

Maison Henry Bertrand (England) Ltd

52 Holmes Road, Camden

Revised Energy Statement

712445R(02)



12TH AUGUST 2016



RSK GENERAL NOTES

Project No.: 712445R(02)

Title: 52 Holmes Road, Camden – Revised Energy Statement

Client: Maison Henry Bertrand (England) Ltd

Date: 12th August 2016

| Author | James Blake | Reviewer | David Lloyd |
|--------|------------------------------|----------|------------------------------|
| Date: | 12 th August 2016 | Date: | 12 th August 2016 |

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1 INTRODUCTION

RSK Environment Ltd ("RSK") has been appointed by GML Architects, on behalf of Maison Henry Bertrand (England) Ltd (the applicant), to prepare this Revised Energy Statement in support of the planning application to the London Borough of Camden for the proposed development of 9 new residential apartments and 377 sqm light industrial space at 52 Holmes Road.

Chapter 2 of this Statement sets out requests for further information as received from the London Borough of Camden following submission of the original Energy Statement [RSK Ref. 712140R(02), 5th April 2016], together with responses to each request.

Chapter 3 sets out Camden's planning policies in relation to required energy and carbon dioxide (CO₂) standards. **Chapter 4** describes the approach taken to the energy assessment work, whilst **Chapter 5** reports the findings of energy modelling which establishes how the targeted energy / CO₂ standards can be achieved. SAP reports for selected apartments are presented at **Appendix 1**, whilst SBEM reports for the ground floor non-domestic space are presented at **Appendix 2**.



2 **REQUEST FOR FURTHER INFORMATION**

2.1 Introduction

The London Borough of Camden's Sustainability Officer has raised the following requests for further information based on the original Energy Statement [RSK Ref. 712140R(02), 5th April 2016]. Responses are provided below each item.

2.2 Further Information Requests & Responses

2.2.1 Applicant to seek further reductions with the aim of meeting/exceeding the London Plan 35% CO₂ reduction (beyond Part L 2013) target.

Further SAP and SBEM modelling has been undertaken to demonstrate how the development can achieve a 35% reduction in regulated CO_2 emissions below 2013 Building Regulations standards, as reported in **Chapter 5**. This performance is achieved through a range of energy efficiency measures including good u values, facade air tightness, 100% low energy lighting, high efficiency gas condensing boilers with 'gas saver' units (apartments) and ASHP (commercial) for space and water heating. A 9.9 kWp solar PV array is proposed to achieve the remaining CO_2 reduction necessary to achieve the 35% target in full on site.

2.2.2 Applicant to submit details of sampled apartments used in the energy assessment.

Two apartments (top floor unit and 2^{nd} floor unit 'B') have been selected for SAP modelling, as stated in **Chapter 5**, on the basis of having energy / CO₂ performance that is likely to be representative of the development as a whole given their relatives sizes and locations within the block, as determined by professional experience and judgement. The modelled units are presented in **Figures 1 & 2** below.



Figure 1. SAP Modelled 2nd Floor Unit 'B'





Figure 2. SAP Modelled Top Floor Unit

2.2.3 Applicant to confirm measures undertaken to reduce overheating

All living rooms have balconies above them, or projecting eaves / louvers on the top floor which are south facing. Only the south-facing bedrooms are unprotected, however these have smaller windows in order to minimise overheating risks. Indeed SAP reports only a 'slight' risk of overheating between June and August in the modelled apartments, with natural ventilation (dual aspect units), dark roller blinds and windows open half the time assumed.

2.2.4 Applicant to reconsider implementing a communal heating system and consider the feasibility of connecting to a future decentralized energy network

Paragraph 11.13 of the GLA's Energy Planning Guidance (March 2016) states that applicants must work on the assumption that a site heat network will be required unless it can be clearly demonstrated that it is not applicable due to local circumstances. Therefore, where multiple high density buildings are proposed and the development is located in an area that could be served by a district heating network in the future, a communal heating system must ordinarily be adopted with all apartments and non-domestic buildings/uses within the development connected into a single site wide heat network.

However the proposals do not comprise multiple high density buildings and nor is the site located within 1km of an existing or emerging local heat network according to Figure 4 of London Borough of Camden's Planning Guidance – Sustainability CGP3 (July 2015).

Additionally, paragraph 11.14 of the GLA guidance recognises that, where a development contains small commercial/retail units, i.e. total area less than 500 sqm, as is the case for the proposed development, it is not necessary to connect these to the site heat network. These units are often categorised as shell and core at the planning stage and, when built out, have very small heating demands which are usually met by air source heat pumps. Therefore, on balance, in these circumstances the small benefit in terms of carbon reduction and contribution to strategic heat network policy is not considered to outweigh the practical constraints involved in connecting to the site heat network.



Finally, specifying individual high efficiency gas condensing boilers for the 9 apartments allows the integration of 'gas saver' units which deliver CO_2 emission savings at the first stage of the energy hierarchy. We have modelled a communal gas boiler and can confirm this increases CO_2 emissions by around 4% relative to the proposed individual gas boiler plus gas saver scenario given its effect on both DER and TER values.

2.2.5 Applicant to seek to improve efficiency of ASHP further

A coefficient of performance (COP) of 3.0 has been assumed for the air source heat pump (ASHP) unit in the commercial space as part of the updated SBEM modelling reported in this Revised Energy Statement. This compares to a COP of 2.5 assumed in the original energy statement.

The Heat Pump Field Trial report published by the Energy Saving Trust (2010) concluded that heat pump performance is highly sensitive to installation and commissioning practices but that the highest measured system efficiencies for air source heat pumps was in excess of 3.0 therefore this increased COP assumption appears reasonable.

2.2.6 Applicant to submit details of the solar PV array and seek to expand further (considering combining with green roof spaces where feasible)

A 9.9 kWp solar PV array is proposed, with 8.2 kWp serving the apartments and 1.2 kWp serving the commercial use. A total PV array area of circa 74 sqm is estimated, which will be integrated in the roof of the development whilst allowing space between the arrays to avoid overshadowing, as well as space for the ASHP unit, lift and roof access for maintenance etc.

2.2.7 Should the proposals not meet the 35% CO₂ reduction target on-site, Camden may accept a financial contribution (charged at £90/tonne CO₂/yr over a 30 year period), which will be used to secure CO₂ reduction measures elsewhere in the Borough

The development can achieve the 35% CO₂ reduction target in full on-site and therefore offset payment is not required.



3 PLANNING POLICY CONTEXT

3.1 London Borough of Camden

3.1.1 Planning Guidance – Sustainability CGP3 (July 2015)

Developments providing 500 sqm or more of non-residential floorspace need to be designed in line with BREEAM. It should be noted that the proposed ground floor commercial uses fall below this threshold and therefore BREEAM certification is not required.

This guidance mirrors the requirements of London Plan Policy 5.2 'Minimising CO_2 Emissions' and the GLA's Energy Planning Guidance (March 2016) in requiring new developments to achieve a 35% reduction in CO_2 emissions below 2013 Building Regulations standards through application of the energy hierarchy, and including a 20% CO_2 reduction through on-site renewable energy. **Chapter 4** explains the approach taken to this assessment.



4 APPROACH TO MODELLING

In order to demonstrate how the development can achieve the targeted 35% reduction in CO_2 emissions below 2013 Building Regulation standards (including a 20% CO_2 reduction through on-site renewable energy), SAP 2012 modelling has been undertaken on 2 No. apartments (top floor unit and 2nd floor unit B), selected on the basis of having energy / CO_2 performance that is likely to be representative of the development as a whole given their relatives sizes and locations within the block, as determined by professional experience and judgement.

The SAP models were run initially to achieve a "baseline" performance (i.e. compliance with the 2013 Building Regulations only). Additional model iterations were then run to establish the CO_2 reduction effect of energy efficiency measures (e.g. enhanced U values, thermal bridging, air tightness, low energy lighting etc), followed by on-site renewable energy (solar PV) in accordance with the energy hierarchy.

SAP results from the modelled apartments are then extrapolated to all units on an areaweighted basis in order to estimate energy / CO_2 performance of the development as a whole. A similar approach to the above has been undertaken for the SBEM modelling of the commercial space. The results of the energy modelling work are presented in **Chapter 5**.



5 ENERGY & CO₂ STRATEGY

5.1 Energy Efficiency ("Be Lean")

The first stage of the energy hierarchy is to ensure energy demand and associated CO_2 emissions are minimised from the outset through good design and energy efficiency measures. A range of energy efficiency measures beyond the standard 'back stop' values permitted by 2013 Building Regulations are proposed, as presented in Table 1.

| Parameter | Standard Value | Enhanced Value | |
|---|----------------------------|---|--|
| U values (W/m ² K) | | | |
| External wall | 0.30 | 0.20 | |
| Party wall | 0.20 | 0.00 | |
| Basement floor | 0.25 | 0.25 | |
| Ground floor | 0.25 | 0.10 | |
| Roof | 0.20 | 0.15 | |
| Glazing | 2.00 | 1.10 | |
| Door | 2.00 | 1.00 | |
| Air permeability (m ³ /m ² /hr) | 10 | 5 | |
| Thermal bridging (y value, W/m ² k) | 0.05 | 0.1 | |
| Low energy lighting | 100% | | |
| Lighting (commercial) | 5W | /m ² | |
| Heating (residential) | Independent gas boilers | Independent gas boilers + Zenex Gas Savers | |
| Heating (commercial) | Independent gas boiler | Air Source Heat Pump (COP = 3.0) | |
| Ventilation | Natural V | entilation | |

Table 1: 'Standard' & 'Enhanced' Energy Efficiency Specifications

Communal heating arrangements (e.g. gas boilers within a central plant room), as sought by London Plan Policy 5.6 as part of the energy hierarchy, are unlikely to be merited at the limited scale of development proposed here.

5.2 Supply Energy Efficiently ("Be Clean")

The second stage of the energy hierarchy is to ensure that energy demands following the implementation of energy efficiency measures are met as efficiently as possible. This can be achieved in appropriate developments by connecting them to local energy networks, or by providing on-site combined heat & power (CHP) which can generate both heat and power in a highly efficient manner on suitable applications.



5.2.1 Energy Networks

The London Plan seeks that new developments connect to an existing or approved decentralised energy network, safeguard potential network routes, and make provision to allow future connection to a network, where possible. However the limited scale of development that is proposed is considered unlikely to justify communal heating arrangements (with individual gas boilers for each apartment more likely to be preferred), and a result is unlikely to be either technically or commercially viable for the development to connect to a local heat network in the event that one is available.

5.2.2 Combined Heat & Power (CHP)

The GLA recognises that, for small to medium scale residential developments comprising less than 500 apartments, it is generally not economic to install on-site CHP as the lead heat source. This is particularly relevant to the development proposals given the limited amount of commercial floorspace that is proposed which otherwise may help to increase CHP feasibility by providing complementary heat demand e.g. daytime during week days when apartments are unoccupied. For these reasons on-site CHP is not proposed.

5.3 Renewable Energy ("Be Green")

The third and final stage of the energy hierarchy is to incorporate on-site renewable energy technology to address any residual energy demand or CO_2 emissions reduction that may be required to achieve planning policy targets following the two previous stages of the energy hierarchy. Preferred renewable energy technology options are discussed below.

5.3.1.1 Solar photovoltaics (PV)

Solar photovoltaic (PV) arrays generate zero carbon electricity from sunlight. They have a range of benefits over other renewable energy technologies which make them attractive to new developments, including:

- ease of building integration;
- a proven technology widely accepted by home owners;
- minimal maintenance requirements;
- minimal environmental or planning implications; and
- commercial benefits through the Feed In Tariff despite recent cuts.

5.3.1.2 Air Source Heat Pump

Air Source Heat Pump (COP = 3) is proposed to provide space and water heating demand in the commercial unit.

5.4 Modelling Results

Table 2 presents the SAP results for the apartments. It first presents CO_2 emissions estimated for all 9 apartments in the "baseline" (i.e. 2013 Building Regulations Part L compliant) scenario. It then shows the CO_2 reduction effect of the energy efficiency



measures set out in Table 1 ("Be Lean"), which includes the provision of "gas savers" for the apartment boilers. CO_2 emissions are then presented following the "Be Clean" stage of the energy hierarchy, for which no measures are proposed given the limited scale of development. Finally, a solar PV array of 8.2 kWp (kilowatt peak) is proposed as the final "Be Green" scenario for the apartments.

| Seconaria | CO ₂ emissions (tonnes/year) | | |
|---|---|-------------|--|
| Scenario | Regulated | Unregulated | |
| "Baseline" - 2013 Building Regulations compliance | 13.6 | | |
| "Be Lean" - Energy efficiency measures (Table 1) | 12.5 | 15.0 | |
| " Be Clean " – CHP (not proposed) | 12.5 | 15.0 | |
| " Be Green" – 8.2 kWp solar PV | 8.8 | | |

Table 2. Apartments CO₂ Emissions at each stage of Energy Hierarchy

Table 3 presents regulated CO_2 emission savings at each stage of the energy hierarchy for the apartments from which it can be seen that the energy efficiency measures set out in Table 1 are together predicted to achieve a circa 7.9% CO_2 emissions reduction below 2013 Building Regulations standards ("Be Lean"). "Be Clean" measures (e.g. onsite CHP) are not proposed. An 8.2 kWp solar PV array is estimated to deliver the remaining CO_2 emissions reduction to achieve the 35% CO_2 reduction target. The SAP reports for the final "Be Green" scenario for the modelled apartments are presented at **Appendix 1**.

| Scenario | CO ₂ emission saving (tonnes / year) | % Saving |
|---|---|----------|
| "Baseline" - 2013 Building Regulations compliance | | |
| "Be Lean" - Energy efficiency measures (Table 1) | 1.1 | 7.9% |
| "Be Clean" – CHP (not proposed) | | |
| " Be Green" – 8.2 kWp solar PV | 3.7 | 27.1% |
| Total CO ₂ Savings | 4.7 | 35.0% |

Table 3. Apartments Regulated CO₂ Emissions Savings

Tables 4 and 5 presents the SBEM modelling results for the ground floor commercial space. It can be that the energy efficiency measures in Table 1 (which include Air Source Heat Pump) are predicted to achieve a 21.8% reduction in CO_2 emissions below 2013 Building Regulations standards. The SBEM reports are presented at **Appendix 2**.



| Soonario | CO ₂ emissions (tonnes/year) | | |
|---|---|-------------|--|
| | Regulated | Unregulated | |
| "Baseline" - 2013 Building Regulations compliance | 7.7 | | |
| "Be Lean" - Energy efficiency measures (Table 1) | 5.7 | | |
| "Be Clean" – CHP (not proposed) | 5.7 | 9.7 | |
| " Be Green" – 1.7 kWp solar PV | 5.0 | | |

Table 4. Commercial CO₂ Emissions at each stage of Energy Hierarchy

Table 5. Commercial Space Regulated CO2 Emissions Savings

| Scenario | CO ₂ emission saving (tonnes / year) | % Saving |
|---|---|----------|
| "Baseline" - 2013 Building Regulations compliance | | |
| "Be Lean" - Energy efficiency measures (Table 1) | 2.0 | 26.0% |
| "Be Clean" – CHP (not proposed) | | |
| " Be Green" – 1.7 kWp solar PV | 0.7 | 9.0% |
| Total CO ₂ Savings | 2.7 | 35.0% |

The SAP and SBEM results are combined on an area-weighted basis to provide the modelling results for the development as a whole in Tables 6 and 7. It can be seen that a 35.0% reduction in CO_2 emissions below 2013 Building Regulations standards is predicted for the development as whole (including a 20.5% CO_2 through on-site renewable energy) in accordance with Camden planning policy.

| Table 6. | Develop | ment CO ₂ | Emissions a | t each stad | e of Enerav | Hierarchy |
|----------|---------|----------------------|--------------------|-------------|-------------|-----------|
| | | | | | | |

| Soonaria | CO ₂ emissions (tonnes/year) | | |
|---|---|-------------|--|
| | Regulated | Unregulated | |
| "Baseline" - 2013 Building Regulations compliance | 21.3 | | |
| "Be Lean" - Energy efficiency measures (Table 1) | 18.2 | 04.7 | |
| "Be Clean" – CHP (not proposed) | 18.2 | 24.7 | |
| " Be Green" – 9.9 kWp solar PV | 13.8 | | |

Because the 35% CO_2 reduction target is achieved in full on site, no cash payment to Camden for offsetting residual CO_2 emissions is required.



| Scenario | CO ₂ emission saving (tonnes / year) | % Saving |
|---|---|----------|
| "Baseline" - 2013 Building Regulations compliance | | |
| "Be Lean" - Energy efficiency measures (Table 1) | 3.1 | 14.5% |
| "Be Clean" – CHP (not proposed) | | |
| " Be Green" – 9.9 kWp solar PV | 4.4 | 20.5% |
| Total CO ₂ Savings | 7.5 | 35.0% |

Table 7. Development Regulated CO₂ Emissions Savings

5.5 Estimated Area of Solar PV Array

Each kWp of solar PV in the UK, assuming a suitable orientation (i.e. from south-east to south-west facing) and pitch (between 30 and 40 degrees) requires an area of approximately 7.5 sqm. On this basis, the 9.9 kWp PV array estimated for the development will require a total area of approximately 74 sqm relative to the development's useable roof area of circa 120 sqm.

5.6 **Further Work**

Further work will be required as part of detailed architectural and M&E design and to progress the energy / CO_2 strategy work reported here, including:

- SAP models and "as designed" and "as built" EPCs for all dwellings;
- SBEM model, "as designed" and "as built" EPC for the commercial unit; and
- Engagement with a solar PV and Air Source Heat Pump installation company.



Appendix 1 SAP 2012 Reports (Top Floor Unit & 2nd Floor Unit B)



Regulations Compliance Report Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.3.10 Printed on 09 August 2016 at 13:36:46 Project Information: Assessed By: David Lloyd (STRO006228) **Building Type:** Flat Dwelling Details: **NEW DWELLING DESIGN STAGE** Total Floor Area: 83.85m² Site Reference : **Plot Reference:** 52 Holmes Rd 2nd Floor B GS PV 2nd Floor B GS PV Address : Client Details: Name: Address : This report covers items included within the SAP calculations. It is not a complete report of regulations compliance. 1a TER and DER Fuel for main heating system: Mains gas Fuel factor: 1.00 (mains gas) 16.35 kg/m² Target Carbon Dioxide Emission Rate (TER) Dwelling Carbon Dioxide Emission Rate (DER) 10.62 kg/m² 1b TFEE and DFEE Target Fabric Energy Efficiency (TFEE) 41.4 kWh/m² Dwelling Fabric Energy Efficiency (DFEE) 37.1 kWh/m² 2 Fabric U-values Element Average Highest External wall 0.20 (max. 0.30) 0.20 (max. 0.70) Party wall 0.00 (max. 0.20) Floor (no floor)

Openings 2a Thermal bridging Thermal bridging ca

Roof

Thermal bridging calculated from linear thermal transmittances for each junction

None

(no roof)

1.09 (max. 2.00)

| Air permeability at 50 pascals Maximum | 5.00 (design value) 10.0 | ок |
|---|-----------------------------|----|
| | | |

4 Heating efficiency Main Heating system:

Database: (rev 396, product index 017556): Boiler systems with radiators or underfloor heating - mains gas Brand name: Worcester Model: Greenstar Model qualifier: 29CDi Classic ErP (Combi) Efficiency 89.1 % SEDBUK2009 Minimum 88.0 %

1.10 (max. 3.30)

ΟΚ

OK

OK

OK

OK

OK

Secondary heating system:

Regulations Compliance Report



| 5 Cylinder insulation | | | |
|---------------------------------|------------------------|---------------------------------------|----|
| Hot water Storage: | No cylinder | | |
| 6 Controls | | | |
| | | | |
| Space heating controls | TTZC by plumbing and e | electrical services | ОК |
| Hot water controls: | No cylinder | | |
| Boiler interlock: | Yes | | OK |
| 7 Low energy lights | | | |
| Percentage of fixed lights with | n low-energy fittings | 100.0% | |
| Minimum | | 75.0% | OK |
| 8 Mechanical ventilation | | | |
| Not applicable | | | |
| 9 Summertime temperature | | | |
| Overheating risk (Thames va | lley): | Slight | ОК |
| Based on: | | | |
| Overshading: | | Average or unknown | |
| Windows facing: South | | 3.99m ² | |
| Windows facing: North | | 6.26m ² | |
| Windows facing: North | | 2.16m ² | |
| Ventilation rate: | | 3.00 | |
| Blinds/curtains: | | Dark-coloured curtain or roller blind | |
| | | Closed 100% of daylight hours | |
| 10 Key features | | | |
| Windows U-value | | 1.1 W/m²K | |
| Doors U-value | | 1 W/m²K | |
| Party Walls U-value | | 0 W/m²K | |
| Photovoltaic array | | | |



2nd Floor B GS PV

Dwelling type: Date of assessment: Produced by: Total floor area: Mid floor Flat 09 August 2016 David Lloyd 83.85 m²

Environmental Impact (CO₂) Rating

This is a Predicted Energy Assessment for a property which is not yet complete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, an Energy Performance Certificate is required providing information about the energy performance of the completed property.

Energy performance has been assessed using the SAP 2012 methodology and is rated in terms of the energy use per square metre of floor area, energy efficiency based on fuel costs and environmental impact based on carbon dioxide (CO2) emissions.

Energy Efficiency Rating



The energy efficiency rating is a measure of the overall efficiency of a home. The higher the rating the more energy efficient the home is and the lower the fuel bills are likely to be. The environmental impact rating is a measure of a home's impact on the environment in terms of carbonn dioxide (CO2) emissions. The higher the rating the less impact it has on the environment.



| | | | | | User [| Details: | | | | | | |
|--|--|--------------|-------------------------------|-------------|--------------|-----------------------------|--------------|-------------|------------------------|-----------|-------------------------|-----------|
| Assessor Name: | David | d Lloyo | ł | | | Strom | a Num | ber: | | STRO | 006228 | |
| Software Name: | Stron | na FS/ | AP 201 | 2 | | Softwa | are Ver | sion: | | Versio | n: 1.0.3.10 | |
| | | | | P | operty | Address | : 2nd Flo | or B GS | PV | | | |
| Address : | 2nd F | loor B | GS PV | | | | | | | | | |
| 1. Overall dwelling dim | ensions: | | | | | ()) | | | | | N I (D) | |
| Ground floor | | | | | Are | 83.85 | (1a) x | AV. He | l gnt(m) 2.5 | (2a) = | 209.62 |) (3a) |
| Total floor area TFA = (1 | la)+(1b)+ | +(1c)+(| 1d)+(1e |)+(1n |) | 83.85 | (4) | | | | | |
| Dwelling volume | | | | | | | (3a)+(3b) |)+(3c)+(3d |)+(3e)+ | .(3n) = | 209.62 | (5) |
| 2. Ventilation rate: | | - | | | | 4 | | | | | <u> </u> | |
| Number of chimneys | m he | ain ating | se h □ + □ | eating | у Л + Г | other | 7 = Г | | x 4 | 40 = | m ³ per hour | |
| Number of open flues | | 0 | 」 」 | 0 | 」 L コ + Г | 0 | 」 L ヿ _ Γ | 0 | x 2 | 20 = | 0 | |
| Number of intermittent f | | 0 | | 0 |] · L | 0 | JĽ | 0 | | | 0 | |
| | ans | | | | | | | 3 | ^ | 10 = | 30 | (7a) |
| Number of passive vents | S | | | | | | | 0 | x ? | 10 = | 0 | (7b) |
| Number of flueless gas t | fires | | | | | | | 0 | X 4 | 40 = | 0 | (7c) |
| | | | | | | | | | | Air ch | anges per ho | ur |
| Infiltration due to chimne | eys, flues | s and fa | ins = (6 | a)+(6b)+(7 | a)+(7b)+ | (7c) = | Γ | 30 | <u> </u> | ÷ (5) = | 0.14 | (8) |
| If a pressurisation test has | been carrie | ed out or | is intende | ed, proceed | l to (17), | otherwise of | continue fro | om (9) to (| (16) | | | _ |
| Number of storeys in t | the dwell | ling (ns |) | | | | | | | | 0 | (9) |
| Additional infiltration |) OF for a | tool or | timborf | romo or | 0 25 fe | * **** | n / oo potr | uction | [(9) | -1]x0.1 = | 0 | |
| if both types of wall are p deducting areas of open | D.25 IOI S present, us inas): if eau | e the val | umber 1 ue corresj 0.35 | ponding to | the grea | ter wall are | a (after | uction | | | 0 | _(11) |
| If suspended wooden | floor, en | ter 0.2 | (unseal | ed) or 0. | 1 (seal | ed), else | enter 0 | | | | 0 | (12) |
| If no draught lobby, er | nter 0.05 | , else e | nter 0 | | | | | | | | 0 | (13) |
| Percentage of window | is and do | oors dra | aught st | ripped | | | | | | | 0 | (14) |
| Window infiltration | | | | | | 0.25 - [0.2 | 2 x (14) ÷ 1 | = [00 | | | 0 | (15) |
| Infiltration rate | -0 | | | | | (8) + (10) | + (11) + (1 | 2) + (13) + | + (15) = | | 0 | (16) |
| Air permeability value | , q50, ex ility volue | presse | d in cub (18) – [(1) | (C metre) | s per h | our per se vise (18) – (| quare m | etre of e | nvelope | area | 5 | = (17) |
| Air permeability value appli | es if a pres | surisatio | n test has | been don | e or a de | aree air pe | rmeabilitv | is beina us | sed | | 0.39 | _(18) |
| Number of sides shelter | ed | | | | | 5 | , | J | | | 2 | (19) |
| Shelter factor | | | | | | (20) = 1 - | [0.075 x (1 | 9)] = | | | 0.85 | (20) |
| Infiltration rate incorpora | ting shel | lter fact | or | | | (21) = (18 |) x (20) = | | | | 0.33 | (21) |
| Infiltration rate modified | for mont | hly win | d speed | | | | | | | | | |
| Jan Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | | |
| Monthly average wind s | peed fror | m Table | e 7 | | | | | | | | | |
| (22)m= 5.1 5 | 4.9 | 4.4 | 4.3 | 3.8 | 3.8 | 3.7 | 4 | 4.3 | 4.5 | 4.7 | | |
| Wind Factor (22a)m = (2 | 22)m ÷ 4 | | | | | | | | | | | |
| (22a)m= 1.27 1.25 | 1.23 | 1.1 | 1.08 | 0.95 | 0.95 | 0.92 | 1 | 1.08 | 1.12 | 1.18 | | |
| | | | | | | | | | | | | |



