges (Default value 0.200 * total exposed area)							39.8920	(36)
Point Thermal bridges						(36a) =	0.0000	
Total fabric heat loss					(33) + (36) + (36a) =		292.4767	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	104.3621	101.5441	101.5441	97.5748	97.5748	92.7636	93.9148	91.6467	92.7636	95.1005	95.1005	98.8636	(38)
Heat transfer coeff	396.8388	394.0208	394.0208	390.0515	390.0515	385.2402	386.3915	384.1233	385.2402	387.5771	387.5771	391.3402	(39)
Average = Sum(39)m / 12 =												389.3727	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	2.4609	2.4434	2.4434	2.4188	2.4188	2.3889	2.3961	2.3820	2.3889	2.4034	2.4034	2.4268	(40)
HLP (average)												2.4146	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy											2.9507	(42)
Hot water usage for mixer showers	64.4812	63.5122	62.1002	59.3984	57.4046	55.1811	53.9173	55.3187	56.8549	59.2422	62.0020	64.2342	(42a)
Hot water usage for baths													

	33.4880	32.9906	32.2902	30.9989	30.0320	28.9598	28.3806	29.0761	29.8333	30.9806	32.2985	33.3747 (42b)
Hot water usage for other uses												
	47.2082	45.4915	43.7749	42.0582	40.3416	38.6249	38.6249	40.3416	42.0582	43.7749	45.4915	47.2082 (42c)
Average daily hot water use (litres/day)												133.4147 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	145.1774	141.9944	138.1653	132.4555	127.7781	122.7658	120.9228	124.7363	128.7464	133.9977	139.7920	144.8171	(44)
Energy conte	229.9255	202.1981	212.3549	181.3250	172.0139	150.9549	146.2457	154.4497	158.7572	181.8336	199.1594	226.7486	(45)
Energy content (annual)										Total = Sum(45)m =		2215.9665	
Distribution loss (46)m = 0.15 x (45)m													
	34.4888	30.3297	31.8532	27.1988	25.8021	22.6432	21.9369	23.1674	23.8136	27.2750	29.8739	34.0123	(46)
Water storage loss:													
Store volume												250.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												2.0900	(48)
Temperature factor from Table 2b												0.7800	(49)
Enter (49) or (54) in (55)												1.6302	(55)
Total storage loss													
	50.5362	45.6456	50.5362	48.9060	50.5362	48.9060	50.5362	50.5362	48.9060	50.5362	48.9060	50.5362	(56)
If cylinder contains dedicated solar storage													
	35.3753	31.9519	35.3753	34.2342	35.3753	34.2342	35.3753	35.3753	34.2342	35.3753	34.2342	35.3753	(57)
Primary loss	106.3213	96.0322	106.3213	102.8916	106.3213	36.0948	37.2980	37.2980	36.0948	106.3213	102.8916	106.3213	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month													
	371.6222	330.1822	354.0516	318.4508	313.7106	221.2839	218.9190	227.1230	229.0862	323.5303	336.2852	368.4453	(62)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.8000	(H2)
Collector linear heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0000	(H4)
Collector loop efficiency												0.9000	(H5)
Incidence angle modifier												1.0000	(H6)
Overshading factor												0.8000	(H8)
Overall heat loss coefficient of system												6.5000	(H10)
Heat loss coefficient of collector loop												3.9667	(H11)
Dedicated solar storage volume												75.0000	(H12)
If combined cylinder, total volume of cylinder												250.0000	(H13)
Effective solar volume												127.5000	(H14)
Reference volume												225.0000	(H15)
Storage tank correction coefficient												1.1526	(H16)
Heat delivered to hot water												776.6919	(H24)
Heat delivered to space heating												0.0000	(H29)
Solar input												776.6919	
Solar input	-3.1323	-22.6026	-67.0572	-96.1033	-123.6188	-117.7087	-116.1164	-104.5684	-73.8604	-42.4846	-9.4393	-0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h													
	368.4899	307.5796	286.9944	222.3476	190.0918	103.5752	102.8026	122.5546	155.2258	281.0456	326.8459	368.4453	(64)
										Total per year (kWh/year) = Sum(64)m =		2835.9982	(64)
Electric shower(s)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
										Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =		0.0000	(64a)
Heat gains from water heating, kWh/month													
	161.5073	144.0566	155.6651	142.6039	142.2517	79.0683	78.4651	81.1929	81.6626	145.5167	148.5338	160.4510	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	177.0401	177.0401	177.0401	177.0401	177.0401	177.0401	177.0401	177.0401	177.0401	177.0401	177.0401	177.0401	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	65.3442	58.0381	47.1998	35.7333	26.7110	22.5506	24.3667	31.6727	42.5111	53.9776	62.9998	67.1603	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	496.3056	501.4557	488.4776	460.8488	425.9724	393.1935	371.2952	366.1451	379.1232	406.7520	441.6284	474.4073	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.6547	55.6547	55.6547	55.6547	55.6547	55.6547	55.6547	55.6547	55.6547	55.6547	55.6547	55.6547	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-118.0267	-118.0267	-118.0267	-118.0267	-118.0267	-118.0267	-118.0267	-118.0267	-118.0267	-118.0267	-118.0267	-118.0267	(71)
Water heating gains (Table 5)													
	217.0797	214.3699	209.2272	198.0609	191.1985	109.8171	105.4638	109.1302	113.4203	195.5870	206.2969	215.6599	(72)
Total internal gains													
	896.3975	891.5318	862.5727	812.3110	761.5500	640.2293	615.7937	621.6161	649.7226	773.9846	828.5932	874.8955	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	15.4400	11.9814	0.7600	0.7000	0.7700	68.2026	(74)
South	22.1600	50.9848	0.7600	0.7000	0.7700	416.5389	(78)