| Adjust | ed infiltr | ation rat | e (allowi | ing for sh | nelter an | d wind s | peed) = | (21a) x | (22a)m | | | | _ | |
|------------------------------|--------------------------|--------------------------------|---------------------------|-----------------------|-------------------------|-------------------------|----------------------|------------------------|-----------------|---------------|-----------------------|--------------------|------------|--------------|
| | 0.43 | 0.42 | 0.41 | 0.37 | 0.36 | 0.32 | 0.32 | 0.31 | 0.33 | 0.36 | 0.38 | 0.39 | | |
| Calcul If m | late effe echanic: | <i>ctive air</i> al ventila | change | rate for t | he appli | cable ca | se | | | | | | 0 | (232) |
| lf exh | naust air h | eat pump | using App | endix N, (2 | 3b) = (23a | ı) × Fmv (e | equation (| N5)) , othe | rwise (23b |) = (23a) | | | 0 | (23b) |
| If bal | anced with | h heat reco | overy: effic | ciency in % | allowing f | or in-use fa | actor (fron | n Table 4h |) = | , , , | | | 0 | (23c) |
| a) If | balance | ed mecha | anical ve | entilation | with he | at recove | erv (MVI | HR) (24a | a)m = (22 | 2b)m + () | 23b) x [⁻ | 1 – (23c) | → 100] | (200) |
| (24a)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |] | (24a) |
| b) If | balance | ed mecha | anical ve | entilation | without | heat rec | covery (N | u MV) (24b |)m = (22 | 2b)m + (2 | 23b) | ! | 1 | |
| , (24b)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |] | (24b) |
| c) If | whole h | iouse ex | tract ver | ntilation c | or positiv | ve input v | ventilatio | n from o | outside | | | | 1 | |
| | if (22b)r | n < 0.5 × | (23b), t | then (24o | c) = (23b |); otherv | wise (24 | c) = (22k | o) m + 0. | 5 × (23b |) | | _ | |
| (24c)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | (24c) |
| d) If | natural if (22b)r | ventilation = 1, the | on or wh en (24d) | ole hous) m = (22) | e positiv b)m othe | ve input v erwise (2 | ventilatio 4d)m = | on from l 0.5 + [(2 | oft 2b)m² x | 0.5] | | | | |
| (24d)m= | 0.59 | 0.59 | 0.58 | 0.57 | 0.56 | 0.55 | 0.55 | 0.55 | 0.56 | 0.56 | 0.57 | 0.58 | | (24d) |
| Effe | ctive air | change | rate - er | nter (24a |) or (24t | o) or (240 | c) or (24 | d) in box | x (25) | - | | | | |
| (25)m= | 0.59 | 0.59 | 0.58 | 0.57 | 0.56 | 0.55 | 0.55 | 0.55 | 0.56 | 0.56 | 0.57 | 0.58 |] | (25) |
| 3 He | at losse | s and he | eat loss | paramet | . . | | | | | | | | | |
| ELEN | MENT | Gros area | 3S (m²) | Openin rr | gs 1 ² | Net Ar A ,r | ea n² | U-valı W/m2 | ue :K | A X U (W/I | <) | k-value kJ/m²⋅l | e A K k | . X k J/K |
| Doors | | | | | | 1.91 | x | 1 | = | 1.91 | | | | (26) |
| Windo | ws Type | e 1 | | | | 3.99 | x1. | /[1/(1.1)+ | 0.04] = | 4.2 | | | | (27) |
| Windo | ws Type | e 2 | | | | 6.26 | x1, | /[1/(1.1)+ | 0.04] = | 6.6 | | | | (27) |
| Windo | ws Type | e 3 | | | | 2.16 | | /[1/(1.1)+ | 0.04] = | 2.28 | | | | (27) |
| Walls | Type1 | 73. | 1 | 12.4 | 1 | 60.69 |) x | 0.2 | = [| 12.14 | | | | (29) |
| Walls | Type2 | 20.0 |)4 | 1.91 | | 18.13 | 3 X | 0.19 | | 3.41 | = i | | \dashv | (29) |
| Total a | area of e | elements | , m² | | | 93.14 | | | | | L | | | (31) |
| Party | wall | | | | | 32.61 | x | 0 | | 0 | | | | (32) |
| * for win | ndows and de the area | l roof wind as on both | ows, use e sides of ii | effective wi | ndow U-va Is and pan | alue calcula titions | ated using | formula 1 | /[(1/U-valu | ıe)+0.04] a | ns given in | paragraph | 1 3.2 | |
| Fabric | heat los | ss, W/K : | = S (A x | U) | | | | (26)(30) |) + (32) = | | | | 30.54 | (33) |
| Heat c | apacity | Cm = S(| (Axk) | | | | | | ((28) | .(30) + (32 | 2) + (32a). | (32e) = | 17709.11 | (34) |
| Therm | al mass | parame | ter (TMI | P = Cm ÷ | - TFA) ir | n kJ/m²K | | | Indica | tive Value: | Medium | | 250 | (35) |
| For des can be i | ign asses: used inste | sments wh ad of a de | ere the de tailed calc | atails of the | construct | ion are not | t known pr | recisely the | e indicative | e values of | TMP in T | able 1f | | |
| Therm | al bridg | es : S (L | x Y) cal | culated u | using Ap | pendix ł | < | | | | | | 9.65 | (36) |
| <i>if details</i> Total f | s of therma abric he | al bridging at loss | are not kr | 10wn (36) = | = 0.15 x (3 | 1) | | | (33) + | (36) = | | | 40.19 | (37) |
| Ventila | ation hea | at loss ca | alculated | d monthly | ý | | | | (38)m | = 0.33 × (| 25)m x (5) |) | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |] | |
| (38)m= | 40.87 | 40.62 | 40.38 | 39.26 | 39.05 | 38.07 | 38.07 | 37.89 | 38.45 | 39.05 | 39.48 | 39.92 |] | (38) |
| Heat t | ransfer o | coefficier | nt, W/K | | | | | | (39)m | = (37) + (3 | 38)m | | | |
| (39)m= | 81.06 | 80.82 | 80.58 | 79.45 | 79.24 | 78.27 | 78.27 | 78.09 | 78.64 | 79.24 | 79.67 | 80.11 | | |
| | | | | | | | | | | Average = | Sum(39)1 | 12 /12= | 79.45 | (39) |



| Heat Ic | oss para | meter (H | HLP), W | /m²K | | | | | (40)m | = (39)m ÷ | - (4) | | | |
|------------------------------|-------------------------------------|---|-------------------------------------|---|--|---------------------------------------|------------------------------|------------------------|-----------------------|-------------|------------------------|----------|---------|----------|
| (40)m= | 0.97 | 0.96 | 0.96 | 0.95 | 0.95 | 0.93 | 0.93 | 0.93 | 0.94 | 0.95 | 0.95 | 0.96 | | _ |
| Numbe | er of day | /s in mo | nth (Tab | le 1a) | | | | | , | Average = | Sum(40) ₁ . | 12 /12= | 0.95 | (40) |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | | |
| (41)m= | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | | (41) |
| | | | | | | | | | | | | | | |
| 4. Wa | iter hea | ting ene | rgy requ | irement: | | | | | | | | kWh/ye | ear: | |
| Assum if TF if TF | ed occu A > 13. A £ 13. | upancy, 9, N = 1 9, N = 1 | N + 1.76 x | [1 - exp | (-0.0003 | 349 x (TF | ⁻ A -13.9 |)2)] + 0.(| 0013 x (⁻ | ΓFA -13. | 2. .9) | 53 | | (42) |
| Annual Reduce not more | l averag the annua e that 125 | je hot wa al average litres per j | ater usag hot water person pe | ge in litre usage by s r day (all w | es per da 5% if the a rater use, I | ay Vd,av Iwelling is hot and co | erage = designed : ld) | (25 x N) to achieve | + 36 a water us | se target o | 94 f | .33 | | (43) |
| | lan | Feb | Mar | Apr | May | lun | , Int | Δυσ | Sen | Oct | Nov | Dec | | |
| Hot wate | er usage i | n litres per | r day for ea | ach month | Vd,m = fa | ctor from T | Table 1c x | (43) | Ocp | 001 | | Dee | | |
| (44)m= | 103.76 | 99.99 | 96.22 | 92.45 | 88.67 | 84.9 | 84.9 | 88.67 | 92.45 | 96.22 | 99.99 | 103.76 | | |
| | | 1 | 1 | | | | | | - | Total = Su | m(44) ₁₁₂ = | | 1131.98 | (44) |
| Energy o | content of | hot water | used - cal | culated mo | onthly $= 4$. | 190 x Vd,r | n x nm x E | DTm / 3600 |) kWh/mor | oth (see Ta | ables 1b, 1 | c, 1d) | L | |
| (45)m= | 153.88 | 134.58 | 138.88 | 121.08 | 116.18 | 100.25 | 92.9 | 106.6 | 107.88 | 125.72 | 137.23 | 149.02 | | - |
| lf instant | aneous v | /ater heati | ng at point | of use (no | hot water | r storage), | enter 0 in | boxes (46 |) to (61) | Fotal = Su | m(45) ₁₁₂ = | - | 1484.21 | (45) |
| (46)m= | 23.08 | 20.19 | 20.83 | 18.16 | 17.43 | 15.04 | 13.93 | 15.99 | 16.18 | 18.86 | 20.58 | 22.35 | | (46) |
| Water | storage | loss: | includir | | alar or M | | storage | within or | amo vos | sol | | 0 | l | (47) |
| If comr Otherw Water | nunity h vise if no storage | neating a postored loss: | and no ta | ink in dw er (this in | velling, e icludes i | nter 110 nstantar | litres in neous co | (47) ombi boil | ers) ente | er '0' in (| 47) | 0 | | (47) |
| a) If m | anufact | urer's de | eclared I | oss facto | or is kno | wn (kWł | n/day): | | | | | 0 | | (48) |
| Tempe | rature f | actor fro | m Table | 2b | | | | | | | | 0 | | (49) |
| Energy b) If m | / lost fro anufact | om water urer's de | r storage eclared (| e, kWh/ye cvlinder l | ear oss facto | or is not | known: | (48) x (49) |) = | | | 0 | | (50) |
| Hot wa | iter stor | age loss neating s | factor fi | om Tabl | e 2 (kW | h/litre/da | ıy) | | | | | 0 | | (51) |
| Volume | e factor | from Ta | ble 2a | | | | | | | | | 0 | | (52) |
| Tempe | rature f | actor fro | m Table | 2b | | | | | | | | 0 | | (53) |
| Energy | lost fro | om water | r storage | , kWh/ye | ear | | | (47) x (51) |) x (52) x (| 53) = | | 0 | | (54) |
| Enter | (50) or | (54) in (5 | 55) | | | | | | | | | 0 | | (55) |
| Water | storage | loss cal | culated | for each | month | i | i | ((56)m = (| 55) × (41)ı | n | i | | L | |
| (56)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | (56) |
| If cylinde | er contain | s dedicate | a solar sto | rage, (57)i I | n = (56)m | x [(50) – (I | H11)] ÷ (5 I | 0), eise (5 1 | 7)m = (56) | m wnere (| H11) IS Tro | m Appena | IX H | |
| (57)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | (57) |
| Primar Primar | y circuit y circuit | loss (ar loss cal | nnual) fro | om Table for each | e 3 month (| 59)m = (| (58) ÷ 36 | 65 × (41) | m | | | 0 | | (58) |
| (moo | dified by | r factor f | rom Tab | le H5 if t | here is s | solar wat | er heati | ng and a | cylinde | r thermo | stat) | | I | (==) |
| (59)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | (59) |



| Combi | loss ca | lculated | for eacl | n month (| (61)m = | (60) ÷ 3 | 865 × (41 |)m | | | | | | | |
|----------|-----------|---------------|------------|----------------|-----------|------------|--------------|---------------------|-----------|------------|------------|---------------|-------------|---------------|-----------|
| (61)m= | 38.44 | 34.72 | 38.44 | 37.2 | 38.44 | 37.2 | 38.44 | 38.4 | 14 | 37.2 | 38.44 | 37.2 | 38.44 | | (61) |
| Total h | eat req | uired for | water h | eating ca | alculated | d for eac | ch month | (62)r | n = 0 |).85 × (| (45)m + | · (46)m + | (57)m + | (59)m + (61)m | |
| (62)m= | 192.32 | 169.3 | 177.32 | 158.27 | 154.61 | 137.45 | 131.33 | 145. | 04 | 145.07 | 164.15 | 174.43 | 187.46 | | (62) |
| Solar DH | HW input | calculated | using Ap | pendix G or | Appendi | k H (negat | tive quantit | y) (ente | er '0' if | f no sola | r contribu | ution to wate | er heating) | - | |
| (add a | dditiona | I lines if | FGHRS | and/or \ | WWHRS | applies | s, see Ap | pend | ix G) | | | _ | | | |
| (63)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | | (63) |
| FHRS | 42.12 | 34.93 | 32.24 | 23.51 | 15.77 | 10.22 | 9.51 | 10.8 | 31 | 10.93 | 24.11 | 33.46 | 42.15 | | (63) (G2) |
| Output | from w | ater hea | ter | | | | | | | | | | | | |
| (64)m= | 150.2 | 134.37 | 145.07 | 134.76 | 138.84 | 127.23 | 121.83 | 134. | 23 | 134.14 | 140.04 | 140.97 | 145.31 | | _ |
| | | | | | | | | (| Outpu | t from wa | ater heat | er (annual)1 | 12 | 1647 | (64) |
| Heat g | ains fro | m water | heating | , kWh/m | onth 0.2 | 5 ´ [0.85 | 5 × (45)m | n + (6 ⁻ | 1)m] | + 0.8 × | (46)n | n + (57)m | + (59)m |] | |
| (65)m= | 60.77 | 53.43 | 55.79 | 49.56 | 48.24 | 42.63 | 40.5 | 45.0 |)5 | 45.17 | 51.41 | 54.93 | 59.16 | | (65) |
| inclu | ide (57) | m in calo | culation | of (65)m | only if a | cylinder | is in the | dwelli | ng o | r hot w | ater is | from com | munity h | eating | |
| 5. Int | ternal g | ains (see | e Table | 5 and 5a |): | | | | | | | | | | |
| Metab | olic gair | ns (Table | e 5), Wa | tts | | | | | | | | | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Au | ıg | Sep | Oct | Nov | Dec | | |
| (66)m= | 126.59 | 126.59 | 126.59 | 126.59 | 126.59 | 126.59 | 126.59 | 126. | 59 | 126.59 | 126.59 | 126.59 | 126.59 | | (66) |
| Lightin | g gains | (calcula | ted in A | ppendix | L, equat | tion L9 c | or L9a), a | lso se | ee Ta | able 5 | | - | | | |
| (67)m= | 21.48 | 19.08 | 15.52 | 11.75 | 8.78 | 7.41 | 8.01 | 10.4 | 11 | 13.98 | 17.74 | 20.71 | 22.08 | | (67) |
| Applia | nces ga | ins (calc | ulated i | n Append | dix L, eq | uation L | _13 or L1 | 3a), a | also s | see Tal | ble 5 | | | | |
| (68)m= | 227.3 | 229.66 | 223.71 | 211.06 | 195.09 | 180.08 | 170.05 | 167. | 69 | 173.63 | 186.28 | 202.26 | 217.27 | | (68) |
| Cookir | ng gains | (calcula | Ited in A | ppendix | L, equa | tion L15 | or L15a |), also | o see | e Table | 5 | • | | | |
| (69)m= | 35.66 | 35.66 | 35.66 | 35.66 | 35.66 | 35.66 | 35.66 | 35.6 | 66 | 35.66 | 35.66 | 35.66 | 35.66 | | (69) |
| Pumps | and fa | ns gains | (Table | 5a) | | | • | | | | | • | | | |
| (70)m= | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | | 3 | 3 | 3 | 3 | | (70) |
| Losses | s e.g. ev | , aporatio | n (nega | tive valu | es) (Tab | ole 5) | • | | | | | • | | | |
| (71)m= | -101.27 | -101.27 | -101.27 | -101.27 | -101.27 | -101.27 | -101.27 | -101. | 27 - | 101.27 | -101.27 | -101.27 | -101.27 | | (71) |
| Water | heating | gains (T | able 5) | • | | | 1 | | | | | • | | 1 | |
| (72)m= | 81.69 | 79.51 | 74.98 | 68.83 | 64.84 | 59.21 | 54.43 | 60.5 | 56 | 62.73 | 69.1 | 76.29 | 79.52 | | (72) |
| Total i | nternal | gains = | : | • | | . (66 | δ)m + (67)n | n + (68 |)m + (| (69)m + (| (70)m + (| 71)m + (72) | m | | |
| (73)m= | 394.44 | 392.22 | 378.19 | 355.62 | 332.68 | 310.68 | 296.47 | 302. | 63 | 314.32 | 337.11 | 363.24 | 382.84 | | (73) |
| 6. So | lar gain | s: | | | | | • | | | | | | | | |
| Solar g | ains are | calculated | using sola | ar flux from | Table 6a | and asso | ciated equa | ations t | o con | vert to th | e applica | able orientat | ion. | | |
| Orienta | ation: | Access F | actor | Area | | Fl | ux | | _ (| g_ | _ | FF | | Gains | |
| | | i able 6d | | m ² | | | able 6a | _ | la | ble 6b | | able 6c | | (VV) | _ |
| North | 0.9x | 0.77 | x | 6.2 | 26 | x | 10.63 | x | | 0.72 | x | 0.7 | = | 23.25 | (74) |
| North | 0.9x | 0.77 | x | 2.1 | 6 | x | 10.63 |] x [| | 0.72 | x | 0.7 | = | 8.02 | (74) |
| North | 0.9x | 0.77 | x | 6.2 | 26 | x | 20.32 |] × [| | 0.72 | × [| 0.7 | = | 44.43 | (74) |

x

2.16

20.32

x

0.72

x

0.7

=

x

North

0.9x

0.77

15.33

(74)



| North | 0.9x | 0.77 | | x | 6. | 26 | x | 3 | 4.53 | × | | 0.72 | x | 0.7 | = | 75.5 | (74) |
|----------|------------|-----------|-----------|-------|----------|--------------|----------|----------|----------|-------|--------|---------|----------|----------|--------|--------|-------|
| North | 0.9x | 0.77 | | x | 2. | 16 | x | 3 | 4.53 | x | | 0.72 | × | 0.7 | = | 26.05 | (74) |
| North | 0.9x | 0.77 | | x | 6. | 26 | x | 5 | 5.46 | x | | 0.72 | x | 0.7 | = | 121.27 | (74) |
| North | 0.9x | 0.77 | | x | 2. | 16 | x | 5 | 5.46 | x | | 0.72 | × | 0.7 | = | 41.84 | (74) |
| North | 0.9x | 0.77 | | x | 6. | 26 | x | 7 | 4.72 | x | | 0.72 | x | 0.7 | = | 163.36 | (74) |
| North | 0.9x | 0.77 | | x | 2. | 16 | x | 7 | 4.72 | x | | 0.72 | × | 0.7 | = | 56.37 | (74) |
| North | 0.9x | 0.77 | | x | 6. | 26 | x | 7 | '9.99 | x | | 0.72 | x | 0.7 | = | 174.88 | (74) |
| North | 0.9x | 0.77 | | x | 2. | 16 | x | 7 | '9.99 | x | | 0.72 | × | 0.7 | = | 60.34 | (74) |
| North | 0.9x | 0.77 | | x | 6. | 26 | x | 7 | 4.68 | x | | 0.72 | × | 0.7 | = | 163.28 | (74) |
| North | 0.9x | 0.77 | | x | 2. | 16 | x | 7 | 4.68 | x | | 0.72 | x | 0.7 | = | 56.34 | (74) |
| North | 0.9x | 0.77 | | x | 6. | 26 | x | 5 | 9.25 | x | | 0.72 | × | 0.7 | = | 129.54 | (74) |
| North | 0.9x | 0.77 | | x | 2. | 16 | x | 5 | 9.25 | x | | 0.72 | x | 0.7 | = | 44.7 | (74) |
| North | 0.9x | 0.77 | | x | 6. | 26 | x | 4 | 1.52 | x | | 0.72 | × | 0.7 | = | 90.77 | (74) |
| North | 0.9x | 0.77 | | x | 2. | 16 | x | 4 | 1.52 | x | | 0.72 | x | 0.7 | = | 31.32 | (74) |
| North | 0.9x | 0.77 | | x | 6. | 26 | x | 2 | 4.19 | x | | 0.72 | x | 0.7 | = | 52.89 | (74) |
| North | 0.9x | 0.77 | | x | 2. | 16 | x | 2 | 4.19 | x | | 0.72 | × | 0.7 | = | 18.25 | (74) |
| North | 0.9x | 0.77 | | x | 6. | 26 | x | 1 | 3.12 | x | | 0.72 | × | 0.7 | = | 28.68 | (74) |
| North | 0.9x | 0.77 | | x | 2. | 16 | x | 1 | 3.12 | x | | 0.72 | × | 0.7 | = | 9.9 | (74) |
| North | 0.9x | 0.77 | | x | 6. | 26 | x | | 8.86 | x | | 0.72 | _ x [| 0.7 | = | 19.38 | (74) |
| North | 0.9x | 0.77 | | x | 2. | 16 | x | 1 | 8.86 | x | | 0.72 | × | 0.7 | = | 6.69 | (74) |
| South | 0.9x | 0.77 | | x | 3. | 99 | x | 4 | 6.75 | x | | 0.72 | x | 0.7 | = | 65.15 | (78) |
| South | 0.9x | 0.77 | | x | 3. | 99 | x | 7 | 6.57 | x | | 0.72 | x | 0.7 | = | 106.7 | (78) |
| South | 0.9x | 0.77 | | x | 3. | 99 | x | g | 7.53 | x | | 0.72 | x | 0.7 | = | 135.92 | (78) |
| South | 0.9x | 0.77 | | x | 3. | 99 | x | 1 | 10.23 | x | | 0.72 | x | 0.7 | = | 153.62 | (78) |
| South | 0.9x | 0.77 | | x | 3. | 99 | x | 1 | 14.87 | x | | 0.72 | × | 0.7 | = | 160.08 | (78) |
| South | 0.9x | 0.77 | | x | 3. | 99 | x | 1 | 10.55 | x | | 0.72 | x | 0.7 | = | 154.06 | (78) |
| South | 0.9x | 0.77 | | x | 3. | 99 | x | 1 | 08.01 | x | | 0.72 | x | 0.7 | = | 150.52 | (78) |
| South | 0.9x | 0.77 | | x | 3. | 99 | x | 1 | 04.89 | x | | 0.72 | × | 0.7 | = | 146.18 | (78) |
| South | 0.9x | 0.77 | | x | 3. | 99 | x | 1 | 01.89 | x | | 0.72 | × | 0.7 | = | 141.99 | (78) |
| South | 0.9x | 0.77 | | x | 3. | 99 | x | 8 | 2.59 | x | | 0.72 | x | 0.7 | = | 115.09 | (78) |
| South | 0.9x | 0.77 | | x | 3. | 99 | x | 5 | 5.42 | x | | 0.72 | x | 0.7 | = | 77.23 | (78) |
| South | 0.9x | 0.77 | | x | 3. | 99 | x | | 40.4 | x | | 0.72 | × | 0.7 | = | 56.3 | (78) |
| | | | | | | | | | | | | | | | | | |
| Solar g | pains in | watts, ca | alcula | ated | for eac | h mont | h | | r | (83)m | ו = Sו | um(74)m | (82)m | | r | - | |
| (83)m= | 96.42 | 166.47 | 237. | .47 | 316.74 | 379.8 | 1 | 389.29 | 370.14 | 320 | .42 | 264.08 | 186.23 | 115.81 | 82.37 | | (83) |
| l otal g | jains – II | nternal a | and s | olar | (84)m : | = (73)n T | ר ו ר | (83)m | , watts | | | | | 1 .== 0 | | 1 | (0.4) |
| (84)m= | 490.87 | 558.69 | 615. | .66 | 672.35 | 712.5 | | 699.96 | 666.61 | 623 | .05 | 578.4 | 523.34 | 479.04 | 465.21 | | (84) |
| 7. Me | an inter | nal temp | perat | ure | (heating | j seasc | on) | | | | | | | | | F | |
| Temp | erature | during h | neatir | ng p | eriods i | n the liv | ving | g area t | from Tal | ble 9 | , Th | 1 (°C) | | | | 21 | (85) |
| Utilisa | ation fac | tor for g | ains I | for I | iving ar | ea, h1, | m (: | see Ta | ble 9a) | - | | | | <u> </u> | _ | 1 | |
| (00) | Jan | Feb | M | ar | Apr | May | / | Jun | Jul | | ug | Sep | Oct | Nov | Dec | 4 | (00) |
| (86)m= | 1 | 1 | 0.9 | 9 | 0.96 | 0.87 | | 0.68 | 0.51 | 0.5 | 57 | 0.83 | 0.97 | 1 | 1 |] | (86) |



| Mean | interna | l temper | ature in | living are | ea T1 (fo | ollow ste | ps 3 to 7 | in Table | e 9c) | | | | | |
|-----------------|-------------------------|-----------------------|------------------------|----------------------|----------------------|-------------|-----------|-------------|------------|------------|-------------------------|------------|---------|----------|
| (87)m= | 20 | 20.14 | 20.35 | 20.63 | 20.86 | 20.97 | 21 | 20.99 | 20.93 | 20.63 | 20.27 | 19.98 | | (87) |
| Temp | erature | during h | neating p | periods ir | n rest of | dwelling | from Ta | able 9, Tl | h2 (°C) | | | | | |
| (88)m= | 20.11 | 20.11 | 20.12 | 20.13 | 20.13 | 20.14 | 20.14 | 20.14 | 20.14 | 20.13 | 20.13 | 20.12 | | (88) |
| Utilisa | ation fac | tor for g | ains for | rest of d | welling, | h2,m (se | e Table | 9a) | | | | | | |
| (89)m= | 1 | 0.99 | 0.98 | 0.95 | 0.83 | 0.61 | 0.41 | 0.47 | 0.76 | 0.96 | 0.99 | 1 | | (89) |
| Mean | interna | l temper | ature in | the rest | of dwelli | ing T2 (fe | ollow ste | eps 3 to 7 | 7 in Tabl | e 9c) | | | | |
| (90)m= | 18.77 | 18.97 | 19.28 | 19.69 | 19.99 | 20.12 | 20.14 | 20.14 | 20.08 | 19.7 | 19.17 | 18.74 | | (90) |
| | | | | | | | | | f | LA = Livin | g area ÷ (4 | 4) = | 0.39 | (91) |
| Mean | interna | l temper | ature (fo | or the wh | ole dwe | lling) = fl | _A × T1 | + (1 – fL | .A) × T2 | | | | | |
| (92)m= | 19.25 | 19.43 | 19.7 | 20.06 | 20.34 | 20.46 | 20.48 | 20.47 | 20.41 | 20.07 | 19.6 | 19.23 | | (92) |
| Apply | adjustn | nent to t | he mear | n internal | l temper | ature fro | m Table | 4e, whe | ere appro | opriate | | | | |
| (93)m= | 19.25 | 19.43 | 19.7 | 20.06 | 20.34 | 20.46 | 20.48 | 20.47 | 20.41 | 20.07 | 19.6 | 19.23 | | (93) |
| 8. Sp | ace hea | ting requ | uirement | t | | | | | | | | | | |
| Set T the ut | i to the r ilisation | mean int factor fo | ternal ter or gains | mperatui using Ta | re obtair able 9a | ned at ste | ep 11 of | Table 9 | o, so tha | t Ti,m=(| 76)m an | d re-calc | ulate | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | | |
| Utilisa | ation fac | tor for g | ains, hm | 1 <u></u> 1: | | | | | | | | | | |
| (94)m= | 1 | 0.99 | 0.98 | 0.94 | 0.84 | 0.64 | 0.45 | 0.51 | 0.78 | 0.96 | 0.99 | 1 | | (94) |
| Usefu | ıl gains, | hmGm | , W = (9 | 4)m x (84 | 4)m | | | | | | | | | |
| (95)m= | 489.31 | 554.73 | 604.63 | 634.91 | 596.55 | 445.07 | 301.81 | 315.33 | 452.85 | 502.71 | 475.64 | 464.11 | | (95) |
| Month | nly aver | age exte | ernal terr | perature | e from Ta | able 8 | | | | | | | | |
| (96)m= | 4.3 | 4.9 | 6.5 | 8.9 | 11.7 | 14.6 | 16.6 | 16.4 | 14.1 | 10.6 | 7.1 | 4.2 | | (96) |
| Heat | loss rate | e for mea | an interr | al tempe | erature, | Lm , W = | =[(39)m : | x [(93)m | – (96)m |] | | | | |
| (97)m= | 1212 | 1174.13 | 1063.8 | 886.82 | 684.35 | 458.48 | 303.33 | 318.17 | 496.21 | 750.26 | 995.97 | 1203.89 | | (97) |
| Space | e heatin | g require | ement fo | or each n | nonth, k\ I | Wh/mont | h = 0.02 | 24 x [(97] |)m – (95 |)m] x (4′ | 1)m | | | |
| (98)m= | 537.68 | 416.24 | 341.62 | 181.37 | 65.33 | 0 | 0 | 0 | 0 | 184.18 | 374.64 | 550.4 | | - |
| | | | | | | | | Tota | l per year | (kWh/year |) = Sum(9 | 8)15,912 = | 2651.46 | (98) |
| Space | e heatin | g require | ement in | kWh/m² | /year | | | | | | | | 31.62 | (99) |
| 9a. En | ergy rec | luiremer | nts – Ind | ividual h | eating s | ystems i | ncluding | micro-C | CHP) | | | | | |
| Spac | e heatir | ng: | | | | | | | | | | | | |
| Fracti | on of sp | ace hea | at from s | econdar | y/supple | mentary | system | | | | | | 0 | (201) |
| Fracti | ion of sp | ace hea | at from n | nain syst | em(s) | | | (202) = 1 - | - (201) = | | | | 1 | (202) |
| Fracti | on of to | tal heati | ng from | main sys | stem 1 | | | (204) = (2 | 02) × [1 – | (203)] = | | | 1 | (204) |
| Efficie | ency of r | main spa | ace heat | ing syste | em 1 | | | | | | | | 90 | (206) |
| Efficie | ency of s | seconda | ry/suppl | ementar | y heatin | g system | n, % | | | | | | 0 | (208) |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | kWh/ye | ear |
| Space | e heatin | g require | ement (c | alculate | d above |) | | | | | | | | |
| | 537.68 | 416.24 | 341.62 | 181.37 | 65.33 | 0 | 0 | 0 | 0 | 184.18 | 374.64 | 550.4 | | |
| (211)m | n = {[(98 |)m x (20 | 04)] } x 1 | 00 ÷ (20 |)6) | | | | | | | | | (211) |
| | 597.43 | 462.49 | 379.58 | 201.52 | 72.59 | 0 | 0 | 0 | 0 | 204.64 | 416.27 | 611.56 | | |
| | | | | | | | | Tota | l (kWh/yea | ar) =Sum(2 | 211) _{15,1012} | = | 2946.07 | (211) |



Space heating fuel (secondary), kWh/month

| opuo | | | | y), ite viii/ | monun | | | | | | | | | |
|------------------|----------------------|----------------------|------------|---------------|-----------|--------------------|------------|-------------|-----------|-----------------------|-------------------------|----------|-----------|------------|
| = {[(98 |)m x (20 |)1)]}x1 | 00 ÷ (20 | (8) | | | | | | | | | I | |
| (215)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | U Tota | | 0 | 215) | 0 | | 7(215) |
| Matar | heating | | | | | | | 1010 | | | 210) _{15,10} 1 | <u>-</u> | 0 | (215) |
| Output | from w |) ater hea | iter (calc | ulated al | hove) | | | | | | | | | |
| Carpa | 150.2 | 134.37 | 145.07 | 134.76 | 138.84 | 127.23 | 121.83 | 134.23 | 134.14 | 140.04 | 140.97 | 145.31 | | |
| Efficier | ncy of w | ater hea | ater | | | | | | | | | | 86.7 | (216) |
| (217)m= | 89.26 | 89.17 | 88.99 | 88.56 | 87.73 | 86.7 | 86.7 | 86.7 | 86.7 | 88.54 | 89.07 | 89.29 | | (217) |
| Fuel fo | or water a = (64) | heating | , kWh/mo | onth | | | | | | | - | | | |
| (219)m= | 168.27 | 150.69 | 163.02 | 152.16 | 158.26 | 146.75 | 140.52 | 154.82 | 154.72 | 158.16 | 158.26 | 162.74 | | |
| | | | 1 | | | | | Tota | I = Sum(2 | 19a) ₁₁₂ = | 1 | | 1868.38 | (219) |
| Annua | al totals | | | | | | | | | k | Wh/yea | | kWh/year | |
| Space | heating | fuel use | ed, main | system | 1 | | | | | | | | 2946.07 | |
| Water | heating | fuel use | ed | | | | | | | | | | 1868.38 | |
| Electri | city for p | oumps, f | ans and | electric | keep-ho | t | | | | | | | | _ |
| centra | al heatir | ng pump | : | | | | | | | | | 30 | | (230c) |
| boiler | with a f | an-assis | sted flue | | | | | | | | | 45 | | (230e |
| Total e | electricity | y for the | above, l | kWh/yea | r | | | sum | of (230a) | (230g) = | | | 75 | (231) |
| Electri | city for I | ighting | | | | | | | | | | | 379.37 | (232) |
| Electri | city gen | erated b | y PVs | | | | | | | | | | -742.71 | (233) |
| 12a. (| CO2 em | issions | – Individ | ual heati | ing syste | ems inclu | uding mi | icro-CHF |) | | | | | |
| | | | | | | En | orav | | | Emice | ion fac | tor | Emissions | • |
| | | | | | | k٧ | /h/year | | | kg CO | 2/kWh | | kg CO2/ye | ar |
| Space | heating | (main s | system 1 |) | | (21 | 1) x | | | 0.2 | 16 | = | 636.35 | (261) |
| Space | heating | (secon | dary) | | | (21 | 5) x | | | 0.5 | 19 | = | 0 | (263) |
| Water | heating | | | | | (219 | 9) x | | | 0.2 | 16 | = | 403.57 | (264) |
| Space | and wa | ter heat | ing | | | (26 | 1) + (262) | + (263) + (| (264) = | | | | 1039.92 | (265) |
| Electri | city for p | oumps, f | ans and | electric | keep-ho | t (23 ⁻ | 1) x | | | 0.5 | 19 | = | 38.93 | (267) |
| Electri | city for I | ighting | | | | (232 | 2) x | | | 0.5 | 19 | = | 196.89 | (268) |
| Energy Item 1 | / saving | /genera | tion tech | nologies | i | | | | | 0.5 | 19 | = | -385.47 | (269) |
| Total C | CO2, kg/ | /year | | | | | | | sum c | of (265)(2 | 271) = | | 890.27 | (272) |
| Dwelli | ng CO2 | Emissi | ion Rate | • | | | | | (272) | ÷ (4) = | | | 10.62 |](273) |
| EI ratir | ng (secti | ion 14) | | | | | | | | | | | 91 | (274) |
| | | | | | | | | | | | | | | |



| | | | User E | Details: | | | | | | |
|--|-----------------------|--|-----------------|-----------------------|--------------|-------------------|----------|-----------|------------------------|----------------|
| Assessor Name: | David Lloy | d | | Strom | a Num | ber: | | STRO | 006228 | |
| Software Name: | Stroma FS | AP 2012 | | Softwa | are Ver | sion: | | Versio | on: 1.0.3.10 | |
| | 2nd Eloor B | CS DV | Property | Address | : 2nd Flo | or B GS | S PV | | | |
| 1. Overall dwelling dime | nsions: | 03 F V | | | | | | | | |
| | | | Are | a(m²) | | Av. He | ight(m) | | Volume(m ³ | [;]) |
| Ground floor | | | 8 | 33.85 | (1a) x | 2 | 2.5 | (2a) = | 209.62 | (3a) |
| Total floor area TFA = (1a | a)+(1b)+(1c)+ | (1d)+(1e)+ | (1n) 👔 | 33.85 | (4) | | | | | |
| Dwelling volume | | | | | (3a)+(3b) |)+(3c)+(3d | l)+(3e)+ | .(3n) = | 209.62 | (5) |
| 2. Ventilation rate: | | | | | | | | | | |
| | main heating | seconc heatin | lary g | other | | total | | | m ³ per hou | r |
| Number of chimneys | 0 | + 0 | + | 0 | = | 0 | X 4 | 40 = | 0 | (6a) |
| Number of open flues | 0 | + 0 | + | 0 | | 0 | x 2 | 20 = | 0 | (6b) |
| Number of intermittent fai | าร | | | | - Ē | 3 | x ′ | 10 = | 30 | (7a) |
| Number of passive vents | | | | | | 0 | x | 10 = | 0 | (7b) |
| Number of flueless gas fin | res | | | | Γ | 0 | x 4 | 40 = | 0 | (7c) |
| | | | | | | | | Air ob | | |
| Infiltration due to chimme | a fluce and f | | u (Zo) u (Zb) u | (70) - | F | | | Air Ch | langes per no | ur To |
| Inflitration due to chimney | /s, flues and fa | ans = $(6a) + (6b)$ r is intended. proc | +(7a)+(7b)+(| (10) = otherwise (| continue fro | 30 om (9) to (| (16) | ÷ (5) = | 0.14 | (8) |
| Number of storeys in th | e dwelling (ne | 6) | | | | | , | | 0 | (9) |
| Additional infiltration | | | | | | | [(9)- | -1]x0.1 = | 0 | (10) |
| Structural infiltration: 0. | 25 for steel or | r timber frame | or 0.35 fo | r masoni | ry constr | uction | | | 0 | (11) |
| if both types of wall are pr | esent, use the va | lue corresponding | g to the grea | ter wall are | a (after | | | | | |
| If suspended wooden f | loor, enter 0.2 | (unsealed) or | 0.1 (seale | ed), else | enter 0 | | | | 0 | (12) |
| If no draught lobby, ent | er 0.05, else e | enter 0 | | | | | | | 0 | (13) |
| Percentage of windows | and doors dr | aught stripped | I | | | | | · | 0 | (14) |
| Window infiltration | | | | 0.25 - [0.2 | 2 x (14) ÷ 1 | = [00 | | | 0 | (15) |
| Infiltration rate | | | | (8) + (10) | + (11) + (1 | 2) + (13) - | + (15) = | | 0 | (16) |
| Air permeability value, | q50, expresse | ed in cubic me | tres per ho | our per s | quare m | etre of e | nvelope | area | 5 | (17) |
| If based on air permeabili | ty value, then | (18) = [(17) ÷ 20 | +(8), otherw | ise (18) = (| (16) | | | | 0.39 | (18) |
| Air permeability value applies | s if a pressurisation | on test has been o | lone or a de | gree air pe | rmeability | is being us | sed | | | |
| Shelter factor | u | | | (20) = 1 - | [0.075 x (1 | 9)] = | | | 0.85 | (19) |
| Infiltration rate incorporat | ing shelter fac | tor | | (21) = (18 |) x (20) = | | | | 0.33 | - (21) |
| Infiltration rate modified for | or monthly wir | nd speed | | | | | | I | | |
| Jan Feb | Mar Apr | May Jur | n Jul | Aug | Sep | Oct | Nov | Dec | | |
| Monthly average wind sp | eed from Tabl | e 7 | | | | | | | | |
| (22)m= 5.1 5 | 4.9 4.4 | 4.3 3.8 | 3.8 | 3.7 | 4 | 4.3 | 4.5 | 4.7 | | |
| Wind Eactor $(22a)m = (22a)m $ | 2)m $\div 4$ | | | | | | | | - | |
| (22a)m= 1.27 1.25 | 1.23 1.1 | 1.08 0.95 | 0.95 | 0.92 | 1 | 1.08 | 1.12 | 1.18 | | |
| | I | | | 1 | I | L | I | | I | |



| Adjust | ed infiltr | ation rat | e (allow | ing for sh | nelter an | d wind s | peed) = | (21a) x | (22a)m | | | | _ | |
|------------------------------|--------------------------|----------------------------|---------------------------|----------------------------|--------------------------|-------------------------|----------------------|------------------------|----------------|-------------|-------------|-----------|----------|-------|
| | 0.43 | 0.42 | 0.41 | 0.37 | 0.36 | 0.32 | 0.32 | 0.31 | 0.33 | 0.36 | 0.38 | 0.39 | | |
| Calcul If m | late etter | ctive air | change | rate for t | he appli | cable ca | se | | | | | | | (220) |
| lf exh | haust air h | eat pump | using App | endix N. (2 | ² 3b) = (23a | a) x Fmv (e | equation (N | N5)), othe | rwise (23b |) = (23a) | | | 0 | (23a) |
| lf bal | anced with | h heat reco | overv: effic | iencv in % | allowing f | or in-use f | actor (from | n Table 4h |) = |) (200) | | | 0 | |
| a) If | halance | nd mech | anicalv | antilation | with he | at recove | arv (MI\/F | HR) (24a | $^{\prime}$ | 2b)m + (' | 23h) v [· | 1 _ (23c) | <u> </u> | (230) |
| (24a)m= | | | | | | | | | | | | |] | (24a) |
| () If | halance | d mech | anical ve | | without | heat rec | noverv (N | 1 /1\/) (24h | 1 - (22) | 2b)m + (ʻ | 23h) | |] | |
| (24b)m= | | | | | | | | | 0 | | 0 | 0 | 1 | (24b) |
| c) If | whole h | | tract ver | L tilation (| l | l input y | l | n from c | L | | | | J | |
| 0) 11 | if (22b)r | n < 0.5 > | < (23b), † | then (24 | c) = (23b |); otherv | vise (24 | c) = (22k | o) m + 0. | .5 × (23b |)) | | | |
| (24c)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |] | (24c) |
| d) If | natural if (22b)r | ventilation ventilation | on or wh en (24d) | ole hous m = (221 | se positiv b)m othe | ve input v erwise (2 | ventilatio 4d)m = | on from l 0.5 + [(2 | oft 2b)m² x | 0.5] | | | | |
| (24d)m= | 0.59 | 0.59 | 0.58 | 0.57 | 0.56 | 0.55 | 0.55 | 0.55 | 0.56 | 0.56 | 0.57 | 0.58 |] | (24d) |
| Effe | ctive air | change | rate - er | nter (24a | u) or (24t | b) or (24 | c) or (24 | d) in bo | (25) | | | | 1 | |
| (25)m= | 0.59 | 0.59 | 0.58 | 0.57 | 0.56 | 0.55 | 0.55 | 0.55 | 0.56 | 0.56 | 0.57 | 0.58 |] | (25) |
| 2 1 10 | otlassa | | | | | | | 1 | | | | • | 1 | |
| ELEN | | Gros | SS (m ²) | Openin | IGS | Net Ar | ea n² | U-valı W/m2 | ne | A X U | <) | k-value | e A | Xk |
| Doors | | alea | (111-) | 11 | I | 1.01 | | | | 1.01 | | NJ/111-1 | | (26) |
| Windo | | 1 | | | | 1.91 | | /[1/(1 4)+ | 0.041 - [| T.91 | | | | (20) |
| Windo | | | | | | 3.99 | | /[1/(1.4)) | 0.041 | 5.29 | | | | (27) |
| Windo | ws Type | - 2 | | | | 6.26 | | /[1/(1.4)+ | 0.04] = | 8.3 | | | | (27) |
| windo | ws type Ture 4 | : | | | | 2.16 | X | /[1/(1.4)+ | 0.04] = | 2.86 | ╡╷ | | | (27) |
| vvalis | турет | 73. | 1 | 12.4 | 1 | 60.69 |) × | 0.18 | = [| 10.92 | | | \dashv | (29) |
| Walls | Type2 | 20.0 |)4 | 1.91 | | 18.13 | 3 X | 0.18 | = | 3.26 | | | | (29) |
| l otal a | area of e | elements | , m² | | | 93.14 | <u> </u> | | | | | | | (31) |
| Party | wall | | | | | 32.61 | X | 0 | = | 0 | | | | (32) |
| * for win | ndows and de the area | l roof wind as on both | ows, use e sides of in | βfective wi αternal wal | indow U-va Is and par | alue calcul titions | ated using | g formula 1 | /[(1/U-valı | ıe)+0.04] a | is given in | paragraph | ז 3.2 | |
| Fabric | heat los | ss, W/K | = S (A x | U) | io ana pan | | | (26)(30) |) + (32) = | | | | 32.55 | (33) |
| Heat c | apacity | Cm = S(| (Axk) | , | | | | | ((28) | (30) + (32 | 2) + (32a). | (32e) = | 17709.11 | (34) |
| Therm | al mass | parame | eter (TMI | P = Cm - | + TFA) ir | n kJ/m²K | | | Indica | tive Value: | Medium | | 250 | (35) |
| For des can be t | ign asses: used inste | sments wh ad of a de | ere the de tailed calc | atails of the | construct | ion are not | t known pr | recisely the | e indicative | e values of | TMP in T | able 1f | | |
| Therm | al bridg | es : S (L | . x Y) cal | culated | using Ap | pendix ł | < | | | | | | 6.14 | (36) |
| <i>if details</i> Total f | s of therma abric he | al bridging at loss | are not kr | 10wn (36) = | = 0.15 x (3 | 1) | | | (33) + | (36) = | | | 38.69 | (37) |
| Ventila | ation hea | at loss ca | alculated | d monthly | y | | | | (38)m | = 0.33 × (| 25)m x (5) |) | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |] | |
| (38)m= | 40.87 | 40.62 | 40.38 | 39.26 | 39.05 | 38.07 | 38.07 | 37.89 | 38.45 | 39.05 | 39.48 | 39.92 | 1 | (38) |
| Heat t | ransfer o | coefficie | nt, W/K | | | | | • | (39)m | = (37) + (3 | 38)m | • | • | |
| (39)m= | 79.55 | 79.31 | 79.07 | 77.95 | 77.74 | 76.76 | 76.76 | 76.58 | 77.14 | 77.74 | 78.16 | 78.61 | | |
| | • | - | • | • | • | • | • | - | • | Average = | Sum(39)1 | | 77.95 | (39) |



| Heat lo | oss para | meter (H | HLP), W | /m²K | | | | | (40)m | = (39)m ÷ | - (4) | | | |
|-------------------|------------------------|------------------------|--|--------------------------|--------------------------|-------------------------|---------------------|------------------------|-----------------------|-------------------|------------------------|----------|---------|------|
| (40)m= | 0.95 | 0.95 | 0.94 | 0.93 | 0.93 | 0.92 | 0.92 | 0.91 | 0.92 | 0.93 | 0.93 | 0.94 | | _ |
| Numbe | er of day | vs in mo | nth (Tab | le 1a) | | | | | , | Average = | Sum(40) ₁ . | 12 /12= | 0.93 | (40) |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | | |
| (41)m= | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | | (41) |
| | | | | | | | | | | | | | | |
| 4. Wa | ater heat | ting ene | rgy requ | irement: | | | | | | | | kWh/ye | ear: | |
| Assum if TF | ied occu | ipancy, 9, N = 1 | N + 1.76 x | : [1 - exp | (-0.0003 | 349 x (TF | -A -13.9 |)2)] + 0.(| 0013 x (⁻ | TFA -13. | 2. .9) | 53 | | (42) |
| Annua Reduce | l averag | e hot wa al average | ater usa hot water | ge in litre usage by | es per da 5% if the d | ay Vd,av Iwelling is | erage = designed | (25 x N) to achieve | + 36 a water us | se target o | 94 f | .33 | | (43) |
| normore | | | | | | | | A | 0.00 | Ort | Neu | Dee | l | |
| Hot wate | Jan er usage ii | ⊢eb n litres per | dav for ea | Apr ach month | Vd.m = fa | Jun ctor from 7 | JUI Table 1c x | Aug (43) | Sep | Oct | NOV | Dec | | |
| (44)m- | 103.76 | 99 99 | 96.22 | 92.45 | 88.67 | 84.9 | 84.9 | 88.67 | 92.45 | 96.22 | 99 99 | 103 76 | | |
| (++) | 100.70 | 00.00 | 50.22 | 52.45 | 00.07 | 04.0 | 04.5 | 00.07 | 52.45 | Total = Su | m(44)1_12 = | 100.70 | 1131.98 | (44) |
| Energy o | content of | hot water | used - cal | culated m | onthly = 4. | 190 x Vd,r | n x nm x D | OTm / 3600 |) kWh/mor | nth (see Ta | ables 1b, 1 | c, 1d) | | |
| (45)m= | 153.88 | 134.58 | 138.88 | 121.08 | 116.18 | 100.25 | 92.9 | 106.6 | 107.88 | 125.72 | 137.23 | 149.02 | | |
| lf instan | taneous w | ater heati | ng at point | of use (no | o hot water | r storage), | enter 0 in | boxes (46 |) to (61) | Total = Su | m(45) ₁₁₂ = | - | 1484.21 | (45) |
| (46)m= | 23.08 | 20.19 | 20.83 | 18.16 | 17.43 | 15.04 | 13.93 | 15.99 | 16.18 | 18.86 | 20.58 | 22.35 | | (46) |
| Water | storage | loss: | | | | | | | | | | | | |
| Storag | e volum | e (litres) | | ng any se | Diar or W | /WHRS | storage | within sa | ame ves | sel | | 0 | | (47) |
| If comi Otherw | munity n vise if no | eating a | nd no ta hot wate | INK IN AW Pr (this in | /elling, e ocludes i | nter 110 nstantar | Iltres in | (47) Imbi boil | ers) ente | r '0' in <i>(</i> | (47) | | | |
| Water | storage | loss: | not wate | | | notantai | | | | | | | | |
| a) If m | nanufact | urer's de | eclared I | oss facto | or is kno | wn (kWł | n/day): | | | | | 0 | | (48) |
| Tempe | erature fa | actor fro | m Table | 2b | | | | | | | | 0 | | (49) |
| Energy | / lost fro | m water | · storage | , kWh/ye | ear | | | (48) x (49) |) = | | | 0 | | (50) |
| b) If m | nanufact | urer's de | eclared of the second s | cylinder | loss fact | or is not | known: | | | | | _ | I | (54) |
| | munity h | age loss leating s | ee secti | on 4.3 | ie z (kvv | n/iitre/ua | iy) | | | | | 0 | | (51) |
| Volum | e factor | from Ta | ble 2a | 011 1.0 | | | | | | | | 0 | | (52) |
| Tempe | erature fa | actor fro | m Table | 2b | | | | | | | | 0 | | (53) |
| Energy | / lost fro | m water | · storage | , kWh/ye | ear | | | (47) x (51) |) x (52) x (| 53) = | | 0 | | (54) |
| Enter | (50) or (| (54) in (5 | 55) | | | | | | | | | 0 | | (55) |
| Water | storage | loss cal | culated | for each | month | | | ((56)m = (| 55) × (41)ı | m | | | | |
| (56)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | (56) |
| If cylinde | er contains | s dedicate | d solar sto | rage, (57) | m = (56)m | x [(50) – (| H11)] ÷ (5 | 0), else (5 | 7)m = (56) | m where (| H11) is fro | m Append | ix H | |
| (57)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | (57) |
| Primar | y circuit | loss (ar | nual) fro | om Table | e 3 | | - | - | - | | | 0 | | (58) |
| Primar | y circuit | loss cal | culated | for each | month (| 59)m = (| (58) ÷ 36 | 65 × (41) | m | | | | - | |
| (moo | dified by | factor f | rom Tab | le H5 if t | here is s | solar wat | er heati | ng and a | cylinde | r thermo | stat) | | | |
| (59)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | (59) |



| Combi | loss ca | lculated | for eac | ch month | (61)m = | (60) ÷ | 365 × (41 |)m | | | | | | | |
|----------|-----------|----------------|-----------------|---------------|-----------|--------------|------------------|--------------|---------|-------------|------------|----------------|------------|----------------------|-----------|
| (61)m= | 50.96 | 46.02 | 49.03 | 45.59 | 45.19 | 41.87 | 7 43.26 | 45. | 19 | 45.59 | 49.03 | 49.31 | 50.96 |] | (61) |
| Total h | eat req | uired for | water | heating c | alculate | d for ea | ach month | (62) | m = | 0.85 × (| (45)m + | - (46)m + | (57)m · | – + (59)m + (61)m | |
| (62)m= | 204.84 | 180.61 | 187.91 | 166.67 | 161.36 | 142.1 | 2 136.16 | 151 | .79 | 153.47 | 174.75 | 186.54 | 199.98 |] | (62) |
| Solar DH | W input | calculated | using Ap | opendix G o | r Appendi | x H (neg | ative quantit | y) (ent | ter '0' | if no sola | r contribu | ution to wate | er heating |) | |
| (add ad | dditiona | I lines if | FGHR | S and/or | WWHR | S applie | es, see Ap | penc | dix G | 6) | - | | | _ | |
| (63)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |) | 0 | 0 | 0 | 0 | | (63) |
| FHRS | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |) | 0 | 0 | 0 | 0 | | (63) (G2) |
| Output | from w | ater hea | ter | | | | | | | | | | | | |
| (64)m= | 204.84 | 180.61 | 187.91 | 166.67 | 161.36 | 142.1 | 2 136.16 | 151 | .79 | 153.47 | 174.75 | 186.54 | 199.98 | | _ |
| | | | | | | | | | Outp | ut from wa | ater heat | er (annual) | 112 | 2046.2 | (64) |
| Heat g | ains fro | m water | heatin | g, kWh/m | onth 0.2 | 25 ´ [0.8 | 35 × (45)m | n + (6 | 61)m |] + 0.8 × | (46)n | n + (57)m | ı + (59)r | n] | |
| (65)m= | 63.9 | 56.26 | 58.44 | 51.66 | 49.93 | 43.8 | 41.7 | 46. | 74 | 47.27 | 54.06 | 57.96 | 62.29 | | (65) |
| inclu | de (57) | m in calo | culatior | n of (65)m | only if | cylinde | r is in the | dwell | ling | or hot w | ater is | from com | munity | – heating | |
| 5. Int | ernal g | ains (see | e Table | 5 and 5a |): | | | | | | | | | | |
| Metabo | olic gair | ns (Table | e 5). Wa | atts | | | | | | | | | | | |
| | Jan | Feb | Mar | Apr | May | Jur | n Jul | A | ug | Sep | Oct | Nov | Dec | 7 | |
| (66)m= | 126.59 | 126.59 | 126.59 |) 126.59 | 126.59 | 126.5 | 9 126.59 | 126 | .59 | 126.59 | 126.59 | 126.59 | 126.59 | 1 | (66) |
| Lightin | g gains | (calcula | ted in <i>i</i> | Appendix | L, equa | tion L9 | or L9a), a | lso s | iee T | Table 5 | | - | | - | |
| (67)m= | 21.48 | 19.08 | 15.52 | 11.75 | 8.78 | 7.41 | 8.01 | 10.4 | 41 | 13.98 | 17.74 | 20.71 | 22.08 | 7 | (67) |
| Appliar | nces ga | ins (calc | ulated | in Appen | dix L, ec | , quation | L13 or L1 | 3a), a | also | see Ta | ble 5 | | | - | |
| (68)m= | 227.3 | 229.66 | 223.71 | 1 211.06 | 195.09 | 180.0 | 8 170.05 | 167 | .69 | 173.63 | 186.28 | 202.26 | 217.27 | 7 | (68) |
| Cookin | ig gains | (calcula | ted in | Appendix | L, equa | tion L1 | 5 or L15a |), als | o se | e Table | 5 | - I | 1 | _ | |
| (69)m= | 35.66 | 35.66 | 35.66 | 35.66 | 35.66 | 35.66 | 35.66 | 35. | 66 | 35.66 | 35.66 | 35.66 | 35.66 | 7 | (69) |
| Pumps | and fa | ns gains | (Table | 9 5a) | | 1 | | | | | | - I | | | |
| (70)m= | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 7 | (70) |
| Losses | s e.a. ev | ı /aporatio | n (nea | ative valu | es) (Tal | ole 5) | - 1 | | | | | | 1 | | |
| (71)m= | -101.27 | -101.27 | -101.2 | 7 -101.27 | -101.27 | -101.2 | .7 -101.27 | -101 | .27 | -101.27 | -101.27 | -101.27 | -101.27 | 7 | (71) |
| Water | heating | u dains (T | i able 5 |) | | | ! | | | | | | | _ | |
| (72)m= | 85.89 | 83.71 | 78.54 | 71.74 | 67.1 | 60.83 | 3 56.05 | 62. | 83 | 65.65 | 72.66 | 80.5 | 83.72 | 7 | (72) |
| Total i | nternal | aains = | I | | | | 66)m + (67)n | ן 1 + (68 | 3)m + | (69)m + (| (70)m + (| 71)m + (72 |)m | | |
| (73)m= | 398.65 | 396.43 | 381.75 | 5 358.53 | 334.95 | 312.3 | 3 298.09 | 304 | 1.9 | 317.23 | 340.67 | 367.44 | 387.05 | 7 | (73) |
| 6. Sol | ar dain | s: | <u> </u> | | | 1 | | I | | | | | | | |
| Solar g | ains are | calculated | using so | lar flux from | Table 6a | and ass | ociated equa | ations | to co | nvert to th | e applica | able orienta | tion. | | |
| Orienta | ation: | Access F | actor | Area | l | F | lux | | | g_ | | FF | | Gains | |
| | - | Table 6d | | m² | | Т | able 6a | | Та | able 6b | - | Table 6c | | (W) | |
| North | 0.9x | 0.77 | | × 6.: | 26 | x | 10.63 | x | | 0.63 | x | 0.7 | = | 20.34 | (74) |
| North | 0.9x | 0.77 | | x 2. | 16 | × | 10.63 | x | | 0.63 | | 0.7 | = | 7.02 | (74) |
| North | 0.9x | 0.77 | | × 6.: | 26 | x 🗌 | 20.32 | x | | 0.63 | × [| 0.7 | = | 38.88 | (74) |