Solar gains	484.7415	730.5452	969.7604	1232.5036	1356.0656	1450.2136	1378.8424	1280.2094	1133.6186	855.3747	591.8165	412.9324	(83)
Total gains	1381.1390	1622.0770	1832.3331	2044.8146	2117.6156	2090.4429	1994.6361	1901.8255	1783.3412	1629.3593	1420.4096	1287.8280	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	19.3304	19.4687	19.4687	19.6668	19.6668	19.9124	19.8531	19.9703	19.9124	19.7923	19.7923	19.6020	
alpha	2.2887	2.2979	2.2979	2.3111	2.3111	2.3275	2.3235	2.3314	2.3275	2.3195	2.3195	2.3068	
util living area													
	0.9757	0.9642	0.9424	0.8983	0.8185	0.6704	0.5107	0.5385	0.7737	0.9081	0.9613	0.9789	(86)
MIT	17.6672	17.9652	18.5529	19.3127	20.0611	20.6428	20.8782	20.8602	20.4183	19.5314	18.5067	17.6466	(87)
Th 2	19.0438	19.0541	19.0541	19.0688	19.0688	19.0866	19.0824	19.0908	19.0866	19.0779	19.0779	19.0640	(88)
util rest of house													
	0.9684	0.9534	0.9235	0.8604	0.7358	0.4909	0.2232	0.2522	0.6363	0.8649	0.9472	0.9725	(89)
MIT 2	16.2256	16.5242	17.1003	17.8390	18.5212	18.9758	19.0745	19.0798	18.8399	18.0672	17.0767	16.2170	(90)

Living area fraction										fLA = Living area / (4) =		0.4379	(91)
MIT	16.8568	17.1552	17.7363	18.4843	19.1955	19.7057	19.8643	19.8594	19.5310	18.7083	17.7029	16.8430	(92)
Temperature adjustment												0.0000	
adjusted MIT	16.8568	17.1552	17.7363	18.4843	19.1955	19.7057	19.8643	19.8594	19.5310	18.7083	17.7029	16.8430	(93)

---

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9558	0.9379	0.9054	0.8452	0.7426	0.5589	0.3545	0.3827	0.6759	0.8536	0.9323	0.9612	(94)
Useful gains	1320.0679	1521.2716	1659.0749	1728.3219	1572.5338	1168.4160	707.0848	727.8912	1205.3057	1390.7418	1324.2224	1237.8112	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W													
	4665.5700	4552.9784	4072.7186	3348.3101	2416.5604	1427.5951	758.9753	791.0649	1668.4908	2755.0141	3760.6121	4595.5000	(97)
Space heating kWh													
	2489.0535	2037.3069	1795.7509	1166.3915	627.9558	0.0000	0.0000	0.0000	0.0000	1015.0186	1754.2006	2498.1204	(98a)
Space heating requirement - total per year (kWh/year)												13383.7982	
Solar heating kWh													
	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh													
	2489.0535	2037.3069	1795.7509	1166.3915	627.9558	0.0000	0.0000	0.0000	0.0000	1015.0186	1754.2006	2498.1204	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												13383.7982	
Space heating per m2											(98c) / (4) =	82.9952	(99)

8c. Space cooling requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	3081.9217	2356.9880	2381.5645	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.5980	0.6791	0.6578	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1843.1404	1600.6750	1566.6453	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	2335.2841	2227.4276	2117.9647	0.0000	0.0000	0.0000	0.0000	(103)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	354.3434	466.3040	410.1817	0.0000	0.0000	0.0000	0.0000	(104)
Cooled fraction											fC = cooled area / (4) =	0.5271	(105)
Intermittency factor (Table 10b)													
	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	46.6935	61.4471	54.0516	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling requirement												162.1922	(107)