x

0.63

x

0.7

x

2.16

x

20.32

North

0.9x

0.77

13.41

(74)



| North | 0.9x | 0.77 | | x | 6.2 | 6 | x | 3 | 4.53 |] x | | 0.63 | × | 0.7 | = | 66.06 | (74) |
|---------|-----------|------------|---------|--------------|-----------|---------|--|--------|----------|-------|--------|-------------------|--------|--------|--------|----------|------|
| North | 0.9x | 0.77 | | x | 2.1 | 6 | x | 3 | 4.53 |] x | | 0.63 | × | 0.7 | = | 22.79 | (74) |
| North | 0.9x | 0.77 | | x | 6.2 | 6 | x | 5 | 5.46 |] x | | 0.63 | × | 0.7 | = = | 106.11 | (74) |
| North | 0.9x | 0.77 | | x | 2.1 | 6 | x | 5 | 5.46 | x | | 0.63 | × | 0.7 | = = | 36.61 | (74) |
| North | 0.9x | 0.77 | | x | 6.2 | 6 | x | 7 | 4.72 |] x | | 0.63 | × | 0.7 | = | 142.94 | (74) |
| North | 0.9x | 0.77 | | x | 2.1 | 6 | x | 7 | 4.72 | × | | 0.63 | × | 0.7 | = | 49.32 | (74) |
| North | 0.9x | 0.77 | | x | 6.2 | 6 | x | 7 | 9.99 | x | | 0.63 | x | 0.7 | = | 153.02 | (74) |
| North | 0.9x | 0.77 | | x | 2.1 | 6 | x | 7 | 9.99 | x | | 0.63 | × | 0.7 | = | 52.8 | (74) |
| North | 0.9x | 0.77 | | x | 6.2 | 6 | x | 7 | 4.68 | x | | 0.63 | x | 0.7 | = | 142.87 | (74) |
| North | 0.9x | 0.77 | | x | 2.1 | 6 | x | 7 | 4.68 | x | | 0.63 | × | 0.7 | = | 49.3 | (74) |
| North | 0.9x | 0.77 | | x | 6.2 | 6 | x | 5 | 9.25 | x | | 0.63 | x | 0.7 | = | 113.35 | (74) |
| North | 0.9x | 0.77 | | x | 2.1 | 6 | x | 5 | 9.25 | x | | 0.63 | x | 0.7 | = | 39.11 | (74) |
| North | 0.9x | 0.77 | | x | 6.2 | 6 | x | 4 | 1.52 | x | | 0.63 | x | 0.7 | = | 79.43 | (74) |
| North | 0.9x | 0.77 | | x | 2.1 | 6 | x | 4 | 1.52 | x | | 0.63 | x | 0.7 | = | 27.41 | (74) |
| North | 0.9x | 0.77 | | x | 6.2 | 6 | x | 2 | 4.19 | x | | 0.63 | x | 0.7 | = | 46.28 | (74) |
| North | 0.9x | 0.77 | | x | 2.1 | 6 | x | 2 | 4.19 | x | | 0.63 | x | 0.7 | = | 15.97 | (74) |
| North | 0.9x | 0.77 | | x | 6.2 | 6 | x | 1 | 3.12 | x | | 0.63 | x | 0.7 | = | 25.1 | (74) |
| North | 0.9x | 0.77 | | x | 2.1 | 6 | x | 1 | 3.12 | x | | 0.63 | x | 0.7 | = | 8.66 | (74) |
| North | 0.9x | 0.77 | | x | 6.2 | 6 | x | 8 | 3.86 | x | | 0.63 | x | 0.7 | = | 16.96 | (74) |
| North | 0.9x | 0.77 | | x | 2.1 | 6 | x | 8 | 3.86 | x | | 0.63 | x | 0.7 | = | 5.85 | (74) |
| South | 0.9x | 0.77 | | x | 3.9 | 9 | x | 4 | 6.75 | x | | 0.63 | x | 0.7 | = | 57.01 | (78) |
| South | 0.9x | 0.77 | | x | 3.9 | 9 | x | 7 | 6.57 | x | | 0.63 | x | 0.7 | = | 93.37 | (78) |
| South | 0.9x | 0.77 | | x | 3.9 | 9 | x | 9 | 7.53 | x | | 0.63 | x | 0.7 | = | 118.93 | (78) |
| South | 0.9x | 0.77 | | x | 3.9 | 9 | x | 1 | 10.23 | x | | 0.63 | × | 0.7 | = | 134.42 | (78) |
| South | 0.9x | 0.77 | | x | 3.9 | 9 | x | 1 | 14.87 | x | | 0.63 | x | 0.7 | = | 140.07 | (78) |
| South | 0.9x | 0.77 | | x | 3.9 | 9 | x | 1 | 10.55 | x | | 0.63 | × | 0.7 | = | 134.8 | (78) |
| South | 0.9x | 0.77 | | x | 3.9 | 9 | x | 10 | 08.01 | x | | 0.63 | × | 0.7 | = | 131.71 | (78) |
| South | 0.9x | 0.77 | | x | 3.9 | 9 | x | 10 | 04.89 | x | | 0.63 | × | 0.7 | = | 127.91 | (78) |
| South | 0.9x | 0.77 | | x | 3.9 | 9 | x | 1 | 01.89 | x | | 0.63 | × | 0.7 | = | 124.24 | (78) |
| South | 0.9x | 0.77 | | x | 3.9 | 9 | x | 8 | 2.59 | x | | 0.63 | × | 0.7 | = | 100.7 | (78) |
| South | 0.9x | 0.77 | | x | 3.9 | 9 | x | 5 | 5.42 | × | | 0.63 | × | 0.7 | = | 67.58 | (78) |
| South | 0.9x | 0.77 | | x | 3.9 | 9 | x | 4 | 40.4 | x | | 0.63 | x | 0.7 | = | 49.26 | (78) |
| | | | | | | | | | | | | | | | | | |
| Solar (| gains in | watts, ca | alculat | ted | for each | 1 mont | h 1 a | 840.62 | 323.87 | (83)m | 1 = Sl | um(74)m 231.07 | (82)m | 101 33 | 72.07 | 1 | (83) |
| Total c | ains - i | nternal a | nd so | " Jar | (84)m = | : (73)n | <u>† </u> | (83)m | watts | 200 | .30 | 231.07 | 102.90 | 101.33 | 12.01 | | (00) |
| (84)m= | 483.02 | 542.09 | 589.5 | 54 T | 635.67 | 667.29 | | 600)m | 621.96 | 585 | .27 | 548.3 | 503.62 | 468.77 | 459.12 | 1 | (84) |
| 7 140 | | | orotu | ro (| booting | | | | | 1 | | | | | [| J | |
| Temr | erature | during b | | re (n ne | eriods ir | the liv | /ind | area | from Tak | ole Q | Th | 1 (°C) | | | | 21 | (85) |
| Utilis | ation fac | ctor for a | ains fo | or li | vina are | a. h1 | m (s | see Ta | ble 9a) | | , | | | | | | |
| 2 | Jan | Feb | Ma | ır T | Apr | May | / | Jun | Jul | A | ug I | Sep | Oct | Nov | Dec |] | |
| (86)m= | 1 | 1 | 0.99 | , | 0.97 | 0.89 | | 0.71 | 0.54 | 0.5 | 59 | 0.84 | 0.98 | 1 | 1 | 4 | (86) |
| | L | | l | | | | | | l | I | | | | 1 | I | _ | |



| Mean | interna | l temper | ature in | living are | ea T1 (fo | ollow ste | ps 3 to 7 | in Tabl | e 9c) | | | | | |
|---------|-------------------------|-----------|------------|------------|-----------|-------------|-----------|-------------|------------|--------------|-------------------------|------------|---------|-------|
| (87)m= | 20.02 | 20.14 | 20.35 | 20.62 | 20.85 | 20.97 | 21 | 20.99 | 20.92 | 20.63 | 20.28 | 20 | | (87) |
| Temp | erature | during h | neating p | periods ir | n rest of | dwelling | from Ta | ble 9, Tl | h2 (°C) | | | | | |
| (88)m= | 20.13 | 20.13 | 20.13 | 20.14 | 20.14 | 20.15 | 20.15 | 20.16 | 20.15 | 20.14 | 20.14 | 20.14 | | (88) |
| Utilisa | ation fac | tor for g | ains for | rest of d | welling, | h2,m (se | e Table | 9a) | | | | | | |
| (89)m= | 1 | 1 | 0.99 | 0.95 | 0.85 | 0.63 | 0.44 | 0.49 | 0.78 | 0.97 | 0.99 | 1 | | (89) |
| Mean | interna | l temper | ature in | the rest | of dwelli | ing T2 (fo | ollow ste | eps 3 to 7 | 7 in Tabl | e 9c) | | | | |
| (90)m= | 18.8 | 18.99 | 19.29 | 19.68 | 19.99 | 20.13 | 20.15 | 20.15 | 20.08 | 19.71 | 19.2 | 18.78 | | (90) |
| | | | | | | | | | f | LA = Livin | g area ÷ (4 | 4) = | 0.39 | (91) |
| Mean | interna | l temper | ature (fo | or the wh | ole dwe | lling) = fl | _A × T1 | + (1 – fL | .A) × T2 | | | | | |
| (92)m= | 19.28 | 19.44 | 19.7 | 20.05 | 20.33 | 20.46 | 20.48 | 20.48 | 20.41 | 20.07 | 19.62 | 19.26 | | (92) |
| Apply | adjustn | nent to t | he mear | n internal | temper | ature fro | m Table | 4e, whe | ere appro | opriate | | | | |
| (93)m= | 19.28 | 19.44 | 19.7 | 20.05 | 20.33 | 20.46 | 20.48 | 20.48 | 20.41 | 20.07 | 19.62 | 19.26 | | (93) |
| 8. Spa | ace hea | ting req | uirement | t | | | | | | | | | | |
| Set T | i to the r ilisation | nean int | ternal ter | mperatui | re obtair | ned at ste | ep 11 of | Table 9 | o, so tha | t Ti,m=(| 76)m an | d re-calc | ulate | |
| | Jan | Feb | Mar | Apr | Mav | Jun | Jul | Αυα | Sep | Oct | Nov | Dec | | |
| Utilisa | ation fac | tor for g | ains, hm |): | | | | | | | | | | |
| (94)m= | 1 | 0.99 | 0.98 | 0.95 | 0.86 | 0.67 | 0.48 | 0.53 | 0.8 | 0.97 | 0.99 | 1 | | (94) |
| Usefu | I gains, | hmGm | , W = (9 | 4)m x (84 | 4)m | | | | | | | | | |
| (95)m= | 481.6 | 538.72 | 580.6 | 606.03 | 573.37 | 434.24 | 296.34 | 309.4 | 439.89 | 486.04 | 465.73 | 458.11 | | (95) |
| Month | nly avera | age exte | ernal tem | perature | e from Ta | able 8 | | | | | | | | |
| (96)m= | 4.3 | 4.9 | 6.5 | 8.9 | 11.7 | 14.6 | 16.6 | 16.4 | 14.1 | 10.6 | 7.1 | 4.2 | | (96) |
| Heat | loss rate | e for me | an interr | al tempe | erature, | Lm , W = | =[(39)m : | x [(93)m | – (96)m |] | | | | |
| (97)m= | 1191.73 | 1153.44 | 1043.93 | 869.11 | 670.79 | 450.07 | 298.16 | 312.69 | 486.95 | 736.25 | 978.7 | 1183.7 | | (97) |
| Space | e heatin | g requir | ement fo | r each n | nonth, k | Wh/mont | h = 0.02 | 24 x [(97] |)m – (95 |)m] x (4 | 1)m | | | |
| (98)m= | 528.33 | 413.1 | 344.71 | 189.42 | 72.49 | 0 | 0 | 0 | 0 | 186.16 | 369.34 | 539.84 | | _ |
| | | | | | | | | Tota | l per year | (kWh/year |) = Sum(9 | 8)15,912 = | 2643.38 | (98) |
| Space | e heatin | g requir | ement in | kWh/m² | ²/year | | | | | | | | 31.53 | (99) |
| 9a. En | erav rec | luiremer | nts – Ind | ividual h | eatina s | vstems i | ncludina | micro-C | CHP) | | | | | |
| Spac | e heatir | ng: | | | <u> </u> | | | | / | | | | | |
| Fracti | on of sp | ace hea | at from s | econdar | y/supple | mentary | system | | | | | | 0 | (201) |
| Fracti | on of sp | ace hea | at from n | nain syst | em(s) | | | (202) = 1 - | - (201) = | | | | 1 | (202) |
| Fracti | on of to | tal heati | ng from | main sys | stem 1 | | | (204) = (2 | 02) × [1 – | (203)] = | | | 1 | (204) |
| Efficie | ency of r | main spa | ace heat | ing syste | em 1 | | | | | | | | 93.4 | (206) |
| Efficie | ency of s | seconda | ry/suppl | ementar | y heatin | g system | n, % | | | | | | 0 | (208) |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | kWh/ye | ear |
| Space | e heatin | g requir | ement (c | alculate | d above |) | | | | | | | | |
| | 528.33 | 413.1 | 344.71 | 189.42 | 72.49 | 0 | 0 | 0 | 0 | 186.16 | 369.34 | 539.84 | | |
| (211)m | n = {[(98 |)m x (20 | 04)] } x 1 | 00 ÷ (20 |)6) | | | | | | | | | (211) |
| | 565.67 | 442.29 | 369.07 | 202.8 | 77.61 | 0 | 0 | 0 | 0 | 199.31 | 395.44 | 577.99 | | |
| | | | _ | | | | | Tota | l (kWh/yea | ar) = Sum(2) | 211) _{15,1012} | - | 2830.17 | (211) |



Space heating fuel (secondary), kWh/month

| (215)m 0 </th <th>= {[(98</th> <th>)m x (20</th> <th>)1)]}x1</th> <th>00 ÷ (20</th> <th>8)</th> <th></th> <th></th> <th></th> <th></th> <th></th> <th></th> <th></th> <th></th> <th>_</th> <th></th> | = {[(98 |)m x (20 |)1)]}x1 | 00 ÷ (20 | 8) | | | | | | | | | _ | |
|--|----------|----------------------------|-----------|-----------|----------|-----------|--------------------|------------------------|-------------|------------|-----------------------|---------------------------------|--------|--------------------------------|--------|
| Water heating 0 (215) Water heating 204.24 150.01 167.91 166.67 161.36 142.12 136.16 151.79 153.47 174.75 186.54 199.98 Efficiency of water heater 80.3 80.3 80.3 80.3 80.3 85.21 86.74 87.43 (217) Fuel for water heating, kWh/month (219)m (240)m x 100.2 (217)m 73.3 27.07 85.52 85.37 83.18 80.3 191.11 205.08 215.06 228.74 (219)m (240)m x 100.2 (217)m (217)m 73.3 27.07 85.22 193.99 176.99 169.57 189.03 191.11 205.08 215.06 228.74 (219)m (243.87 (219)m (243.87 (219)m (2423.87 (219)m 2423.87 (219)m (2423.87 (219)m (230.0)(230g)m (230.0) (230 | (215)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| Water heating Output from water heater (calculated above). 204.84 180.61 187.91 166.67 161.36 142.12 136.16 151.79 153.47 174.75 186.54 199.98 Efficiency of water heater 90.3 80.3 80.3 80.3 80.3 86.21 86.74 87.43 (217) Fuel for water heating, kWh/month (219)m 234.55 207.43 217.08 195.22 193.99 176.99 169.03 191.11 205.08 215.06 228.74 Calculated with out option of the store with a fan-assisted fue Calculate with with year Space heating fuel used KWh/year 2423.87 Calculate with a fan-assisted flue Calculate with a fan-assisted flue Calculate with year Calculate with a fan-assisted flue Space heating (main system 1) (211) x 0.216 75 (231) Calculate with year Sum of (230a)(230g) = Total electricity for tighting Calculate with water | | | | | | | | | Tota | l (kWh/yea | ar) =Sum(2 | 2 15) _{15,1012} | 2 | 0 | (215) |
| Output from water heater (calculated above) Image: calculated above) | Water | heating | J | | | | | | | | | | | | |
| Lotase Totol Tots/s1 | Output | from wa | ater hea | ter (calc | ulated a | bove) | 142.42 | 126.16 | 454 70 | 452.47 | 474 75 | 196 54 | 100.00 | 1 | |
| Lincterly of water heating $1 = 1 + 1 + 2 + 2 + 2 + 2 + 2 + 2 + 2 + 2 +$ | Efficier | 204.64 | ater hea | 107.91 | 100.07 | 101.30 | 142.12 | 130.10 | 151.79 | 153.47 | 174.75 | 160.04 | 199.96 | 00.2 | 7(216) |
| $\begin{array}{cccccccccccccccccccccccccccccccccccc$ | (217)m- | 87.33 | 87.07 | 86 56 | 85 37 | 83.18 | 80.3 | 80.3 | 80.3 | 80.3 | 85.21 | 86 74 | 87.43 | 60.3 | (217) |
| $\begin{array}{c c c c c c c c c c c c c c c c c c c $ | Eucl fo | r water | heating | k\//b/m | | 05.10 | 00.0 | 00.0 | 00.0 | 00.0 | 00.21 | 00.74 | 07.45 | | (217) |
| (219)me 234.55 207.43 217.09 195.22 193.99 176.99 169.07 189.03 191.11 205.08 215.06 228.74 (219) Total = Sum(219a) | (219)m | יישמופו <u>1 = (64)</u> | m x 100 |) ÷ (217) | m | | | | | | | | | | |
| Total = Sum(219a)_{L_{12}} = 2423.87 (219) Annual totals kWh/year 2230.17 Space heating fuel used, main system 1 2423.87 (219) Water heating fuel used 2423.87 (219) Electricity for pumps, fans and electric keep-hot 20 (230e) central heating pump: 30 (230e) boiler with a fan-assisted flue 45 (230) Total = Sum of (230a)(230g) = 75 (231) Electricity for the above, kWh/year sum of (230a)(230g) = 75 (231) Electricity for lighting Total = Serregy Emission factor Emissions KWh/year 0.216 = 611.32 (261) Space heating (main system 1) (211) x 0.216 = 611.32 (261) Space heating (secondary) (215) x 0.519 = 0 (263) Water heating (261) + (262) + (263) + (264) = = 1134.87 (264) Space and water heating (261) + (262) + (263) + (264) = = 1134.87 (265) Electricity for pumps, fans and electric keep-hot (231) x 0.519< | (219)m= | 234.55 | 207.43 | 217.09 | 195.22 | 193.99 | 176.99 | 169.57 | 189.03 | 191.11 | 205.08 | 215.06 | 228.74 | | _ |
| Annual totals kWh/year kWh/year Space heating fuel used, main system 1 2830.17 Water heating fuel used 2423.87 Electricity for pumps, fans and electric keep-hot 30 (230e) boiler with a fan-assisted flue 45 (230e) Total electricity for the above, kWh/year sum of (230a)(230g) = 75 (231) Electricity for lighting 379.37 (232) Lectricity for lighting Emergy kWh/year Emission factor Emissions kg CO2/kWh Space heating (main system 1) (211) x 0.216 = 611.32 (261) Space heating (secondary) (215) x 0.519 = 0 (263) Water heating (261) + (262) + (263) + (264) = 1134.87 (264) Space and water heating (261) + (262) + (263) + (264) = 1134.87 (265) Electricity for pumps, fans and electric keep-hot (231) x 0.519 = 136.83 (267) Electricity for jughting (232) x 0.519 = 1134.87 (265) (267) Electricity for jughting (232) x | | | | | | | | | Tota | I = Sum(2 | 19a) ₁₁₂ = | | | 2423.87 | (219) |
| Space heating fuel used, main system 12830.17Water heating fuel used2423.87Electricity for pumps, fans and electric keep-hotcentral heating pump:30(230e)boiler with a fan-assisted flue45(230e)Total electricity for the above, kWh/yearsum of (230a)(230g) =75(231)Electricity for lighting379.37(232) 12a. CO2 emissions – Individual heating systems including micro-CHP Emission factorEmissions kg CO2/kWhkg CO2/kWhSpace heating (main system 1)(211) x0(261)Space heating (secondary)(215) x0.5190(263)Water heating(211) x0.5190(264)Space and water heating(261) + (262) + (263) + (264) =1134.87(264)Space and water heating(261) + (262) + (263) + (264) =1134.87(264)Space and water heating(261) + (262) + (263) + (264) =1134.87(264)Space heating (secondary)(261) + (262) + (263) + (264) =1134.87(264)Space heating (| Annua | al totals | | | | | | | | | k | Wh/year | • | kWh/year | - |
| Water heating fuel used2423.87Electricity for pumps, fans and electric keep-hot 30 (230c)boiler with a fan-assisted flue 45 (230e)Total electricity for the above, kWh/yearsum of (230a)(230g) =Total electricity for lighting 75 (231)Electricity for lighting 379.37 (232) 12a. CO2 emissions – Individual heating systems including micro-CHPEmergy kWh/yearEmission factor kg CO2/kWhEmissions kg CO2/yearSpace heating (main system 1)(211) x 0.216 = 611.32 (261)Space heating (secondary)(215) x 0.519 = 0 (263)Water heating(219) x 0.216 = 523.56 (264)Space and water heating(261) + (262) + (263) + (264) = 1134.87 (265)Electricity for pumps, fans and electric keep-hot(231) x 0.519 = 38.93 (267)Electricity for lighting(232) x 0.519 = 196.89 (268)Total CO2, kg/yearsum of (265)(271) = 1370.69 (272) | Space | heating | fuel use | ed, main | system | 1 | | | | | | | | 2830.17 | |
| Electricity for pumps, fans and electric keep-hotcentral heating pump: 30 (230c)boiler with a fan-assisted flue 45 (230e)Total electricity for the above, kWh/yearsum of (230a)(230g) = 75 (231)Electricity for lighting 379.37 (232)12a. CO2 emissions – Individual heating systems including micro-CHPEmergy kWh/yearEmission factor kg CO2/kWhEmissions kg CO2/yearSpace heating (main system 1)(211) x 0.216 = 611.32 (261)Space heating (secondary)(215) x 0.519 = 0 (263)Water heating(219) x 0.216 = 523.56 (264)Space and water heating(261) + (262) + (263) + (264) = 1134.87 (265)Electricity for pumps, fans and electric keep-hot(231) x 0.519 = 38.93 (267)Electricity for lighting(232) x 0.519 = 196.89 (268)Total CO2, kg/yearsum of (265)(271) = 1370.69 (272) | Water | heating | fuel use | d | | | | | | | | | | 2423.87 | |
| central heating pump:30(230c)boiler with a fan-assisted flue45(230c)Total electricity for the above, kWh/yearsum of (230a)(230g) =75(231)Clectricity for lighting75(231)Clectricity for lightingEmergy kWh/yearEmission factor kg CO2/kWhEmissions kg CO2/yearSpace heating (main system 1)(211) x0.2166611.32(261)Space heating (secondary)(215) x0.216523.56(264)Space and water heating(261) + (262) + (263) + (264)=1134.87(265)Electricity for pumps, fans and electric keep-hot(231) x0.519=133.93(267)Electricity for lighting(232) x0.519=133.68Colspan="2">Colspan="2">2023.2523.25Colspan="2">Colspan="2">2.216=2.2162.2162.2162.2162.23.25Colspan="2">2.2162.2162.23.252.22.252. | Electri | city for p | oumps, f | ans and | electric | keep-ho | t | | | | | | | | |
| boiler with a fan-assisted flue 45 (230e) Total electricity for the above, kWh/year sum of (230a)(230g) = 75 (231) Electricity for lighting 379.37 (232) 12a. CO2 emissions – Individual heating systems including micro-CHP Energy Emission factor Emissions kWh/year kg CO2/kWh kg CO2/year Space heating (main system 1) (211) \times 0.216 = 611.32 (261) Space heating (secondary) (215) \times 0.519 = 0 (263) Water heating (219) \times 0.216 = 523.56 (264) Space and water heating (261) + (262) + (263) + (264) = 1134.87 (265) Electricity for pumps, fans and electric keep-hot (231) \times 0.519 = 38.93 (267) Electricity for lighting (232) \times 0.519 = 196.89 (268) Total CO2, kg/year | centra | al heatin | ig pump | : | | | | | | | | | 30 |] | (230c) |
| Total electricity for the above, kWh/yearsum of $(230a)(230g) =$ 75(231)Electricity for lighting379.37(232) 12a. CO2 emissions – Individual heating systems including micro-CHP Energy kWh/yearEmission factor kg CO2/kWhEmissions kg CO2/yearSpace heating (main system 1)(211) \times 0.216=611.32(261)Space heating (secondary)(215) \times 0.519=0(263)Water heating(219) \times 0.216=523.56(264)Space and water heating(261) + (262) + (263) + (264) =1134.87(265)Electricity for pumps, fans and electric keep-hot(231) \times 0.519=38.93(267)Electricity for lighting(232) \times 0.519=196.89(268)Total CO2, kg/yearsum of (265)(271) =1370.69(272) | boiler | with a f | an-assis | sted flue | | | | | | | | | 45 | | (230e) |
| Electricity for lighting 379.37 (232) 12a. CO2 emissions – Individual heating systems including micro-CHP Energy kWh/yearEmission factor kg CO2/kWhEmissions kg CO2/kWhSpace heating (main system 1) $(211) \times$ 0.216 $=$ Space heating (secondary) $(215) \times$ 0.519 $=$ Water heating $(219) \times$ 0.216 $=$ 523.56 Space and water heating $(261) + (262) + (263) + (264) =$ 1134.87 (265) Electricity for pumps, fans and electric keep-hot $(231) \times$ 0.519 $=$ 38.93 (267) Electricity for lighting $(232) \times$ 0.519 $=$ 196.89 (268) Total CO2, kg/yearsum of $(265)(271) =$ 1370.69 (272) | Total e | electricity | / for the | above, ł | (Wh/yea | r | | | sum | of (230a). | (230g) = | | | 75 | (231) |
| 12a. CO2 emissions – Individual heating systems including micro-CHPEnergy kWh/yearEmission factor kg CO2/kWhEmissions kg CO2/yearSpace heating (main system 1) $(211) \times $ $0.216 =$ 611.32 (261)Space heating (secondary) $(215) \times $ $0.519 =$ 0 (263)Water heating $(219) \times $ $0.216 =$ 523.56 (264)Space and water heating $(261) + (262) + (263) + (264) =$ 1134.87 (265)Electricity for pumps, fans and electric keep-hot $(231) \times $ $0.519 =$ 38.93 (267)Electricity for lighting $(232) \times $ $0.519 =$ 196.89 (268)Total CO2, kg/yearsum of (265)(271) = 1370.69 (272) | Electri | city for li | ghting | | | | | | | | | | | 379.37 | (232) |
| Energy kWh/yearEmission factor kg CO2/kWhEmissions kg CO2/kearSpace heating (main system 1) $(211) \times$ 0.216 = 611.32 (261) Space heating (secondary) $(215) \times$ 0.519 = 0 (263) Water heating $(219) \times$ 0.216 = 523.56 (264) Space and water heating $(261) + (262) + (263) + (264) =$ 1134.87 (265) Electricity for pumps, fans and electric keep-hot $(231) \times$ 0.519 = 38.93 (267) Electricity for lighting $(232) \times$ 0.519 = 196.89 (268) Total CO2, kg/yearsum of $(265)(271) =$ 1370.69 (272) | 12a. (| CO2 em | issions - | – Individ | ual heat | ing syste | ems inclu | uding mi | cro-CHP |) | | | | | |
| Space heating (main system 1) $(211) \times$ 0.216 = 611.32 (261) Space heating (secondary) $(215) \times$ 0.519 = 0 (263) Water heating $(219) \times$ 0.216 = 523.56 (264) Space and water heating $(261) + (262) + (263) + (264) =$ 1134.87 (265) Electricity for pumps, fans and electric keep-hot $(231) \times$ 0.519 = 38.93 (267) Electricity for lighting $(232) \times$ 0.519 = 196.89 (268) Total CO2, kg/yearsum of $(265)(271) =$ 1370.69 (272) | | | | | | | En kW | ergy /h/year | | | Emiss kg CO | ion fac 2/kWh | tor | Emissions kg CO2/yea | ar |
| Space heating (secondary) $(215) \times$ 0.519 = 0 (263) Water heating $(219) \times$ 0.216 = 523.56 (264) Space and water heating $(261) + (262) + (263) + (264) =$ 1134.87 (265) Electricity for pumps, fans and electric keep-hot $(231) \times$ 0.519 = 38.93 (267) Electricity for lighting $(232) \times$ 0.519 = 196.89 (268) Total CO2, kg/yearsum of $(265)(271) =$ 1370.69 (272) | Space | heating | (main s | ystem 1) |) | | (217 | l) x | | | 0.2 | 16 | = | 611.32 | (261) |
| Water heating $(219) \times$ 0.216 = 523.56 (264) Space and water heating $(261) + (262) + (263) + (264) =$ 1134.87 (265) Electricity for pumps, fans and electric keep-hot $(231) \times$ 0.519 = 38.93 (267) Electricity for lighting $(232) \times$ 0.519 = 196.89 (268) Total CO2, kg/yearsum of $(265)(271) =$ 1370.69 (272) | Space | heating | (second | dary) | | | (21 | 5) x | | | 0.5 | 19 | = | 0 | (263) |
| Space and water heating (261) + (262) + (263) + (264) = 1134.87 (265) Electricity for pumps, fans and electric keep-hot (231) x 0.519 = 38.93 (267) Electricity for lighting (232) x 0.519 = 196.89 (268) Total CO2, kg/year sum of (265)(271) = 1370.69 (272) | Water | heating | | | | | (219 | 9) x | | | 0.2 | 16 | = | 523.56 | (264) |
| Electricity for pumps, fans and electric keep-hot (231) x 0.519 = 38.93 (267) Electricity for lighting (232) x 0.519 = 196.89 (268) Total CO2, kg/year sum of (265)(271) = 1370.69 (272) | Space | and wa | ter heati | ng | | | (26 | I) + (262) | + (263) + (| 264) = | | | | 1134.87 | (265) |
| Electricity for lighting (232) x 0.519 = 196.89 (268) Total CO2, kg/year sum of (265)(271) = 1370.69 (272) | Electri | city for p | oumps, f | ans and | electric | keep-ho | t (23 ⁻ | I) x | | | 0.5 | 19 | = | 38.93 | (267) |
| Total CO2, kg/year sum of (265)(271) = 1370.69 (272) | Electri | city for li | ghting | | | | (232 | 2) x | | | 0.5 | 19 | = | 196.89 | (268) |
| | Total C | CO2, kg/ | year | | | | | | | sum o | of (265)(2 | 271) = | | 1370.69 | (272) |

TER =

16.35 (273)



SAP 2012 Overheating Assessment

Calculated by Stroma FSAP 2012 program, produced and printed on 09 August 2016

Property Details: 2nd Floor B GS PV

| Dwelling type: Located in: Region: Cross ventilation p Number of storeys: Front of dwelling fa Overshading: Overhangs: Thermal mass para Night ventilation: Blinds, curtains, sh Ventilation rate dur | ossible: aces: meter: nutters: ring hot wa | eather (a | ich): | Flat England Thames v Yes 1 West Average o as detaile Indicative False Dark-colo 3 (Windo | valley or unknown od below e Value Medium oured curtain or r ows open half the | oller blind e time) | | |
|--|--|--------------------------------------|---|--|---|---|---|----------------------|
| Overneating Detail | э. | | | | | | | |
| Summer ventilation Transmission heat Summer heat loss | n heat loss loss coeff coefficien | s coeffic ficient: t: | ient: | 207.53 40.2 247.72 | | | | (P1) (P2) |
| Overhangs: | | | | | | | | |
| Orientation: | Ratio | : | Z_overhangs: | | | | | |
| South (South) North (North 1) North (North 2) | 1.19 0.71 0.71 | | 0.48 0.87 0.87 | | | | | |
| Solar shading: | | | | | | | | |
| Orientation: | Z blin | ds: | Solar access: | Ove | erhangs: | Z summer: | | |
| South (South) North (North 1) North (North 2) | 0.85 0.85 0.85 | | 1 1 1 | 0.48 0.87 0.87 | 3 7 7 | 0.41 0.74 0.74 | | (P8) (P8) (P8) |
| Solar gains: | | | | | | | | |
| Orientation South (South) North (North 1) North (North 2) | 1 x 1 x 1 x | Area 3.99 6.26 2.16 | Flux 112.21 81.19 81.19 | g _ 0.72 0.72 0.72 | FF 0.7 0.7 0.7 | Shading 0.41 0.74 0.74 Total | Gains 82.94 170.2 58.73 311.86 | (P3/P4) |
| Internal gains: | | | | | | | | |
| Internal gains Total summer gains Summer gain/loss ra Mean summer extern Thermal mass temper Threshold temperatu Likelihood of high | itio nal tempera erature inci ure internal te | ature (T rement mperatu | hames valley) I re | J 4 7 3 1 0 1 1 N | une 49.23 82.86 .16 6 .25 9.41 lot significant | July 430.92 742.78 3 17.9 0.25 21.15 Slight | August 439.31 707.28 2.86 17.8 0.25 20.91 Slight | (P5) (P6) (P7) |
| Assessment of like | lihood of | high inte | ernal temperatu | re: <u>S</u> | liaht | | | |



Regulations Compliance Report

Approved Document L1A, 2013 Edition, England assessed by Stroma FSAP 2012 program, Version: 1.0.3.10 *Printed on 09 August 2016 at 13:36:38*

| Project Information | h: | | | | |
|--|--|--|---|-------------------|-------------|
| Assessed By: | David Lloyd (STRO | 006228) | Building T | Type: Flat | |
| Dwelling Details: | | | | | |
| NEW DWELLING | DESIGN STAGE | | Total Floor | r Area: 116.37ı | m² |
| Site Reference : | 52 Holmes Rd | | Plot Refer | rence: Top | Floor GS PV |
| Address : | Top Floor GS PV | | | | |
| Client Details: | | | | | |
| Name: Address : | | | | | |
| This report covers It is not a complete | items included wit e report of regulation | hin the SAP calculation ons compliance. | IS. | | |
| 1a TER and DER | | | | | |
| Fuel for main heatin | ng system: Mains gas | 6 | | | |
| Fuel factor: 1.00 (m | ains gas) (ido Emission Poto (| | 17 60 kg | n/m2 | |
| Dwelling Carbon Di | oxide Emission Rate (| | 11.47 kg | μ/m² | ОК |
| 1b TFEE and DFE | E | | | , | |
| Target Fabric Energ | gy Efficiency (TFEE) | | 58.7 kW | h/m² | |
| Dwelling Fabric Ene | ergy Efficiency (DFE | E) | 48.2 kW | h/m² | |
| | | | | | OK |
| 2 Fabric U-values | 5 | Averege | Lighoot | | |
| Element External w | all | $0.20 (max_0.30)$ | 0.20 (max | 0.70) | ОК |
| Floor | | (no floor) | 0.20 (110). | 0.10) | ÖK |
| Roof | | 0.15 (max. 0.20) | 0.15 (max. | . 0.35) | ОК |
| Openings | | 1.09 (max. 2.00) | 1.10 (max. | 3.30) | ОК |
| 2a Thermal bridg | ing | | | | |
| Thermal b | ridging calculated fro | m linear thermal transmi | ttances for each junctio | 'n | |
| 3 Air permeability | / | | | | |
| Air permeabi Maximum | lity at 50 pascals | | 5.00 (de 10.0 | sign value) | ОК |
| 4 Heating efficien |)cv | | | | |
| Main Heating | i system: | Database: (rev 396, pro | duct index 017556): | | |
| | , -, | Boiler systems with radi Brand name: Worcester Model: Greenstar Model qualifier: 29CDi ((Combi) Efficiency 89.1 % SEDB Minimum 88.0 % | ators or underfloor hea Classic ErP 3UK2009 | ting - mains ga | is OK |
| Secondary h | eating system: | None | | | |

Regulations Compliance Report



| 5 Cylinder insulation | | | |
|---------------------------------|------------------------|---------------------------------------|----|
| Hot water Storage: | No cylinder | | |
| 6 Controls | | | |
| | | | |
| Space heating controls | TTZC by plumbing and e | lectrical services | ОК |
| Hot water controls: | No cylinder | | |
| Boiler interlock: | Yes | | ОК |
| 7 Low energy lights | | | |
| Percentage of fixed lights with | n low-energy fittings | 100.0% | |
| Minimum | | 75.0% | OK |
| 8 Mechanical ventilation | | | |
| Not applicable | | | |
| 9 Summertime temperature | | | |
| Overheating risk (Thames va | lley): | Not significant | ОК |
| Based on: | | - | |
| Overshading: | | Average or unknown | |
| Windows facing: South | | 5.8m ² | |
| Windows facing: North | | 6.26m ² | |
| Windows facing: North | | 2.16m ² | |
| Windows facing: North | | 6.2m ² | |
| Windows facing: South | | 6.22m ² | |
| Windows facing: South | | 1.58m ² | |
| Ventilation rate: | | 6.00 | |
| Blinds/curtains: | | Dark-coloured curtain or roller blind | b |
| | | Closed 100% of daylight hours | |
| 10 Key features | | | |
| Windows U-value | | 1 1 W/m²K | |
| Doors U-value | | 1 W/m²K | |
| Photovoltaic array | | | |



Top Floor GS PV

Dwelling type: Date of assessment: Produced by: Total floor area: Top floor Flat 09 August 2016 David Lloyd 116.37 m²

Environmental Impact (CO₂) Rating

This is a Predicted Energy Assessment for a property which is not yet complete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, an Energy Performance Certificate is required providing information about the energy performance of the completed property.

Energy performance has been assessed using the SAP 2012 methodology and is rated in terms of the energy use per square metre of floor area, energy efficiency based on fuel costs and environmental impact based on carbon dioxide (CO2) emissions.

Energy Efficiency Rating



The energy efficiency rating is a measure of the overall efficiency of a home. The higher the rating the more energy efficient the home is and the lower the fuel bills are likely to be. The environmental impact rating is a measure of a home's impact on the environment in terms of carbonn dioxide (CO2) emissions. The higher the rating the less impact it has on the environment.



| | | | | | User [| Details: | | | | | | |
|---|-------------------------|-------------------------------------|--|-------------|--------------|----------------------------|--------------|-------------|------------|-----------|-------------------------|---|
| Assessor Name: | Dav | id Lloy | b | | | Strom | a Num | ber: | | STRO | 006228 | |
| Software Name: | Stro | ma FS | AP 201 | 2 | | Softwa | are Ver | sion: | | Versio | on: 1.0.3.10 | |
| | | | | P | roperty | Address | : Top Flo | or GS F | ٧٧ | | | |
| Address : | Тор | Floor G | S PV | | | | | | | | | |
| 1. Overall dwelling dim | ensions | | | | ۸ro | a(m²) | | | iaht(m) | | Volume(m ³) | |
| Ground floor | | | | | | a(III-) 16.37 | (1a) x | 2 | 2.5 | (2a) = | 290.93 | (3a) |
| Total floor area TFA = (| 1a)+(1b) |)+(1c)+(| 1d)+(1e |)+(1n |) 1 | 16.37 | (4) | | | | | |
| Dwelling volume | | | | | | | (3a)+(3b) |)+(3c)+(3d |)+(3e)+ | .(3n) = | 290.93 | (5) |
| 2. Ventilation rate: | | - | | • | | | | | | | <u> </u> | |
| Number of chimneys | n h | nain eating | se h □ + □ | eating | у Л + Г | other | 7 = Г | | x 4 | 40 = | m³ per houi | <u>,</u> 1(6a) |
| Number of open flues | | 0 | | 0 | 」 L コ + ୮ | 0 | 」 L ヿ _ Γ | 0 | x 2 | 20 = | 0 | |
| Number of intermittent f | | 0 | | 0 |] L | 0 | | 0 | | 10 - | 0 | |
| | ans | | | | | | Ļ | 4 | | 10 = | 40 | (/a) |
| Number of passive vent | S | | | | | | Ĺ | 0 | X ' | 10 = | 0 | (7b) |
| Number of flueless gas | fires | | | | | | | 0 | X 4 | 40 = | 0 | (7c) |
| | | | | | | | | | | Air ch | anges per ho | ur |
| Infiltration due to chimne | eys, flue | es and fa | ans = (6 | a)+(6b)+(7 | a)+(7b)+ | (7c) = | | 40 | | ÷ (5) = | 0.14 | (8) |
| If a pressurisation test has | been carr | ried out or | is intende | ed, proceed | d to (17), | otherwise o | continue fro | om (9) to (| (16) | | | _ |
| Number of storeys in | the dwe | lling (ns | 5) | | | | | | | | 0 | (9) |
| Additional infiltration | 0 25 for | stool or | timbord | romo or | 0 25 fo | r macan | av constr | uction | [(9)- | -1]x0.1 = | 0 | $\begin{bmatrix} (10) \\ \hline (11) \end{bmatrix}$ |
| if both types of wall are deducting areas of oper | present, u | steer of se the val qual user | umber i lue corres _i 0.35 | ponding to | the grea | ter wall are | a (after | uction | | | 0 | |
| If suspended wooden | floor, ei | nter 0.2 | (unseal | ed) or 0. | 1 (seal | ed), else | enter 0 | | | | 0 | (12) |
| If no draught lobby, e | nter 0.08 | 5, else e | enter 0 | | | | | | | | 0 | (13) |
| Percentage of windov | vs and d | loors dr | aught st | ripped | | | | | | | 0 | (14) |
| Window infiltration | | | | | | 0.25 - [0.2 | x (14) ÷ 1 | = [00 | | | 0 | (15) |
| Infiltration rate | | | | | | (8) + (10) | + (11) + (1 | 2) + (13) - | + (15) = | | 0 | (16) |
| Air permeability value | , q50, e: ility volu | xpresse | d in cub (18) - [(1)] | (C metre) | s per he | our per s vise (18) – (| quare m | etre of e | nvelope | area | 5 | $= \begin{pmatrix} (17) \\ (10) \end{pmatrix}$ |
| Air permeability value appl | inty valu | essurisatio | on test has | s been don | e or a de | aree air pe | rmeability | is beina us | sed | | 0.39 | (18) |
| Number of sides shelter | ed | | | | | 5 · · · /· · | , | J | | | 2 | (19) |
| Shelter factor | | | | | | (20) = 1 - | [0.075 x (1 | 9)] = | | | 0.85 | (20) |
| Infiltration rate incorpora | ating she | elter fac | tor | | | (21) = (18 |) x (20) = | | | | 0.33 | (21) |
| Infiltration rate modified | for mon | thly win | d speed | | | | | | | | 1 | |
| Jan Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | | |
| Monthly average wind s | peed fro | om Tabl | e 7 | | | | | | | | | |
| (22)m= 5.1 5 | 4.9 | 4.4 | 4.3 | 3.8 | 3.8 | 3.7 | 4 | 4.3 | 4.5 | 4.7 | | |
| Wind Factor (22a)m = (2 | 22)m ÷ 4 | 1 | | | | | | | | | | |
| (22a)m= 1.27 1.25 | 1.23 | 1.1 | 1.08 | 0.95 | 0.95 | 0.92 | 1 | 1.08 | 1.12 | 1.18 | | |
| | | | | | | | | | | | | |



| Adjuste | ed infiltr | ation rat | e (allowi | ing for sh | elter an | d wind s | peed) = | (21a) x | (22a)m | | | | | |
|--------------------|------------------------|--------------------------------|--------------------------------|---------------------|--------------------------|----------------|----------------|----------------|-------------|----------------|-------------|--------------------|------------|---------------|
| | 0.42 | 0.41 | 0.4 | 0.36 | 0.35 | 0.31 | 0.31 | 0.3 | 0.33 | 0.35 | 0.37 | 0.39 | | |
| Calcula If me | ate ette echanic: | <i>ctive air</i> al ventila | cnange i ition: | rate for ti | ne applik | cable ca | se | | | | | | 0 | (23a) |
| lf exh | aust air h | eat pump | using Appe | endix N, (2 | 3b) = (23a |) × Fmv (e | equation (N | N5)), othe | rwise (23b |) = (23a) | | | 0 | (23b) |
| lf bala | anced wit | h heat reco | overy: effic | iency in % | allowing for | or in-use f | actor (from | n Table 4h |) = | , , , | | | 0 | (23c) |
| a) If | balance | ed mech: | , anical ve | entilation | with her | at recove | erv (MVF | HR) (24a | n)m = (22) | 2b)m + (| 23b) x [′ | l – (23c) | ∸ 1001 | (200) |
| (24a)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |] | (24a) |
| b) If | balance | ed mecha | I anical ve | entilation | without | heat rec | L coverv (N | L /IV) (24b |)m = (22 | L 2b)m + (; | 1 23b) | | | |
| (24b)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | (24b) |
| c) If | whole h | i ouse ex | ract ver | ntilation c | or positiv | re input v | ventilatio | n from c | outside | | | | | |
| i | if (22b)r | n < 0.5 × | (23b), t | then (24c | c) = (23b |); otherv | wise (24 | c) = (22b | o) m + 0. | 5 × (23b |) | | | |
| (24c)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | (24c) |
| d) If | natural | ventilatio | on or wh | ole hous | e positiv | ve input | ventilatio | on from I | oft | • | • | | | |
| i | if (22b)r | n = 1, th | en (24d) | m = (22t |)m othe | rwise (2 | 4d)m = (| 0.5 + [(2 | 2b)m² x | 0.5] | r | | l | |
| (24d)m= | 0.59 | 0.58 | 0.58 | 0.57 | 0.56 | 0.55 | 0.55 | 0.55 | 0.55 | 0.56 | 0.57 | 0.57 | | (24d) |
| Effe | ctive air | change | rate - er | nter (24a |) or (24b | o) or (24 | c) or (24 | d) in boy | (25) | i | i | | I | |
| (25)m= | 0.59 | 0.58 | 0.58 | 0.57 | 0.56 | 0.55 | 0.55 | 0.55 | 0.55 | 0.56 | 0.57 | 0.57 | | (25) |
| 3. He | at losse | s and he | eat loss p | paramete | er: | | | | | | | | | |
| ELEN | IENT | Gros area | ss (m²) | Openin m | gs ² | Net Ar A ,r | ea n² | U-valı W/m2 | le K | A X U (W/I | <) | k-value kJ/m²⋅ł | e ≺ | A X k kJ/K |
| Doors | | | | | | 1.91 | x | 1 | = | 1.91 | | | | (26) |
| Windo | ws Type | e 1 | | | | 5.8 | x1/ | /[1/(1.1)+ | 0.04] = | 6.11 | _ | | | (27) |
| Window | ws Type | e 2 | | | | 6.26 | x1/ | /[1/(1.1)+ | 0.04] = | 6.6 | = | | | (27) |
| Windov | ws Type | e 3 | | | | 2.16 | x1/ | /[1/(1.1)+ | 0.04] = | 2.28 | | | | (27) |
| Windo | ws Type | e 4 | | | | 6.2 | | /[1/(1.1)+ | 0.04] = | 6.53 | = | | | (27) |
| Windo | ws Type | e 5 | | | | 6.22 | | /[1/(1.1)+ | 0.04] = | 6.55 | = | | | (27) |
| Windov | ws Type | e 6 | | | | 1.58 | | /[1/(1.1)+ | 0.04] = | 1.66 | = | | | (27) |
| Walls ⁻ | | 133 | 89 | 28.22 | > | 105.6 | 7 X | 0.2 | | 21 13 | | | - | (29) |
| Walls ⁻ | Tvpe2 | 43.1 | 7 | 1 91 | | 41.26 | | 0.10 | | 7 77 | ╡┟ | | \dashv | (29) |
| Roof | .,,,,,, | 116 | 27 | 1.01 | | 116.20 | | 0.15 | | 17.46 | ╡┟ | | \dashv | (30) |
| Total a | irea of e | | | | | 202.4 | 2 | 0.10 | [| 17.40 | | | | (31) |
| * for win | dows and | l roof wind as on both | , ows, use e sides of ir | effective wil | ndow U-va is and part | alue calcul | ated using | formula 1 | /[(1/U-valu | ie)+0.04] a | ns given in | paragraph | 3.2 | |
| Fabric | heat los | ss. W/K : | = S (A x | U) | o ana part | | | (26)(30) | + (32) = | | | | 78 | (33) |
| Heat c | apacity | Cm = S(| (Axk) | - / | | | | | ((28) | .(30) + (32 | 2) + (32a). | (32e) = | 21826.0 | 5 (34) |
| Therm | al mass | parame | ter (TMF | ⁻ = Cm ÷ | TFA) in | ı kJ/m²K | | | Indica | tive Value | Medium | | 250 | (35) |
| For desi | gn asses used inste | sments wh | ere the de | tails of the | , constructi | on are not | t known pr | ecisely the | indicative | values of | TMP in Ta | able 1f | | (```' |
| Therm | al brida | es : S (L | x Y) cal | culated u | using Ap | pendix ł | < | | | | | | 14.04 | (36) |
| if details | of therma | al bridging | , are not kn | own (36) = | : 0.15 x (3 | 1) | | | | | | | | ` ´ |
| Total fa | abric he | at loss | | | | | | | (33) + | (36) = | | | 92.05 | (37) |