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												74.3000	(206)
Efficiency of main space heating system 2 (in %)												0.0000	(207)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Cooling System Energy Efficiency Ratio (see Table 10c)												3.2000	(209)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	2489.0535	2037.3069	1795.7509	1166.3915	627.9558	0.0000	0.0000	0.0000	0.0000	1015.0186	1754.2006	2498.1204	(98)
Space heating efficiency (main heating system 1)													
	74.3000	74.3000	74.3000	74.3000	74.3000	0.0000	0.0000	0.0000	0.0000	74.3000	74.3000	74.3000	(210)
Space heating fuel (main heating system)													
	3350.0048	2742.0012	2416.8922	1569.8405	845.1626	0.0000	0.0000	0.0000	0.0000	1366.1085	2360.9698	3362.2079	(211)
Space heating efficiency (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	368.4899	307.5796	286.9944	222.3476	190.0918	103.5752	102.8026	122.5546	155.2258	281.0456	326.8459	368.4453	(64)
Efficiency of water heater												69.2000	(216)
(217)m	72.8350	72.8103	72.7366	72.4892	71.6987	64.2000	64.2000	64.2000	64.2000	71.8672	72.5229	72.8397	(217)
Fuel for water heating, kWh/month													
	505.9239	422.4394	394.5668	306.7320	265.1258	161.3321	160.1287	190.8949	241.7848	391.0624	450.6794	505.8300	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	14.5917	19.2022	16.8911	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	14.0986	12.7342	14.0986	13.6438	14.0986	13.6438	14.0986	14.0986	13.6438	14.0986	13.6438	14.0986	(231)
Lighting	57.1954	45.8842	41.3137	30.2682	23.3800	19.1017	21.3280	27.7230	36.0094	47.2463	53.3646	58.7850	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-67.3397	-87.1710	-123.6054	-139.8311	-147.4600	-140.5211	-138.3358	-133.0728	-120.7809	-103.3798	-74.8201	-57.9481	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)
Annual totals kWh/year													
Space heating fuel - main system 1												18013.1874	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												69.2000	
Water heating fuel used												3996.5002	(219)
Space cooling fuel												50.6851	(221)

Electricity for pumps and fans:

central heating pump	41.0000	(230c)
main heating flue fan	45.0000	(230e)
pump for solar water heating	80.0000	(230g)
Total electricity for the above, kWh/year	166.0000	(231)
Electricity for lighting (calculated in Appendix L)	461.5993	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-1334.2657	(233)
Wind generation	0.0000	(234)
Hydro-electric generation (Appendix N)	0.0000	(235a)
Electricity generated - Micro CHP (Appendix N)	0.0000	(235)
Appendix Q - special features		
Energy saved or generated	-0.0000	(236)
Energy used	0.0000	(237)
Total delivered energy for all uses	21353.7062	(238)

10a. Fuel costs - using BEDF prices (550)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	18013.1874	5.6000	1008.7385	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3996.5002	5.6000	223.8040	(247)
Energy for instantaneous electric shower(s)	0.0000	26.0600	0.0000	(247a)
Space cooling	50.6851	26.0600	13.2085	(248)
Pumps, fans and electric keep-hot	86.0000	26.0600	22.4116	(249)
Pump for solar water heating	80.0000	26.0600	20.8480	(249)
Energy for lighting	461.5993	26.0600	120.2928	(250)
Additional standing charges			99.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1334.2657	26.0600	-347.7097	
PV Unit electricity exported	0.0000	5.8100	0.0000	
Total			-347.7097	(252)
Total energy cost			1160.5938	(255)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	18013.1874	0.2100	3782.7694	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3996.5002	0.2100	839.2650	(264)
Space and water heating			4622.0344	(265)
Space cooling	50.6851	0.1139	5.7743	(266)
Pumps, fans and electric keep-hot	166.0000	0.1387	23.0262	(267)
Energy for lighting	461.5993	0.1443	66.6230	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1334.2657	0.1349	-179.9562	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-179.9562	(269)
Total CO2, kg/year			4537.5018	(272)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	18013.1874	1.1300	20354.9018	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3996.5002	1.1300	4516.0452	(278)
Space and water heating			24870.9470	(279)
Space cooling	50.6851	1.4199	71.9690	(280)
Pumps, fans and electric keep-hot	166.0000	1.5128	251.1248	(281)
Energy for lighting	461.5993	1.5338	708.0165	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1334.2657	1.4985	-1999.3588	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-1999.3588	(283)
Total Primary energy kWh/year			23902.6984	(286)