| Ventila | ation hea | at loss ca | alculated | monthl | у | | | | (38)m | = 0.33 × (| 25)m x (5) | | | |
|----------------|------------|------------------------|---------------|------------------------|----------------|-------------|--------------|------------|-----------------------|-------------|------------------------|----------|---------|------|
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | | |
| (38)m= | 56.47 | 56.14 | 55.82 | 54.3 | 54.02 | 52.7 | 52.7 | 52.46 | 53.21 | 54.02 | 54.59 | 55.19 | | (38) |
| Heat t | ransfer o | coefficie | nt, W/K | | | | | | (39)m | = (37) + (3 | 38)m | | | |
| (39)m= | 148.51 | 148.19 | 147.86 | 146.35 | 146.07 | 144.75 | 144.75 | 144.5 | 145.26 | 146.07 | 146.64 | 147.24 | | |
| | | | | | | | | | | Average = | Sum(39)1 | 12 /12= | 146.35 | (39) |
| Heat lo | oss para | meter (I | HLP), W | /m²K | | | | | (40)m | = (39)m ÷ | (4) | | | |
| (40)m= | 1.28 | 1.27 | 1.27 | 1.26 | 1.26 | 1.24 | 1.24 | 1.24 | 1.25 | 1.26 | 1.26 | 1.27 | 4.00 | (40) |
| Numb | er of day | /s in mo | nth (Tab | le 1a) | | | | | , | Average = | Sum(40)1. | 12 / 12= | 1.20 | (40) |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | | |
| (41)m= | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | | (41) |
| | | | - | | - | - | | - | - | - | - | | | |
| 4. Wa | ater heat | ting ene | rgy requ | irement: | | | | | | | | kWh/ye | ear: | |
| | | | | | | | | | | | | | | |
| Assum if TF | A > 13 | ipancy, 9 N = 1 | N + 1 76 x | [1 - exp | (-0 0003 | 349 x (TF | - A -13 9 |)2)] + 0 (|)013 x (⁻ | TFA -13 | 2. | 85 | | (42) |
| if TF | A £ 13.9 | 9, N = 1 | | | (0.0000 | | |)_)] · ••• | | | •) | | | |
| Annua | l averag | e hot wa | ater usag | ge in litre | es per da | ay Vd,av | erage = | (25 x N) | + 36 | a targat a | 10 ⁻ | 1.84 | | (43) |
| not mor | e that 125 | litres per | person pe | r day (all w | ater use, l | hot and co | ld) | o acriieve | a waler us | se largel u | I | | | |
| | lan | Feb | Mar | Anr | May | lun | lul | Διια | Sen | Oct | Nov | Dec | | |
| Hot wat | er usage i | n litres per | r day for ea | ach month | Vd,m = fa | ctor from 1 | Table 1c x | (43) | 0ep | | NOV | Dec | | |
| (44)m= | 112.03 | 107.95 | 103.88 | 99.81 | 95.73 | 91.66 | 91.66 | 95.73 | 99.81 | 103.88 | 107.95 | 112.03 | | |
| () | | | 100100 | | | 01100 | 0.000 | | | Total = Su | m(44) ₁₁₂ = | | 1222.12 | (44) |
| Energy | content of | hot water | used - ca | culated me | onthly $= 4$. | 190 x Vd,r | n x nm x D | 0Tm / 3600 |) kWh/mor | nth (see Ta | ables 1b, 1 | c, 1d) | | |
| (45)m= | 166.13 | 145.3 | 149.94 | 130.72 | 125.43 | 108.24 | 100.3 | 115.09 | 116.47 | 135.73 | 148.16 | 160.89 | | |
| | | | | | | | | | | Total = Su | m(45) ₁₁₂ = | = | 1602.39 | (45) |
| lf instan | taneous w | ater heati | ng at point | t of use (no | o hot water | r storage), | enter 0 in | boxes (46 |) to (61) | | | | | |
| (46)m= | 24.92 | 21.8 | 22.49 | 19.61 | 18.81 | 16.24 | 15.04 | 17.26 | 17.47 | 20.36 | 22.22 | 24.13 | | (46) |
| Storag | storage | 1055. 10 (litros) |) includir | na anv si | olar or M | ////HRS | storane | within s | ame ves | ما | | 0 | | (47) |
| If com | munity h | eating a | and no te | nk in dw | velling e | nter 110 | litres in | (47) | | 001 | | 0 | | (47) |
| Otherv | vise if no | o stored | hot wate | er (this in | ncludes i | nstantar | neous co | mbi boil | ers) ente | er '0' in (| 47) | | | |
| Water | storage | loss: | | , | | | | | , | , | , | | | |
| a) If n | nanufact | urer's d | eclared l | oss facto | or is kno | wn (kWł | n/day): | | | | | 0 | | (48) |
| Tempe | erature f | actor fro | m Table | 2b | | | | | | | | 0 | | (49) |
| Energ | y lost fro | m water | storage | e, kWh/ye | ear | | | (48) x (49 |) = | | | 0 | | (50) |
| b) If m | nanufact | urer's de | eclared (| cylinder com Tobl | loss fact | or is not | known: | | | | | | | (54) |
| If com | munity h | age ioss leating s | see secti | on 4.3 | | n/nne/ua | iy) | | | | | 0 | | (51) |
| Volum | e factor | from Ta | ble 2a | | | | | | | | | 0 | | (52) |
| Tempe | erature f | actor fro | m Table | 2b | | | | | | | | 0 | | (53) |
| Energy | y lost fro | m watei | r storage | , kWh/ye | ear | | | (47) x (51 |) x (52) x (| 53) = | | 0 | | (54) |
| Enter | (50) or (| (54) in (5 | 55) | - | | | | | | | | 0 | | (55) |
| Water | storage | loss cal | culated | for each | month | | | ((56)m = (| 55) × (41) | m | | | | |
| (56)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | (56) |
| | | | • | • | • | • | | • | • | • | • | · | | |



| If cylinde | er contains | s dedicate | d solar sto | rage, (57) | m = (56)m | x [(50) – (| H11)] ÷ (5 | 0), else (5 | 7)m = (56) | m where (| H11) is fro | m Append | ix H | |
|------------|--------------|------------|-------------|------------|------------|-------------|-----------------------|--------------|-------------|-----------------|-------------|-------------|---------------|-----------|
| (57)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | (57) |
| Primar | y circuit | loss (ar | nual) fro | om Table | e 3 | | | | | | | 0 | | (58) |
| Primar | y circuit | loss cal | culated | for each | month (| 59)m = (| (58) ÷ 36 | 65 × (41) | m | | | | I | |
| (mo | dified by | factor f | rom Tab | le H5 if t | here is s | solar wat | er heati | ng and a | cylinde | r thermo | stat) | | | |
| (59)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | (59) |
| Combi | loss ca | lculated | for each | month (| (61)m = | (60) ÷ 36 | 65 × (41 |)m | | | | | | |
| (61)m= | 38.44 | 34.72 | 38.44 | 37.2 | 38.44 | 37.2 | 38.44 | 38.44 | 37.2 | 38.44 | 37.2 | 38.44 | | (61) |
| Total h | eat requ | uired for | water h | eating ca | alculated | for eac | h month | (62)m = | 0.85 × (| (45)m + | (46)m + | (57)m + | (59)m + (61)m | |
| (62)m= | 204.57 | 180.02 | 188.37 | 167.92 | 163.86 | 145.43 | 138.73 | 153.53 | 153.66 | 174.17 | 185.36 | 199.33 | | (62) |
| Solar Dł | -IW input of | calculated | using App | endix G or | · Appendix | H (negati | ve quantity | /) (enter '0 | if no sola | r contribut | on to wate | er heating) | J | |
| (add a | dditiona | l lines if | FGHRS | and/or \ | WWHRS | applies | , see Ap | pendix C | S) | | | | | |
| (63)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | (63) |
| FHRS | 64.23 | 51 | 45.11 | 31.01 | 20.66 | 10.96 | 10.22 | 11.58 | 11.7 | 32.18 | 49.15 | 64.3 | ' | (63) (G2) |
| Output | from w | ater hea | ter | | | | | | | | | | | |
| (64)m= | 140.34 | 129.02 | 143.26 | 136.91 | 143.2 | 134.47 | 128.51 | 141.95 | 141.96 | 141.98 | 136.2 | 135.02 | | |
| | | | | | | | | Outp | out from wa | ater heate | r (annual)₁ | 12 | 1652.83 | (64) |
| Heat g | ains fro | m water | heating, | kWh/m | onth 0.2 | 5 ´ [0.85 | × (45)m | + (61)m | n] + 0.8 > | (46)m | + (57)m | + (59)m |] | _ |
| (65)m= | 64.85 | 56.99 | 59.46 | 52.76 | 51.31 | 45.29 | 42.96 | 47.88 | 48.02 | 54.74 | 58.56 | 63.11 | | (65) |
| inclu | ide (57) | m in calo | culation | of (65)m | only if c | ylinder i | s in the o | dwelling | or hot w | ater is fr | om com | munity h | eating | |
| 5. Int | ternal ga | ains (see | e Table 5 | 5 and 5a |): | | | | | | | | | |
| Metab | olic gain | s (Table | 5) Wat | ts | | | | | | | | | | |
| motab | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | | |
| (66)m= | 142.41 | 142.41 | 142.41 | 142.41 | 142.41 | 142.41 | 142.41 | 142.41 | 142.41 | 142.41 | 142.41 | 142.41 | | (66) |
| Lightin | g gains | (calcula | ted in Ap | pendix | L, equat | ion L9 o | r L9a), a | lso see | Table 5 | | | | I | |
| (67)m= | 25 | 22.2 | 18.06 | 13.67 | 10.22 | 8.63 | 9.32 | 12.12 | 16.26 | 20.65 | 24.1 | 25.69 | | (67) |
| Applia | nces ga | ins (calc | ulated ir | Append | dix L, eq | uation L | 13 or L1 | 3a), also | see Ta | ble 5 | | |] | |
| (68)m= | 280.41 | 283.32 | 275.99 | 260.38 | 240.67 | 222.15 | 209.78 | 206.87 | 214.2 | 229.81 | 249.52 | 268.04 | | (68) |
| Cookir | ng gains | (calcula | ted in A | ppendix | L, equat | ion L15 | or L15a |), also se | e Table | 5 | | | 1 | |
| (69)m= | 37.24 | 37.24 | 37.24 | 37.24 | 37.24 | 37.24 | 37.24 | 37.24 | 37.24 | 37.24 | 37.24 | 37.24 | | (69) |
| Pumps | and fai | ns gains | (Table { | ь | | | | | | | | | 1 | |
| (70)m= | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | | (70) |
| Losses | se.a. ev | aporatio | n (nega | tive valu | es) (Tab | le 5) | <u> </u> | | | <u> </u> | | | 1 | |
| (71)m= | -113.93 | -113.93 | -113.93 | -113.93 | -113.93 | -113.93 | -113.93 | -113.93 | -113.93 | -113.93 | -113.93 | -113.93 | | (71) |
| Water | heating | gains (T | able 5) | I | I | I | I | | | 1 | | | 1 | |
| (72)m= | 87.16 | 84.81 | 79.92 | 73.28 | 68.97 | 62.9 | 57.74 | 64.35 | 66.7 | 73.57 | 81.34 | 84.82 | | (72) |
| Total i | nternal | gains = | | ļ | ļ | (66) | u m + (67)m | ı + (68)m + | - (69)m + (| ı (70)m + (7 | 1)m + (72) | m | 1 | |
| (73)m= | 461.29 | 459.05 | 442.69 | 416.05 | 388.58 | 362.4 | 345.56 | 352.06 | 365.89 | 392.76 | 423.68 | 447.27 | | (73) |
| 6 50 | lar gains | | | | | | | | | I | | | | |

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.



| Orienta | ition: | Access Factor Table 6d | r | Area m² | | Flux Table 6a | | g_ Table 6b | | FF Table 6c | | Gains (W) | |
|---------|--------|---------------------------|---|------------|---|------------------|----------|----------------|---|----------------|------------|--------------|------|
| North | 0.9x | 0.77 | x | 6.26 | × | 10.63 |) x | 0.72 | x | 0.7 |] = | 23.25 | (74) |
| North | 0.9x | 0.77 | x | 2.16 | x | 10.63 | x | 0.72 | x | 0.7 | = | 8.02 | (74) |
| North | 0.9x | 0.77 | x | 6.2 | x | 10.63 | x | 0.72 | x | 0.7 | = | 23.03 | (74) |
| North | 0.9x | 0.77 | x | 6.26 | × | 20.32 | x | 0.72 | × | 0.7 | = | 44.43 | (74) |
| North | 0.9x | 0.77 | x | 2.16 | × | 20.32 | x | 0.72 | × | 0.7 |] = | 15.33 | (74) |
| North | 0.9x | 0.77 | x | 6.2 | × | 20.32 | x | 0.72 | × | 0.7 |] = | 44 | (74) |
| North | 0.9x | 0.77 | x | 6.26 | x | 34.53 | x | 0.72 | x | 0.7 |] = | 75.5 | (74) |
| North | 0.9x | 0.77 | x | 2.16 | x | 34.53 | x | 0.72 | x | 0.7 |] = | 26.05 | (74) |
| North | 0.9x | 0.77 | x | 6.2 | × | 34.53 | x | 0.72 | x | 0.7 |] = | 74.77 | (74) |
| North | 0.9x | 0.77 | x | 6.26 | × | 55.46 | x | 0.72 | × | 0.7 |] = | 121.27 | (74) |
| North | 0.9x | 0.77 | x | 2.16 | × | 55.46 | x | 0.72 | × | 0.7 |] = | 41.84 | (74) |
| North | 0.9x | 0.77 | x | 6.2 | × | 55.46 | x | 0.72 | × | 0.7 | = | 120.11 | (74) |
| North | 0.9x | 0.77 | x | 6.26 | × | 74.72 | x | 0.72 | × | 0.7 | = | 163.36 | (74) |
| North | 0.9x | 0.77 | x | 2.16 | x | 74.72 | x | 0.72 | x | 0.7 | = | 56.37 | (74) |
| North | 0.9x | 0.77 | x | 6.2 | × | 74.72 | x | 0.72 | × | 0.7 |] = | 161.8 | (74) |
| North | 0.9x | 0.77 | x | 6.26 | × | 79.99 | x | 0.72 | × | 0.7 | = | 174.88 | (74) |
| North | 0.9x | 0.77 | x | 2.16 | × | 79.99 | x | 0.72 | x | 0.7 |] = | 60.34 | (74) |
| North | 0.9x | 0.77 | x | 6.2 | × | 79.99 | x | 0.72 | × | 0.7 |] = | 173.21 | (74) |
| North | 0.9x | 0.77 | x | 6.26 | × | 74.68 | x | 0.72 | x | 0.7 | j = | 163.28 | (74) |
| North | 0.9x | 0.77 | x | 2.16 | x | 74.68 | x | 0.72 | x | 0.7 | = | 56.34 | (74) |
| North | 0.9x | 0.77 | x | 6.2 | × | 74.68 | x | 0.72 | × | 0.7 |] = | 161.71 | (74) |
| North | 0.9x | 0.77 | x | 6.26 | x | 59.25 | x | 0.72 | x | 0.7 |] = | 129.54 | (74) |
| North | 0.9x | 0.77 | x | 2.16 | x | 59.25 | x | 0.72 | x | 0.7 |] = | 44.7 | (74) |
| North | 0.9x | 0.77 | x | 6.2 | x | 59.25 | x | 0.72 | x | 0.7 |] = | 128.3 | (74) |
| North | 0.9x | 0.77 | x | 6.26 | x | 41.52 | x | 0.72 | x | 0.7 | = | 90.77 | (74) |
| North | 0.9x | 0.77 | x | 2.16 | x | 41.52 | x | 0.72 | x | 0.7 |] = | 31.32 | (74) |
| North | 0.9x | 0.77 | x | 6.2 | x | 41.52 | x | 0.72 | x | 0.7 |] = | 89.9 | (74) |
| North | 0.9x | 0.77 | x | 6.26 | x | 24.19 | x | 0.72 | x | 0.7 | = | 52.89 | (74) |
| North | 0.9x | 0.77 | x | 2.16 | x | 24.19 | x | 0.72 | x | 0.7 | = | 18.25 | (74) |
| North | 0.9x | 0.77 | x | 6.2 | x | 24.19 | x | 0.72 | x | 0.7 | = | 52.38 | (74) |
| North | 0.9x | 0.77 | x | 6.26 | x | 13.12 | x | 0.72 | x | 0.7 | = | 28.68 | (74) |
| North | 0.9x | 0.77 | x | 2.16 | x | 13.12 | x | 0.72 | x | 0.7 | = | 9.9 | (74) |
| North | 0.9x | 0.77 | x | 6.2 | x | 13.12 | x | 0.72 | x | 0.7 | = | 28.41 | (74) |
| North | 0.9x | 0.77 | x | 6.26 | x | 8.86 | x | 0.72 | x | 0.7 | = | 19.38 | (74) |
| North | 0.9x | 0.77 | x | 2.16 | x | 8.86 | x | 0.72 | x | 0.7 |] = | 6.69 | (74) |
| North | 0.9x | 0.77 | x | 6.2 | × | 8.86 | x | 0.72 | × | 0.7 |] = | 19.2 | (74) |
| South | 0.9x | 0.77 | x | 5.8 | × | 46.75 | x | 0.72 | × | 0.7 | = | 94.71 | (78) |
| South | 0.9x | 0.77 | x | 6.22 | × | 46.75 | x | 0.72 | × | 0.7 |] = | 101.57 | (78) |
| South | 0.9x | 0.77 | x | 1.58 | x | 46.75 | x | 0.72 | x | 0.7 |] = | 25.8 | (78) |



| South | 0.9x | 0.77 | | x | 5.8 | | x | 76.57 |] x | 0 | .72 | א ר <mark>א ר</mark> | 0.7 | | 155.11 | (78) |
|--------|-----------|-------------|---------|-----|-----------|--------|-------|----------------|------------|---------|--------|----------------------|---------|--------|--------|------|
| South | 0.9x | 0.77 | | x | 6.22 | | x | 76.57 | 」 】 x | 0 | 0.72 | ı x Г | 0.7 | = | 166.34 | (78) |
| South | 0.9x | 0.77 | | x | 1.58 | | x | 76.57 | 」 】 x | 0 | .72 | ı L TxT | 0.7 | = | 42.25 | (78) |
| South | 0.9x | 0.77 | | x | 5.8 | | x | 97.53 | 」 】 × | 0 | 0.72 | ı x I | 0.7 | = | 197.58 | (78) |
| South | 0.9x | 0.77 | | x | 6.22 | | x | 97.53 | 」 】 x | 0 | 0.72 | ı x Г | 0.7 | = | 211.89 | (78) |
| South | 0.9x | 0.77 | | x | 1.58 | | x | 97.53 | 」 】 × | 0 | .72 | ı L Ix C | 0.7 | | 53.82 | (78) |
| South | 0.9x | 0.77 | | x | 5.8 | | x | 110.23 | 」 】 × 【 | 0 | .72 | ı L X | 0.7 | = | 223.31 | (78) |
| South | 0.9x | 0.77 | | x | 6.22 | | x | 110.23 | 」 】 × | 0 | 0.72 | ı x I | 0.7 | = | 239.48 | (78) |
| South | 0.9x | 0.77 | | x | 1.58 | | x | 110.23 | 」 】 x | 0 | .72 | | 0.7 | = | 60.83 | (78) |
| South | 0.9x | 0.77 | | x | 5.8 | | x | 114.87 |] x | 0 | .72 | i x l | 0.7 | = | 232.7 | (78) |
| South | 0.9x | 0.77 | | x | 6.22 | | x | 114.87 |] x | 0 | .72 | i x i | 0.7 | = | 249.55 | (78) |
| South | 0.9x | 0.77 | | x | 1.58 | | x | 114.87 |] x | 0 | .72 | i x l | 0.7 | = | 63.39 | (78) |
| South | 0.9x | 0.77 | | x | 5.8 | | x | 110.55 |] x | 0 | .72 | i x i | 0.7 | = | 223.95 | (78) |
| South | 0.9x | 0.77 | | x | 6.22 | | x | 110.55 |] x | 0 | .72 | i x i | 0.7 | | 240.16 | (78) |
| South | 0.9x | 0.77 | = | x | 1.58 | | x | 110.55 |] x | 0 |).72 | | 0.7 | = | 61.01 | (78) |
| South | 0.9x | 0.77 | | x | 5.8 | | x | 108.01 |] × | 0 |).72 | i × i | 0.7 | | 218.81 | (78) |
| South | 0.9x | 0.77 | | x | 6.22 | | x | 108.01 |] x | 0 |).72 | i × i | 0.7 | = = | 234.65 | (78) |
| South | 0.9x | 0.77 | | x | 1.58 | | x | 108.01 |] x | 0 | .72 | i × i | 0.7 | = | 59.61 | (78) |
| South | 0.9x | 0.77 | | x | 5.8 | | x | 104.89 |] × | 0 | .72 | ī × i | 0.7 | = | 212.49 | (78) |
| South | 0.9x | 0.77 | | x | 6.22 | | x | 104.89 | x | 0 | .72 | i × i | 0.7 | = | 227.88 | (78) |
| South | 0.9x | 0.77 | | x | 1.58 | | x | 104.89 | x | 0 | .72 | - × | 0.7 | = | 57.89 | (78) |
| South | 0.9x | 0.77 | | x | 5.8 | | x | 101.89 |] × | 0 | .72 | ī × Ī | 0.7 | = | 206.4 | (78) |
| South | 0.9x | 0.77 | | x | 6.22 | | x | 101.89 | x | 0 | .72 | × | 0.7 | = | 221.34 | (78) |
| South | 0.9x | 0.77 | | x | 1.58 | | x | 101.89 | x | 0 | .72 | - × | 0.7 | = | 56.23 | (78) |
| South | 0.9x | 0.77 | | x | 5.8 | | x | 82.59 | x | 0 | .72 | × | 0.7 | = | 167.3 | (78) |
| South | 0.9x | 0.77 | | x | 6.22 | | x | 82.59 | x | 0 | .72 | × | 0.7 | = | 179.41 | (78) |
| South | 0.9x | 0.77 | | x | 1.58 | | x | 82.59 | _ × | 0 | .72 | x | 0.7 | = | 45.57 | (78) |
| South | 0.9x | 0.77 | | x | 5.8 | | x | 55.42 | x | 0 | .72 | × | 0.7 | = | 112.26 | (78) |
| South | 0.9x | 0.77 | | x | 6.22 | | x | 55.42 | x | 0 | .72 | × | 0.7 | = | 120.39 | (78) |
| South | 0.9x | 0.77 | | x | 1.58 | | x | 55.42 | x | 0 | .72 | × | 0.7 | = | 30.58 | (78) |
| South | 0.9x | 0.77 | | x | 5.8 | | x | 40.4 | x | 0 |).72 | × | 0.7 | = | 81.84 | (78) |
| South | 0.9x | 0.77 | | x | 6.22 | | x | 40.4 | x | 0 | .72 | × | 0.7 | = | 87.76 | (78) |
| South | 0.9x | 0.77 | | x | 1.58 | | x | 40.4 | x | 0 |).72 | × | 0.7 | = | 22.29 | (78) |
| | | | | | | | | | | | | | | | | |
| Solar | gains in | watts, ca | lculate | ed | for each | month | ۱ | | (83)m | ı = Sum | (74)m | .(82)m | · · · · | | 1 | |
| (83)m= | 276.37 | 467.47 | 639.62 | 2 | 806.85 | 927.17 | 9 | 33.55 894.39 | 800 | .79 6 | 95.97 | 515.81 | 330.22 | 237.16 | J | (83) |
| rotal | gains – i | Internal ar | nd sol | ar | (84)m = (| (73)m | + (| 83)m , watts | i | | | | | | 1 | |
| (84)m= | 737.67 | 926.52 | 1082.3 | 1 | 1222.9 1 | 315.76 | 12 | 295.95 1239.95 | 1152 | 2.85 10 | 061.85 | 908.57 | 753.9 | 684.43 | | (84) |
| 7 14 | a a la ta | | | ~ 1 | | | | | | | | | | | | |

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

Utilisation factor for gains for living area, h1,m (see Table 9a)

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

21

(85)



| (86)m= | 1 | 0.99 | 0.98 | 0.94 | 0.84 | 0.67 | 0.5 | 0.56 | 0.8 | 0.96 | 0.99 | 1 | | (86) |
|----------|------------|-----------|-----------|--------------------|-------------|-------------|--------------|-------------|------------|-------------|-------------------------|------------|---------|---------|
| Mean | interna | l temper | ature in | living are | ea T1 (fo | ollow ste | ps 3 to 7 | 7 in Tabl | e 9c) | | | | | |
| (87)m= | 19.62 | 19.84 | 20.14 | 20.51 | 20.8 | 20.95 | 20.99 | 20.98 | 20.88 | 20.49 | 19.98 | 19.58 | | (87) |
| Temp | erature | during h | neating p | beriods ir | n rest of | dwelling | from Ta | able 9, Tl | h2 (°C) | | | | | |
| (88)m= | 19.86 | 19.86 | 19.86 | 19.87 | 19.88 | 19.89 | 19.89 | 19.89 | 19.88 | 19.88 | 19.87 | 19.87 | | (88) |
| Utilisa | ation fac | tor for g | ains for | rest of d | welling, | h2,m (se | e Table | 9a) | | | | | | |
| (89)m= | 1 | 0.99 | 0.97 | 0.92 | 0.78 | 0.57 | 0.38 | 0.43 | 0.72 | 0.94 | 0.99 | 1 | | (89) |
| Mean | interna | l temper | ature in | the rest | of dwelli | ng T2 (f | ollow ste | eps 3 to 7 | 7 in Tabl | le 9c) | | | | |
| (90)m= | 18.04 | 18.36 | 18.79 | 19.31 | 19.68 | 19.85 | 19.88 | 19.88 | 19.79 | , 19.3 | 18.57 | 17.99 | | (90) |
| | | | | | | | | | f | fLA = Livin | g area ÷ (4 | 4) = | 0.28 | (91) |
| Mean | interna | l temper | ature (fc | or the wh | ole dwe | llina) = fl | LA × T1 | + (1 – fL | A) × T2 | | | • | | _ |
| (92)m= | 18.49 | 18.78 | 19.18 | 19.65 | 20 | 20.16 | 20.2 | 20.19 | 20.1 | 19.64 | 18.97 | 18.44 | | (92) |
| Apply | adjustn | nent to t | he mear | n internal | l temper | ature fro | m Table | 4e, whe | ere appro | opriate | | | | |
| (93)m= | 18.49 | 18.78 | 19.18 | 19.65 | 20 | 20.16 | 20.2 | 20.19 | 20.1 | 19.64 | 18.97 | 18.44 | | (93) |
| 8. Sp | ace hea | ting requ | uirement | | | | | | | | | | | |
| Set T | i to the r | nean int | ernal ter | mperatui | re obtair | ned at ste | ep 11 of | Table 9 | o, so tha | t Ti,m=(| 76)m an | d re-calc | ulate | |
| the ut | llisation | Tactor to | or gains | | | luna | 11 | A | Can | Ort | Nov | Dee | | |
| Litilior | Jan Jan | Feb | iviar | Apr | iviay | Jun | Jui | Aug | Sep | Oct | INOV | Dec | i - | |
| (94)m= | 0.99 | 0.99 | 0.97 | 0.91 | 0.79 | 0.59 | 0.42 | 0.47 | 0.73 | 0.94 | 0.99 | 1 | | (94) |
| Usefu | l gains. | hmGm | W = (94 | 4)m x (84 | 4)m | 0.00 | 0112 | •••• | 0.1.0 | 0.01 | 0.00 | | | |
| (95)m= | 733.93 | 913.75 | 1044.92 | 1112.83 | 1037.95 | 770.88 | 515.4 | 539.4 | 780.3 | 852.74 | 745.26 | 681.92 | | (95) |
| Month | nly avera | age exte | rnal tem | perature | e from Ta | able 8 | | | | | | | | |
| (96)m= | 4.3 | 4.9 | 6.5 | 8.9 | 11.7 | 14.6 | 16.6 | 16.4 | 14.1 | 10.6 | 7.1 | 4.2 | | (96) |
| Heat | loss rate | e for mea | an interr | al tempe | erature, | Lm , W = | - =[(39)m | x [(93)m | – (96)m |] | | | | |
| (97)m= | 2107.16 | 2056.74 | 1874.46 | 1573.14 | 1212.32 | 805.41 | 520.45 | 548.07 | 871.37 | 1319.92 | 1740.39 | 2096.76 | | (97) |
| Space | e heatin | g require | ement fo | r each n | nonth, k | Wh/mon | th = 0.02 | 24 x [(97 |)m – (95 |)m] x (4 | 1)m | | | |
| (98)m= | 1021.68 | 768.09 | 617.17 | 331.42 | 129.73 | 0 | 0 | 0 | 0 | 347.59 | 716.49 | 1052.64 | | _ |
| | | | | | | | | Tota | l per year | (kWh/year | [.]) = Sum(9 | 8)15,912 = | 4984.82 | (98) |
| Space | e heatin | g require | ement in | kWh/m ² | /year | | | | | | | | 42.84 | (99) |
| 9a. En | ergy rec | uiremer | nts – Ind | ividual h | eating s | ystems i | ncluding | g micro-C | CHP) | | | - | | |
| Spac | e heatir | ng: | | | | | | | | | | | | |
| Fracti | on of sp | ace hea | at from s | econdar | y/supple | mentary | system | | | | | | 0 | (201) |
| Fracti | ion of sp | ace hea | at from m | nain syst | em(s) | | | (202) = 1 - | – (201) = | | | | 1 | (202) |
| Fracti | on of to | tal heati | ng from | main sys | stem 1 | | | (204) = (2 | 02) × [1 – | (203)] = | | | 1 | (204) |
| Efficie | ency of r | main spa | ace heat | ing syste | em 1 | | | | | | | | 90 | (206) |
| Efficie | ency of s | seconda | ry/suppl | ementar | y heatin | g systen | ו, % | | | | | | 0 | (208) |
| | Jan | Feb | Mar | Apr | Mav | Jun | Jul | Αυα | Sep | Oct | Nov | Dec | kWh/ve | l ar |
| Space | e heatin | a require | ement (c | alculate | d above |) | - Cui | , lug | 000 | | | 200 | | |
| • | 1021.68 | 768.09 | 617.17 | 331.42 | 129.73 | 0 | 0 | 0 | 0 | 347.59 | 716.49 | 1052.64 | | |
| (211)m | n = {[(98 |)m x (20 | 4)]}x1 | 00 ÷ (20 |)6) | | | | | | | | | (211) |
| . , | 1135.2 | 853.43 | 685.75 | 368.25 | , 144.15 | 0 | 0 | 0 | 0 | 386.21 | 796.1 | 1169.6 | | |
| | | | | | | | | Tota | l (kWh/yea | ar) =Sum(2 | 211) _{15,1012} | = | 5538.69 | (211) |



Space heating fuel (secondary), kWh/month

| = {[(98] |)m x (2(|)1)] } x 1 | $00 \div (20)$ | 8) | montin | | | | | | | | | |
|------------------|-------------|------------|--|----------|-----------|--------------------|-------------------------|-------------|------------|-----------------------|-------------------------|------------|--------------------------------|--------|
| (215)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| | | | | | | | | Tota | l (kWh/yea | ar) =Sum(2 | 215) _{15,1012} | <i>;</i> = | 0 | (215) |
| Water | heating | 9 | | | | | | | | | | | | _ |
| Output | from w | ater hea | $\frac{\text{ter}(\text{calc})}{143.26}$ | ulated a | bove) | 124 47 | 129.51 | 141.05 | 141.06 | 1/1 08 | 126.2 | 125.02 | 1 | |
| Efficier | 140.34 | ater hea | | 130.91 | 143.2 | 134.47 | 120.51 | 141.95 | 141.90 | 141.90 | 130.2 | 133.02 | 86.7 | 7(216) |
| (217)m= | 89.59 | 89.51 | 89.36 | 89.01 | 88.24 | 86.7 | 86.7 | 86.7 | 86.7 | 89.02 | 89.46 | 89.61 | | (217) |
| Fuel fo | or water | heating, | kWh/mo | onth | | | | | | | | | 1 | |
| (219)m | 1 = (64) | m x 100 | $) \div (217)$ | m | 162.20 | 155 1 | 149.22 | 162 72 | 162 74 | 150.5 | 152.26 | 150.69 | 1 | |
| (219)11= | 150.04 | 144.14 | 100.32 | 155.01 | 102.29 | 155.1 | 140.23 | Tota | I = Sum(2) | 19a), ₄₂ = | 152.20 | 150.00 | 1870 43 | 7(219) |
| Annua | I totals | | | | | | | | | k' | Wh/year | | kWh/year | |
| Space | heating | fuel use | ed, main | system | 1 | | | | | | , | | 5538.69 |] |
| Water | heating | fuel use | ed | | | | | | | | | | 1870.43 | Ī |
| Electric | city for p | oumps, f | ans and | electric | keep-ho | t | | | | | | | | |
| centra | al heatin | ig pump | : | | | | | | | | | 30 | | (230c) |
| boiler | with a f | an-assis | sted flue | | | | | | | | | 45 | | (230e) |
| Total e | electricity | y for the | above, l | (Wh/yea | r | | | sum | of (230a). | (230g) = | | | 75 | (231) |
| Electric | city for li | ighting | | | | | | | | | | | 441.48 | (232) |
| Electric | city gene | erated b | y PVs | | | | | | | | | | -1027.71 | (233) |
| 12a. (| CO2 em | issions | – Individ | ual heat | ing syste | ems inclu | uding mi | cro-CHF |) | | | | | |
| | | | | | | En kW | e rgy /h/year | | | Emiss kg CO | ion fac 2/kWh | tor | Emissions kg CO2/yea | ar |
| Space | heating | (main s | ystem 1 |) | | (21 | 1) x | | | 0.2 | 16 | = | 1196.36 | (261) |
| Space | heating | (secon | dary) | | | (21 | 5) x | | | 0.5 | 19 | = | 0 | (263) |
| Water | heating | | | | | (219 | 9) x | | | 0.2 | 16 | = | 404.01 | (264) |
| Space | and wa | ter heat | ng | | | (26 | 1) + (262) | + (263) + (| 264) = | | | | 1600.37 | (265) |
| Electric | city for p | oumps, f | ans and | electric | keep-ho | t (23 ⁻ | 1) x | | | 0.5 | 19 | = | 38.93 | (267) |
| Electric | city for li | ighting | | | | (232 | 2) x | | | 0.5 | 19 | = | 229.13 | (268) |
| Energy Item 1 | / saving | /genera | tion tech | nologies | i | | | | | 0.5 | 19 | = | -533.38 | (269) |
| Total C | CO2, kg/ | /year | | | | | | | sum o | of (265)(2 | 271) = | | 1335.05 | (272) |
| Dwelli | ng CO2 | Emissi | on Rate | | | | | | (272) | ÷ (4) = | | | 11.47 | (273) |
| EI ratir | ng (secti | on 14) | | | | | | | | | | | 89 | (274) |



| | | | | | User D | Details: | | | | | | |
|--|--|----------------------------------|------------------------|-------------|------------|-----------------------------|----------------------|-------------|------------|----------|-------------------------|-------------------|
| Assessor Name: | David | l | | | Strom | a Num | ber: | | STRO | 006228 | | |
| Software Name: | Strom | na FSA | AP 201 | 2 | | Softwa | are Ver | sion: | | Versio | n: 1.0.3.10 | |
| | | | | P | roperty | Address | : Top Flo | or GS F | ٧٧ | | | |
| Address : | Top Fl | loor GS | SPV | | | | | | | | | |
| 1. Overall dwelling dim | ensions: | | | | ۸ro | a(m²) | | | iaht(m) | | Volume(m ³) | |
| Ground floor | | | | | 1 | 16.37 | (1a) x | 2 | 2.5 | (2a) = | 290.93 | (3a) |
| Total floor area TFA = (1 | la)+(1b)+ | (1c)+(1 | 1d)+(1e |)+(1n |) 1 | 16.37 | (4) | | | | | |
| Dwelling volume | | | | | L | | (3a)+(3b) |)+(3c)+(3d |)+(3e)+ | .(3n) = | 290.93 | (5) |
| 2. Ventilation rate: | | _ | | | | _ | | | | | | |
| Number of chimpeys | ma hea | ain ating | se h]+ [| eating | у ヿ + Г | other | ┑_┌ | total | × 4 | 40 = | m ³ per hou | – – |
| Number of open flues | | 0 | | 0 | | 0 | | 0 | | 20 - | 0 | |
| Number of open lives | | 0 | | 0 | JĽ | 0 | 」⁻└ | 0 | | | 0 | (60) |
| Number of intermittent fa | ans | | | | | | | 4 | X 1 | 0 = | 40 | (7a) |
| Number of passive vents | S | | | | | | | 0 | x 1 | 0 = | 0 | (7b) |
| Number of flueless gas f | fires | | | | | | | 0 | x 4 | 40 = | 0 | (7c) |
| | | | | | | | | | | Air ch | anges per ho | ur |
| Infiltration due to chimne | eys, flues | and fa | ns = <mark>(6</mark> 8 | a)+(6b)+(7 | a)+(7b)+(| (7c) = | Γ | 40 | | ÷ (5) = | 0.14 | (8) |
| If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16) | | | | | | | | | | | | _ |
| Number of storeys in t | the dwelli | ng (ns) |) | | | | | | | | 0 | (9) |
| Additional infiltration |) 25 for ot | tool or | timbor f | romo or | 0.25 fo | r maaan | a constr | uction | [(9)- | 1]x0.1 = | 0 | |
| if both types of wall are p | D.25 IOI St present, use ings): if equ | e the valu | umber i Je corresj | ponding to | the grea | ter wall are | y constr a (after | uction | | | 0 | _(¹¹⁾ |
| If suspended wooden | floor, ent | er 0.2 (| unseal | ed) or 0. | 1 (seale | ed), else | enter 0 | | | | 0 | (12) |
| If no draught lobby, er | nter 0.05, | else e | nter 0 | | | | | | | | 0 | (13) |
| Percentage of window | s and do | ors dra | aught st | ripped | | | | | | | 0 | (14) |
| Window infiltration | | | | | | 0.25 - [0.2 | x (14) ÷ 1 | = [00 | | | 0 | (15) |
| Infiltration rate | | | | | | (8) + (10) | + (11) + (1 | 2) + (13) - | + (15) = | | 0 | (16) |
| Air permeability value | , q50, exp | pressed | d in cub | ic metre | s per ho | our per se | quare m | etre of e | nvelope | area | 5 | (17) |
| If based on air permeabl | ility value | , then | (18) = [(1)] | 7) ÷ 20]+(8 | s), otherw | ise (18) = (groo air po | (16) rmoobility | is hoing u | od | | 0.39 | (18) |
| Number of sides shelter | es il a piess ed | sunsauor | 1 1631 1183 | been uun | eoraue | yree all pei | ineability | is being us | seu | | 2 |] (19) |
| Shelter factor | | | | | | (20) = 1 - | [0.075 x (1 | 9)] = | | | 0.85 | (20) |
| Infiltration rate incorpora | | $(21) = (18) \times (20) = 0.33$ | | | | | | (21) | | | | |
| Infiltration rate modified | for month | nly wind | d speed | | | - | | | | | | _ |
| Jan Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | | |
| Monthly average wind s | peed from | n Table | e 7 | | | | - | | - | | | |
| (22)m= 5.1 5 | 4.9 | 4.4 | 4.3 | 3.8 | 3.8 | 3.7 | 4 | 4.3 | 4.5 | 4.7 | | |
| Wind Factor (22a)m = (2 | 22)m ÷ 4 | | | | | | | | | | | |
| (22a)m= 1.27 1.25 | 1.23 | 1.1 | 1.08 | 0.95 | 0.95 | 0.92 | 1 | 1.08 | 1.12 | 1.18 | | |
| | | | | | | | | | | | | |



| Adjuste | ed infiltra | ation rat | e (allowi | ng for sh | elter an | d wind s | peed) = | (21a) x | (22a)m | _ | | | | |
|------------------------|--------------------------|------------------------|---------------------------|-------------------------------|--------------------------|-------------------|-------------|---------------|---------------------------|---------------|-----------------------|-----------|------------|----------|
| ~ | 0.42 | 0.41 | 0.4 | 0.36 | 0.35 | 0.31 | 0.31 | 0.3 | 0.33 | 0.35 | 0.37 | 0.39 | | |
| Calcula If me | ate ettec chanica | tive air | change i ition: | rate for t | he appli | cable ca | se | | | | | | 0 | (23a) |
| lf exh | aust air he | eat pump | usina Appe | endix N. (2 | 3b) = (23a | i) x Fmv (e | equation (N | 15)) . othe | rwise (23b |) = (23a) | | | 0 | (23a) |
| lf bala | anced with | heat reco | overv: effic | iencv in % | allowing f | or in-use fa | actor (from | n Table 4h |) = | , (, | | | 0 | (230) |
| a) If | halanco | d mach | anicalve | | with hor | at recove | anu (MA)/F | | (2) | 2b)m ± (' | 23h) v [[,] | 1 _ (23c) | · 1001 | (230) |
| (24a)m= | | | | | 0 | 0 | | 0 | | | 0 | 1 - (200) | ÷ 100] | (24a) |
| (, | halanco | d mech | anical ve | | without | heat rec | | 1\/) (21h | $\int_{-\infty}^{\infty}$ | $\frac{1}{2}$ | 23h) | Ů | | |
| (24b)m= | | | | | 0 | | | 0 | | | 0 | 0 | l | (24b) |
| (2 is)iii- | | | tract ver | | | | ventilatio | n from c | | Ů | | Ŭ | | |
| i c) | f (22b)n | 1 < 0.5 | (23b), t | hen (240 | c) = (23b |); otherv | vise (24 | c) = (22k | b) m + 0. | .5 × (23b |)) | | | |
| (24c)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | (24c) |
| d) If | natural | ventilatio | on or wh | ole hous | e positiv | /e input v | ventilatio | n from l | oft | | | Į | | |
| í | f (22b)n | n = 1, th | en (24d) | m = (22k |)m othe | rwise (2 | 4d)m = (| 0.5 + [(2 | 2b)m² x | 0.5] | | | | |
| (24d)m= | 0.59 | 0.58 | 0.58 | 0.57 | 0.56 | 0.55 | 0.55 | 0.55 | 0.55 | 0.56 | 0.57 | 0.57 | | (24d) |
| Effe | ctive air | change | rate - er | nter (24a |) or (24b | o) or (24 | c) or (24 | d) in boy | (25) | - | | - | | |
| (25)m= | 0.59 | 0.58 | 0.58 | 0.57 | 0.56 | 0.55 | 0.55 | 0.55 | 0.55 | 0.56 | 0.57 | 0.57 | | (25) |
| 3. He | at losse | s and he | eat loss r | paramete | er: | | | | | | | | | |
| ELEN | IENT | Gros | SS | Openin | gs | Net Ar | ea | U-valı | Je | AXU | | k-value | 9 | AXk |
| | | area | (m²) | . m | 2 | A ,n | n² | W/m2 | K | (W/I | <) | kJ/m²∙ł | < | kJ/K |
| Doors | | | | | | 1.91 | x | 1 | = | 1.91 | | | | (26) |
| Window | ws Type | 1 | | | | 5.59 | x1/ | /[1/(1.4)+ | 0.04] = | 7.41 | | | | (27) |
| Window | ws Type | 2 | | | | 6.03 | x1/ | /[1/(1.4)+ | 0.04] = | 7.99 | | | | (27) |
| Windov | ws Type | 3 | | | | 2.08 | x1/ | /[1/(1.4)+ | 0.04] = | 2.76 | | | | (27) |
| Window | ws Type | 4 | | | | 5.97 | x1/ | /[1/(1.4)+ | 0.04] = | 7.91 | | | | (27) |
| Window | ws Type | 5 | | | | 5.99 | x1/ | /[1/(1.4)+ | 0.04] = | 7.94 | | | | (27) |
| Window | ws Type | 6 | | | | 1.52 | x1/ | /[1/(1.4)+ | 0.04] = | 2.02 | | | | (27) |
| Walls - | Гуре1 | 133. | 89 | 27.18 | 3 | 106.7 | 1 X | 0.18 | | 19.21 | Ξ r | | | (29) |
| Walls - | Гуре2 | 43.1 | 7 | 1.91 | | 41.26 | ; x | 0.18 | = [| 7.43 | ה ה | | i F | (29) |
| Roof | | 116. | 37 | 0 | | 116.3 | 7 X | 0.13 | = | 15.13 | 5 | | \dashv | (30) |
| Total a | rea of e | lements | , m² | L | | 293.4 | 3 | | (| | L | | | (31) |
| * for win ** includ | dows and e the area | roof wind s on both | ows, use e sides of in | effective wil nternal wall | ndow U-va 's and part | alue calculations | ated using | formula 1 | /[(1/U-valı | ıe)+0.04] a | ns given in | paragraph | 3.2 | |
| Fabric | heat los | s, W/K | = S (A x | U) | | | | (26)(30) | + (32) = | | | | 79.7 | 1 (33) |
| Heat c | apacity | Cm = S | (Axk) | , | | | | | ((28) | (30) + (32 | 2) + (32a). | (32e) = | 22023. | .65 (34) |
| Therm | al mass | parame | ter (TMF | ⁻ = Cm ÷ | - TFA) in | n kJ/m²K | | | Indica | tive Value: | Medium | | 250 | (35) |
| For desi can be u | gn assess ised instea | ments wh ad of a de | ere the de | tails of the | constructi | ion are not | t known pr | ecisely the | e indicative | values of | TMP in Ta | able 1f | | |
| Therm | al bridae | es : S (L | x Y) cal | culated u | using Ap | pendix ł | < | | | | | | 13.6 | 6 (36) |
| if details | of therma | l bridging | are not kn | own (36) = | = 0.15 x (3 | 1) | | | | | | | 10.00 | () |
| Total fa | abric he | at loss | | . , | · | | | 93.3 | 7 (37) | | | | | |



| Ventila | ation hea | at loss ca | alculated | d monthly | y | | | | (38)m | = 0.33 × (| 25)m x (5) | | | |
|-------------------|------------------------|----------------------|------------------------|--------------------------|------------------|-------------|--------------|--------------|-----------------------|-------------|------------------------|----------|---------|------|
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | | |
| (38)m= | 56.47 | 56.14 | 55.82 | 54.3 | 54.02 | 52.7 | 52.7 | 52.46 | 53.21 | 54.02 | 54.59 | 55.19 | | (38) |
| Heat ti | ransfer c | coefficie | nt, W/K | | | | | | (39)m | = (37) + (3 | 38)m | | | |
| (39)m= | 149.84 | 149.51 | 149.19 | 147.67 | 147.39 | 146.07 | 146.07 | 145.83 | 146.58 | 147.39 | 147.96 | 148.56 | | |
| | | | | | | | - | | | Average = | Sum(39)1. | 12 /12= | 147.67 | (39) |
| Heat lo | oss para | meter (H | HLP), W | /m²K | 4.07 | 4.00 | 4.00 | 4.05 | (40)m | = (39)m ÷ | (4) | | | |
| (40)m= | 1.29 | 1.28 | 1.28 | 1.27 | 1.27 | 1.26 | 1.26 | 1.25 | 1.26 | 1.27 | 1.27 | 1.28 | 1.07 | |
| Numbe | er of day | vs in mo | nth (Tab | le 1a) | | | | | , | Average = | Sum(40)1. | 12 / 12= | 1.27 | (40) |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | | |
| (41)m= | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | | (41) |
| | | | ! | | | | | | | | | | | |
| 4. Wa | ater heat | ting ene | ray reau | irement: | | | | | | | | kWh/yea | ar: | |
| | | Ŭ | | | | | | | | | | | | |
| Assum if TF | A > 13 | ipancy, 9 N = 1 | N + 1 76 x | [1 - exp | (-0.0003 | 349 x (TF | - A -13 9 |)2)] + 0 (|)013 x (⁻ | ΓFA -13 | <u>2.</u> 9) | 85 | | (42) |
| if TF | A £ 13.9 | 9, N = 1 | | i onp | (0.0000 | , io x (ii | | /_/] · on | | | 0) | | | |
| Annua | l averag | e hot wa | ater usag | ge in litre | es per da | ay Vd,av | erage = | (25 x N) | + 36 | o torgot o | 10 ⁻ | 1.84 | | (43) |
| not more | e that 125 | litres per | person pe | r day (all w | ater use, l | hot and co | ld) | lo acriieve | a waler us | e largel u | 1 | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Αυσ | Sen | Oct | Nov | Dec | | |
| Hot wate | er usage ii | n litres per | r day for ea | ach month | Vd,m = fa | ctor from 1 | Table 1c x | (43) | | 001 | 1107 | 000 | | |
| (44)m= | 112.03 | 107.95 | 103.88 | 99.81 | 95.73 | 91.66 | 91.66 | 95.73 | 99.81 | 103.88 | 107.95 | 112.03 | | |
| | | | | ļ | | | | | - | Fotal = Su | m(44) ₁₁₂ = | = | 1222.12 | (44) |
| Energy | content of | hot water | used - cal | culated mo | onthly $= 4$. | 190 x Vd,r | n x nm x D | 0Tm / 3600 |) kWh/mor | oth (see Ta | bles 1b, 1 | c, 1d) | | |
| (45)m= | 166.13 | 145.3 | 149.94 | 130.72 | 125.43 | 108.24 | 100.3 | 115.09 | 116.47 | 135.73 | 148.16 | 160.89 | | |
| lf instan | tanoous u | ator hooti | ng at pain | f uso (no | hot wata | r storago) | ontor 0 in | hovos (16 |) to (61) | Total = Su | m(45) ₁₁₂ = | - | 1602.39 | (45) |
| | | | | | | siorage), | | | | | 00.00 | | | (40) |
| (46)m= Water | storage | 21.8 loss: | 22.49 | 19.61 | 18.81 | 16.24 | 15.04 | 17.26 | 17.47 | 20.36 | 22.22 | 24.13 | | (46) |
| Storag | e volum | e (litres) |) includir | ng any so | olar or W | WHRS | storage | within sa | ame ves | sel | | 0 | | (47) |
| If com | munity h | eating a | and no ta | ink in dw | velling, e | enter 110 | litres in | (47) | | | | | | |
| Otherv | vise if no | stored | hot wate | er (this ir | ncludes i | nstantar | neous co | ombi boil | ers) ente | er '0' in (| 47) | | | |
| Water | storage | loss: | | <i>.</i> | | (1) • (1 | (1) | | | | | | | |
| a) If m | nanufact | urer's de | eclared I | oss facto | or is kno | wn (kvvr | n/day): | | | | | 0 | | (48) |
| i empe | erature ta | actor fro | m Table | 20 | | | | (10) (10) | | | | 0 | | (49) |
| Energy b) If m | / lost fro hanufact | m watei urer's di | r storage eclared (| e, KVVh/ye cylinder l | ear loss fact | or is not | known. | (48) X (49 |) = | | | 0 | | (50) |
| Hot wa | ater stora | age loss | factor fi | om Tabl | e 2 (kW | h/litre/da | iy) | | | | | 0 | | (51) |
| If com | munity h | eating s | see secti | on 4.3 | | | | | | | | | | |
| Volum - | e factor | from Ta | ble 2a | | | | | | | | | 0 | | (52) |
| Tempe | erature fa | actor fro | m Table | 20 | | | | | | | | 0 | | (53) |
| Energy | / lost fro | m water | r storage | e, kWh/ye | ear | | | (47) x (51) |) x (52) x (| 53) = | | 0 | | (54) |
| | | (04) IN (8 | oulotod : | for oach | month | | | ((EG)~~ (| EE) ~ (44) | ~ | | U | | (55) |
| vvaler | Siorage | | | | | | | ((00)11) = (| ວວງ x (41)I | | | | | |
| (56)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | (56) |



| If cylinde | er contains | s dedicate | d solar sto | rage, (57)ı | m = (56)m | x [(50) – (| H11)] ÷ (5 | 0), else (5 | 7)m = (56) | m where (| H11) is fro | m Append | ix H | |
|------------|--------------|------------|-------------|-------------|-----------|--------------|-------------|--------------|--------------|--------------|-------------|-------------|---------------|-----------|
| (57)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | (57) |
| Primar | y circuit | loss (ar | inual) fro | om Table | e 3 | - | - | | | | | 0 | | (58) |
| Primar | y circuit | loss cal | culated | for each | month (| 59)m = (| (58) ÷ 36 | 65 × (41) | m | | | | | |
| (mo | dified by | factor f | om Tab | le H5 if t | here is s | solar wat | er heati | ng and a | cylinde | r thermo | stat) | | | |
| (59)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | (59) |
| Combi | loss ca | lculated | for each | month (| (61)m = | (60) ÷ 36 | 65 × (41) |)m | | | | | | |
| (61)m= | 50.96 | 46.03 | 50.96 | 49.22 | 48.78 | 45.2 | 46.71 | 48.78 | 49.22 | 50.96 | 49.32 | 50.96 | | (61) |
| Total h | eat requ | uired for | water he | eating ca | alculated | for eac | h month | (62)m = | 0.85 × (| (45)m + | (46)m + | (57)m + | (59)m + (61)m | |
| (62)m= | 217.09 | 191.33 | 200.9 | 179.94 | 174.21 | 153.44 | 147 | 163.88 | 165.68 | 186.69 | 197.47 | 211.85 | | (62) |
| Solar DI | -IW input of | calculated | using App | endix G or | Appendix | H (negati | ve quantity | /) (enter '0 | ' if no sola | r contributi | on to wate | er heating) | I | |
| (add a | dditiona | l lines if | FGHRS | and/or \ | WWHRS | applies | , see Ap | pendix (| G) | | | | _ | |
| (63)m= | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | (63) |
| FHRS | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | (63) (G2) |
| Output | t from w | ater hea | ter | | | | | | | | | | | |
| (64)m= | 217.09 | 191.33 | 200.9 | 179.94 | 174.21 | 153.44 | 147 | 163.88 | 165.68 | 186.69 | 197.47 | 211.85 | | |
| | | | | - | | | | Outp | out from w | ater heater | . (annual)₁ | 12 | 2189.48 | (64) |
| Heat g | ains fro | m water | heating, | kWh/m | onth 0.2 | 5 ´ [0.85 | × (45)m | + (61)m | n] + 0.8 x | k [(46)m | + (57)m | + (59)m |] | |
| (65)m= | 67.98 | 59.82 | 62.59 | 55.77 | 53.9 | 47.29 | 45.03 | 50.46 | 51.03 | 57.87 | 61.59 | 66.24 | | (65) |
| inclu | ide (57) | m in calo | culation | of (65)m | only if c | ylinder i | s in the o | dwelling | or hot w | ater is fr | om com | munity h | eating | |
| 5. Int | ternal ga | ains (see | Table 5 | 5 and 5a |): | | | | | | | | | |
| Metab | olic gain | s (Table | 5). Wat | ts | | | | | | | | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | | |
| (66)m= | 142.41 | 142.41 | 142.41 | 142.41 | 142.41 | 142.41 | 142.41 | 142.41 | 142.41 | 142.41 | 142.41 | 142.41 | | (66) |
| Lightin | g gains | (calcula | ted in Ap | opendix | L, equat | ion L9 o | r L9a), a | lso see | Table 5 | | | | | |
| (67)m= | 25 | 22.2 | 18.06 | 13.67 | 10.22 | 8.63 | 9.32 | 12.12 | 16.26 | 20.65 | 24.1 | 25.69 | | (67) |
| Applia | nces ga | ins (calc | ulated ir | n Append | dix L, eq | uation L | 13 or L1 | 3a), alsc | see Ta | ble 5 | | | | |
| (68)m= | 280.41 | 283.32 | 275.99 | 260.38 | 240.67 | 222.15 | 209.78 | 206.87 | 214.2 | 229.81 | 249.52 | 268.04 | | (68) |
| Cookir | ng gains | (calcula | ted in A | ppendix | L, equat | ion L15 | or L15a |), also se | e Table | 5 | | | I | |
| (69)m= | 37.24 | 37.24 | 37.24 | 37.24 | 37.24 | 37.24 | 37.24 | 37.24 | 37.24 | 37.24 | 37.24 | 37.24 | | (69) |
| Pumps | s and fai | ns gains | (Table 5 | 5a) | | | | | | | | | I | |
| (70)m= | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 1 | (70) |
| Losses | s e.g. ev | aporatio | n (nega | tive valu | es) (Tab | le 5) | | | | | | | I | |
| (71)m= | -113.93 | -113.93 | -113.93 | -113.93 | -113.93 | , -113.93 | -113.93 | -113.93 | -113.93 | -113.93 | -113.93 | -113.93 | | (71) |
| Water | heating | gains (T | able 5) | | | | | | | | | | I | |
| (72)m= | 91.37 | 89.02 | 84.13 | 77.46 | 72.45 | 65.68 | 60.52 | 67.83 | 70.87 | 77.78 | 85.54 | 89.03 | | (72) |
| Total i | nternal | gains = | | | | (66) | m + (67)m | n + (68)m + | + (69)m + | (70)m + (7 | 1)m + (72) | m | I | |
| (73)m= | 465.5 | 463.26 | 446.9 | 420.23 | 392.06 | 365.18 | 348.34 | 355.54 | 370.06 | 396.97 | 427.88 | 451.48 | | (73) |
| 6. So | lar gains | s: | | | | | | | | | | | | |

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.



| Orienta | tion: | Access Factor Table 6d | r | Area m² | | Flux Table 6a | | g_ Table 6b | | FF Table 6c | | Gains (W) | |
|---------|-------|---------------------------|---|------------|---|------------------|---|----------------|---|----------------|-----|--------------|------|
| North | 0.9x | 0.77 | x | 6.03 | × | 10.63 | × | 0.63 | × | 0.7 | = | 19.6 | (74) |
| North | 0.9x | 0.77 | x | 2.08 | × | 10.63 | × | 0.63 | × | 0.7 | i = | 6.76 | (74) |
| North | 0.9x | 0.77 | x | 5.97 | × | 10.63 | × | 0.63 | × | 0.7 | = | 19.4 | (74) |
| North | 0.9x | 0.77 | x | 6.03 | × | 20.32 | × | 0.63 | × | 0.7 | = | 37.45 | (74) |
| North | 0.9x | 0.77 | x | 2.08 | × | 20.32 | x | 0.63 | × | 0.7 | = | 12.92 | (74) |
| North | 0.9x | 0.77 | x | 5.97 | × | 20.32 | × | 0.63 | × | 0.7 | = | 37.08 | (74) |
| North | 0.9x | 0.77 | x | 6.03 | x | 34.53 | × | 0.63 | x | 0.7 | = | 63.63 | (74) |
| North | 0.9x | 0.77 | x | 2.08 | x | 34.53 | x | 0.63 | x | 0.7 | = | 21.95 | (74) |
| North | 0.9x | 0.77 | x | 5.97 | x | 34.53 | × | 0.63 | x | 0.7 | = | 63 | (74) |
| North | 0.9x | 0.77 | x | 6.03 | x | 55.46 | x | 0.63 | x | 0.7 | = | 102.21 | (74) |
| North | 0.9x | 0.77 | x | 2.08 | x | 55.46 | x | 0.63 | x | 0.7 | = | 35.26 | (74) |
| North | 0.9x | 0.77 | x | 5.97 | × | 55.46 | x | 0.63 | × | 0.7 | = | 101.2 | (74) |
| North | 0.9x | 0.77 | x | 6.03 | x | 74.72 | x | 0.63 | x | 0.7 | = | 137.69 | (74) |
| North | 0.9x | 0.77 | x | 2.08 | x | 74.72 | x | 0.63 | x | 0.7 | = | 47.49 | (74) |
| North | 0.9x | 0.77 | x | 5.97 | x | 74.72 | × | 0.63 | x | 0.7 | = | 136.32 | (74) |
| North | 0.9x | 0.77 | x | 6.03 | x | 79.99 | x | 0.63 | x | 0.7 | = | 147.4 | (74) |
| North | 0.9x | 0.77 | x | 2.08 | x | 79.99 | x | 0.63 | x | 0.7 | = | 50.84 | (74) |
| North | 0.9x | 0.77 | x | 5.97 | x | 79.99 | × | 0.63 | x | 0.7 | = | 145.93 | (74) |
| North | 0.9x | 0.77 | x | 6.03 | x | 74.68 | x | 0.63 | x | 0.7 | = | 137.62 | (74) |
| North | 0.9x | 0.77 | x | 2.08 | × | 74.68 | × | 0.63 | × | 0.7 | = | 47.47 | (74) |
| North | 0.9x | 0.77 | x | 5.97 | x | 74.68 | x | 0.63 | x | 0.7 | = | 136.25 | (74) |
| North | 0.9x | 0.77 | x | 6.03 | x | 59.25 | x | 0.63 | x | 0.7 | = | 109.18 | (74) |
| North | 0.9x | 0.77 | x | 2.08 | x | 59.25 | x | 0.63 | x | 0.7 | = | 37.66 | (74) |
| North | 0.9x | 0.77 | x | 5.97 | x | 59.25 | x | 0.63 | x | 0.7 | = | 108.1 | (74) |
| North | 0.9x | 0.77 | x | 6.03 | x | 41.52 | x | 0.63 | x | 0.7 | = | 76.51 | (74) |
| North | 0.9x | 0.77 | x | 2.08 | x | 41.52 | x | 0.63 | x | 0.7 | = | 26.39 | (74) |
| North | 0.9x | 0.77 | x | 5.97 | x | 41.52 | x | 0.63 | x | 0.7 | = | 75.75 | (74) |
| North | 0.9x | 0.77 | x | 6.03 | x | 24.19 | x | 0.63 | x | 0.7 | = | 44.58 | (74) |
| North | 0.9x | 0.77 | x | 2.08 | x | 24.19 | x | 0.63 | x | 0.7 | = | 15.38 | (74) |
| North | 0.9x | 0.77 | x | 5.97 | x | 24.19 | x | 0.63 | x | 0.7 | = | 44.13 | (74) |
| North | 0.9x | 0.77 | x | 6.03 | x | 13.12 | x | 0.63 | x | 0.7 | = | 24.17 | (74) |
| North | 0.9x | 0.77 | x | 2.08 | x | 13.12 | x | 0.63 | x | 0.7 | = | 8.34 | (74) |
| North | 0.9x | 0.77 | x | 5.97 | x | 13.12 | x | 0.63 | x | 0.7 | = | 23.93 | (74) |
| North | 0.9x | 0.77 | x | 6.03 | × | 8.86 | × | 0.63 | x | 0.7 | = | 16.34 | (74) |
| North | 0.9x | 0.77 | x | 2.08 | x | 8.86 | x | 0.63 | x | 0.7 | = | 5.63 | (74) |
| North | 0.9x | 0.77 | x | 5.97 | × | 8.86 | × | 0.63 | × | 0.7 |] = | 16.17 | (74) |
| South | 0.9x | 0.77 | x | 5.59 | × | 46.75 | × | 0.63 | × | 0.7 |] = | 79.87 | (78) |
| South | 0.9x | 0.77 | x | 5.99 | x | 46.75 | × | 0.63 | × | 0.7 | = | 85.59 | (78) |
| South | 0.9x | 0.77 | x | 1.52 | x | 46.75 | x | 0.63 | x | 0.7 | = | 21.72 | (78) |



| South | 0.9x | 0.77 | x | 5.59 | x | 76.57 | x | 0.63 | x | 0.7 | = | 130.81 | (78) |
|------------------------------|---------------------------------|---|----------------------------|--|--------------------|------------------------------|----------------------------|----------------------------|--------------------------------|----------|--------|--------|------|
| South | 0.9x | 0.77 | x | 5.99 | x | 76.57 | x | 0.63 | x | 0.7 | = | 140.17 | (78) |
| South | 0.9x | 0.77 | x | 1.52 | x | 76.57 | x | 0.63 | x | 0.7 | = | 35.57 | (78) |
| South | 0.9x | 0.77 | x | 5.59 | x | 97.53 |) x | 0.63 | x | 0.7 | = | 166.62 | (78) |
| South | 0.9x | 0.77 | x | 5.99 | x | 97.53 | x | 0.63 | x | 0.7 | = | 178.55 | (78) |
| South | 0.9x | 0.77 | x | 1.52 | x | 97.53 | x | 0.63 | x | 0.7 | = | 45.31 | (78) |
| South | 0.9x | 0.77 | x | 5.59 | x | 110.23 | x | 0.63 | x | 0.7 | = | 188.32 | (78) |
| South | 0.9x | 0.77 | x | 5.99 | x | 110.23 | x | 0.63 | x | 0.7 | = | 201.8 | (78) |
| South | 0.9x | 0.77 | x | 1.52 | x | 110.23 | x | 0.63 | x | 0.7 | = | 51.21 | (78) |
| South | 0.9x | 0.77 | x | 5.59 | x | 114.87 | x | 0.63 | x | 0.7 | = | 196.24 | (78) |
| South | 0.9x | 0.77 | x | 5.99 | x | 114.87 | x | 0.63 | x | 0.7 | = | 210.29 | (78) |
| South | 0.9x | 0.77 | x | 1.52 | x | 114.87 | x | 0.63 | x | 0.7 | = | 53.36 | (78) |
| South | 0.9x | 0.77 | x | 5.59 | x | 110.55 | x | 0.63 | x | 0.7 | = | 188.86 | (78) |
| South | 0.9x | 0.77 | x | 5.99 | x | 110.55 | x | 0.63 | x | 0.7 | = | 202.37 | (78) |
| South | 0.9x | 0.77 | x | 1.52 | x | 110.55 | x | 0.63 | x | 0.7 | = | 51.35 | (78) |
| South | 0.9x | 0.77 | x | 5.59 | x | 108.01 | x | 0.63 | x | 0.7 | = | 184.53 | (78) |
| South | 0.9x | 0.77 | x | 5.99 | × | 108.01 | x | 0.63 | x | 0.7 | = | 197.73 | (78) |
| South | 0.9x | 0.77 | x | 1.52 | x | 108.01 | x | 0.63 | x | 0.7 | = | 50.17 | (78) |
| South | 0.9x | 0.77 | x | 5.59 | x | 104.89 | x | 0.63 | x | 0.7 | = | 179.2 | (78) |
| South | 0.9x | 0.77 | x | 5.99 | x | 104.89 | x | 0.63 | x | 0.7 | = | 192.02 | (78) |
| South | 0.9x | 0.77 | x | 1.52 | x | 104.89 | x | 0.63 | x | 0.7 | = | 48.73 | (78) |
| South | 0.9x | 0.77 | x | 5.59 | x | 101.89 | x | 0.63 | x | 0.7 | = | 174.06 | (78) |
| South | 0.9x | 0.77 | x | 5.99 | x | 101.89 | x | 0.63 | x | 0.7 | = | 186.51 | (78) |
| South | 0.9x | 0.77 | x | 1.52 | x | 101.89 | x | 0.63 | × | 0.7 | = | 47.33 | (78) |
| South | 0.9x | 0.77 | x | 5.59 | x | 82.59 | x | 0.63 | x | 0.7 | = | 141.09 | (78) |
| South | 0.9x | 0.77 | x | 5.99 | x | 82.59 | x | 0.63 | x | 0.7 | = | 151.18 | (78) |
| South | 0.9x | 0.77 | x | 1.52 | x | 82.59 | x | 0.63 | × | 0.7 | = | 38.36 | (78) |
| South | 0.9x | 0.77 | x | 5.59 | x | 55.42 | x | 0.63 | x | 0.7 | = | 94.67 | (78) |
| South | 0.9x | 0.77 | x | 5.99 | x | 55.42 | x | 0.63 | x | 0.7 | = | 101.45 | (78) |
| South | 0.9x | 0.77 | x | 1.52 | x | 55.42 | x | 0.63 | x | 0.7 | = | 25.74 | (78) |
| South | 0.9x | 0.77 | x | 5.59 | x | 40.4 | x | 0.63 | x | 0.7 | = | 69.02 | (78) |
| South | 0.9x | 0.77 | x | 5.99 | x | 40.4 | x | 0.63 | x | 0.7 | = | 73.95 | (78) |
| South | 0.9x | 0.77 | x | 1.52 | x | 40.4 | x | 0.63 | × | 0.7 | = | 18.77 | (78) |
| Solar ((83)m= Total (| gains in 232.93 gains – i | watts, calc 393.98 5 internal and | ulated ^{39.06} | for each mon 679.99 781.33 (84)m = (73)n | th 9 7 n + (| 86.76 753.76 83)m , watts | <mark>(83)</mark> m 674 | a = Sum(74)m .89 586.55 | . <mark>(82)m</mark> 434.72 | 2 278.31 | 199.88 | | (83) |
| (84)m= | 698.43 | 857.24 9 | 85.96 | 1100.22 1173.4 | 15 1 <i>°</i> | 151.94 1102.11 | 1030 | 0.42 956.61 | 831.69 | 9 706.19 | 651.36 | | (84) |
| 7. Me | ean intei | rnal temper | ature (| heating seaso | on) | | | | | | | | |
| Temp | perature | during hea | ating pe | eriods in the li | ving | area from Tab | ole 9 | , Th1 (°C) | | | [| 21 | (85) |

Utilisation factor for gains for living area, h1,m (see Table 9a)

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



| (86)m= | 1 | 0.99 | 0.99 | 0.96 | 0.88 | 0.73 | 0.56 | 0.62 | 0.85 | 0.97 | 1 | 1 | | (86) |
|----------|------------|------------|-----------|------------|-----------|-------------|--------------|-------------|------------|-------------|-------------------------|------------|---------|----------|
| Mean | interna | l temper | ature in | living are | ea T1 (fo | ollow ste | ps 3 to 7 | 7 in Table | e 9c) | | | | | |
| (87)m= | 19.58 | 19.78 | 20.06 | 20.42 | 20.73 | 20.92 | 20.98 | 20.97 | 20.84 | 20.43 | 19.93 | 19.54 | | (87) |
| Temp | erature | during h | eating p | beriods ir | n rest of | dwelling | from Ta | able 9, Tl | h2 (°C) | | | | | |
| (88)m= | 19.85 | 19.85 | 19.85 | 19.87 | 19.87 | 19.88 | 19.88 | 19.88 | 19.87 | 19.87 | 19.86 | 19.86 | | (88) |
| Utilisa | ation fac | tor for g | ains for | rest of d | welling, | h2,m (se | e Table | 9a) | | | | | | |
| (89)m= | 1 | 0.99 | 0.98 | 0.94 | 0.83 | 0.63 | 0.43 | 0.48 | 0.77 | 0.96 | 0.99 | 1 | | (89) |
| Mean | interna | l temper | ature in | the rest | of dwelli | ina T2 (fe | ollow ste | eps 3 to 7 | 7 in Tabl | e 9c) | | | | |
| (90)m= | 17.97 | 18.26 | 18.67 | 19.19 | 19.61 | 19.83 | 19.87 | 19.87 | 19.75 | 19.21 | 18.49 | 17.92 | | (90) |
| | | | | | | | | | f | iLA = Livin | g area ÷ (4 | 4) = | 0.28 | (91) |
| Mean | interna | l temper | ature (fo | or the wh | ole dwe | llina) = fl | A x T1 | + (1 – fl | A) x T2 | | | I | | |
| (92)m= | 18.42 | 18.69 | 19.06 | 19.54 | 19.93 | 20.14 | 20.19 | 20.18 | 20.06 | 19.55 | 18.9 | 18.38 | | (92) |
| Apply | adjustn | nent to t | he mear | n internal | temper | ature fro | n Table | 4e, whe | ere appro | opriate | | | | |
| (93)m= | 18.42 | 18.69 | 19.06 | 19.54 | 19.93 | 20.14 | 20.19 | 20.18 | 20.06 | 19.55 | 18.9 | 18.38 | | (93) |
| 8. Sp | ace hea | ting requ | uirement | t | | | | | | | | | | |
| Set T | i to the r | mean int | ernal tei | mperatur | re obtair | ned at ste | ep 11 of | Table 9t | b, so tha | t Ti,m=(| 76)m an | d re-calc | ulate | |
| the ut | ilisation | factor fo | or gains | using la | ble 9a | | | | 0 | | NL. | | | |
| Litilior | Jan | Feb | iviar | Apr | May | Jun | Jui | Aug | Sep | Oct | NOV | Dec | | |
| (94)m= | 1 | 0.99 | 0.97 | 0.93 | 0.84 | 0.66 | 0 47 | 0.52 | 0.78 | 0.95 | 0.99 | 1 | | (94) |
| Usefu | l gains | hmGm | W = (94) | 4)m x (84 | 4)m | 0.00 | 0.47 | 0.02 | 0.70 | 0.00 | 0.00 | ' | | () |
| (95)m= | 695.55 | 848.36 | 961.13 | 1027.53 | 981.4 | 755.88 | 515.18 | 537.3 | 750.14 | 793.01 | 699.85 | 649.39 | | (95) |
| Month | nly avera | age exte | rnal tem | perature | e from Ta | able 8 | | | | | | | | |
| (96)m= | 4.3 | 4.9 | 6.5 | 8.9 | 11.7 | 14.6 | 16.6 | 16.4 | 14.1 | 10.6 | 7.1 | 4.2 | | (96) |
| Heat | loss rate | e for mea | an interr | al tempe | erature, | Lm , W = | - =[(39)m | x [(93)m | – (96)m |] | | | | |
| (97)m= | 2116.31 | 2061.19 | 1874.5 | 1570.92 | 1212.39 | 808.89 | 523.7 | 551.3 | 873.01 | 1319.84 | 1745.85 | 2106.97 | | (97) |
| Space | e heatin | g require | ement fo | or each m | nonth, k | Wh/mon | th = 0.02 | 24 x [(97) |)m – (95 |)m] x (4 | 1)m | | | |
| (98)m= | 1057.05 | 815.02 | 679.55 | 391.24 | 171.86 | 0 | 0 | 0 | 0 | 391.96 | 753.12 | 1084.44 | | _ |
| | | | | | | | | Tota | l per year | (kWh/year | r) = Sum(9 | 8)15,912 = | 5344.23 | (98) |
| Space | e heatin | g require | ement in | kWh/m² | /year | | | | | | | | 45.92 | (99) |
| 9a. En | ergy rec | luiremer | nts – Ind | ividual h | eating s | ystems i | ncluding | ı micro-C | CHP) | | | - | | _ |
| Spac | e heatir | ng: | | | | | | | | | | | | _ |
| Fracti | on of sp | ace hea | at from s | econdar | y/supple | ementary | system | | | | | | 0 | (201) |
| Fracti | on of sp | ace hea | at from m | nain syst | em(s) | | | (202) = 1 - | - (201) = | | | | 1 | (202) |
| Fracti | on of to | tal heatii | ng from | main sys | stem 1 | | | (204) = (2 | 02) × [1 – | (203)] = | | | 1 | (204) |
| Efficie | ency of r | main spa | ace heat | ing syste | em 1 | | | | | | | İ | 93.4 | (206) |
| Efficie | ency of s | seconda | ry/suppl | ementar | y heatin | g system | ז, % | | | | | | 0 | (208) |
| | Jan | Feb | Mar | Apr | Mav | Jun | Jul | Αυα | Sep | Oct | Nov | Dec | kWh/ve | _l ar |
| Space | e heatin | g require | ement (c | alculate | d above |) | •••• | | 000 | ••• | | | | |
| | 1057.05 | 815.02 | 679.55 | 391.24 | 171.86 | 0 | 0 | 0 | 0 | 391.96 | 753.12 | 1084.44 | | |
| (211)m | n = {[(98 |)m x (20 | 4)]}x1 | 00 ÷ (20 |)6) | • | • | | | • | | | | (211) |
| | 1131.74 | 872.62 | 727.57 | 418.89 | 184 | 0 | 0 | 0 | 0 | 419.66 | 806.33 | 1161.07 | | |
| | | | • | | | | • | Tota | l (kWh/yea | ar) =Sum(2 | 211) _{15,1012} | = | 5721.87 | (211) |



Space heating fuel (secondary), kWh/month

| (215)m= 0 0 0 0 0 0 0 0 Total (kWh/year) = Water heating | 0 0 =Sum(215) _{15,10} | 0 | | |
|--|-----------------------------------|--------|-------------------------|--------|
| Total (kWh/year) = | =Sum(215) _{15,10} | | | |
| Water heating | | 12 | 0 | (215) |
| | | | | |
| Output from water heater (calculated above) | 96 60 107 47 | 211.05 | 1 | |
| Efficiency of water beater | 00.09 197.47 | 211.00 | 80.2 | 7(216) |
| (217)m 88 5 88 29 87 88 86 95 85 02 80 3 80 3 80 3 80 3 80 3 | 36.87 88.1 | 88 58 | 00.3 | (217) |
| Fuel for water beating $kWb/month$ | 00.07 | 00.00 | | () |
| $(219)m = (64)m \times 100 \div (217)m$ | | | _ | |
| (219)m= 245.29 216.71 228.61 206.93 204.92 191.08 183.07 204.08 206.33 214 | 14.89 224.15 | 239.16 | | _ |
| Total = Sum(219a), | $(a)_{112} =$ | | 2565.23 | (219) |
| Annual totals | kWh/yea | r | kWh/year | ٦ |
| Space heating fuel used, main system i | | | 5/21.8/ | ļ |
| Water heating fuel used | | | 2565.23 | |
| Electricity for pumps, fans and electric keep-hot | | | | |
| central heating pump: | | 30 | | (230c) |
| boiler with a fan-assisted flue | | 45 |] | (230e) |
| Total electricity for the above, kWh/year sum of (230a)(23 | 230g) = | | 75 | (231) |
| Electricity for lighting | | | 441.48 | (232) |
| 12a. CO2 emissions – Individual heating systems including micro-CHP | | | | |
| Energy En kWh/year kg | mission fac g CO2/kWh | ctor | Emissions kg CO2/yea | ar |
| Space heating (main system 1) (211) x | 0.216 | = | 1235.92 | (261) |
| Space heating (secondary) (215) x | 0.519 | = | 0 | (263) |
| Water heating (219) x | 0.216 | = | 554.09 | (264) |
| Space and water heating (261) + (262) + (263) + (264) = | | | 1790.01 | (265) |
| Electricity for pumps, fans and electric keep-hot (231) x | 0.519 | = | 38.93 | (267) |
| Electricity for lighting (232) × | 0.519 | = | 229.13 | (268) |
| Total CO2, kg/year sum of (26 | 265)(271) = | | 2058.07 | (272) |

TER =

17.69 (273)



SAP 2012 Overheating Assessment

Calculated by Stroma FSAP 2012 program, produced and printed on 09 August 2016

Property Details: Top Floor GS PV

| Dwelling type: | Flat | |
|--|---------------------------------------|------|
| Located in: | England | |
| Region: | Thames valley | |
| Cross ventilation possible: | Yes | |
| Number of storeys: | 1 | |
| Front of dwelling faces: | West | |
| Overshading: | Average or unknown | |
| Overhangs: | None | |
| Thermal mass parameter: | Indicative Value Medium | |
| Night ventilation: | False | |
| Blinds, curtains, shutters: | Dark-coloured curtain or roller blind | |
| Ventilation rate during hot weather (ach): | 6 (Windows fully open) | |
| Overheating Details: | | |
| | | |
| Summer ventilation heat loss coefficient: | 576.03 | (P1) |
| Transmission heat loss coefficient: | 92 | |
| Summer heat loss coefficient: | 668.08 | (P2) |

Overhangs:

| Orientation: | Ratio: | Z_overhangs: |
|-----------------|--------|--------------|
| South (South 1) | 0 | 1 |
| North (North 1) | 0 | 1 |
| North (North 2) | 0 | 1 |
| North (North 3) | 0 | 1 |
| South (South 2) | 0 | 1 |
| South (South 3) | 0 | 1 |
| | | |

Solar shading:

| Orientation: | Z blin | ds: | Solar access: | Ove | rhangs: | Z summer: | | |
|--------------------|--------|------|---------------|-----------|---------|-----------|--------|---------|
| South (South 1) | 0.85 | | 1 | 1 | | 0.85 | | (P8) |
| North (North 1) | 0.85 | | 1 | 1 | | 0.85 | | (P8) |
| North (North 2) | 0.85 | | 1 | 1 | | 0.85 | | (P8) |
| North (North 3) | 0.85 | | 1 | 1 | | 0.85 | | (P8) |
| South (South 2) | 0.85 | | 1 | 1 | | 0.85 | | (P8) |
| South (South 3) | 0.85 | | 1 | 1 | | 0.85 | | (P8) |
| Solar gains: | | | | | | | | |
| Orientation | | Area | Flux | g_ | FF | Shading | Gains | |
| South (South 1) | 1 x | 5.8 | 112.21 | 0.72 | 0.7 | 0.85 | 250.92 | |
| North (North 1) | 1 x | 6.26 | 81.19 | 0.72 | 0.7 | 0.85 | 195.95 | |
| North (North 2) | 1 x | 2.16 | 81.19 | 0.72 | 0.7 | 0.85 | 67.61 | |
| North (North 3) | 1 x | 6.2 | 81.19 | 0.72 | 0.7 | 0.85 | 194.07 | |
| South (South 2) | 1 x | 6.22 | 112.21 | 0.72 | 0.7 | 0.85 | 269.09 | |
| South (South 3) | 1 x | 1.58 | 112.21 | 0.72 | 0.7 | 0.85 | 68.35 | |
| | | | | | | Total | 1046 | (P3/P4) |
| Internal gains: | | | | | | | | |
| | | | | Ju | ine | July | August | |
| Internal gains | | | | 52 | 27.94 | 506.05 | 515.3 | |
| Total summer gains | | | | 16 | 532.92 | 1552.04 | 1467.9 | (P5) |



SAP 2012 Overheating Assessment

| Summer gain/loss ratio | 2.44 | 2.32 | 2.2 (P6) |
|--|-----------------|-----------------|-------------------|
| Mean summer external temperature (Thames valley) | 16 | 17.9 | 17.8 |
| Thermal mass temperature increment | 0.25 | 0.25 | 0.25 |
| Threshold temperature | 18.69 | 20.47 | 20.25 (P7) |
| Likelihood of high internal temperature | Not significant | Not significant | Not significant |
| | | | |

Assessment of likelihood of high internal temperature:

Not significant



Appendix 2 SBEM Report (Commercial Space)

SBEM Main Calculation Output Document

Tue Aug 09 10:24:07 2016

v5.2.g.3

Building name

52 Holmes Rd PV

Building type: B1 Offices and Workshop businesses

SBEM is an energy calculation tool for the purpose of assessing and demonstrating compliance with Building Regulations (Part L for England and Wales, Section 6 for Scotland, Part F for Northern Ireland, Part L for Republic of Ireland and Building Bye-laws Jersey Part 11) and to produce Energy Performance Certificates and Building Energy Ratings. Although the data produced by the tool may be of use in the design process, SBEM is not intended as a building design tool.

Building Energy Performance and CO2 emissions



2 kgCO2/m2 displaced by the use of renewable sources.

Building area is 447.06 m2



(Pie chart excluding Equipment end-use)



(*) Although energy consumption by equipment is shown in the graphs, the CO2 emissions associated with this end-use have not been taken into account when producing the rating.





Annual Heating Demand









BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

52 Holmes Rd PV

Date: Tue Aug 09 10:24:07 2016

Administrative information

Building Details

Address: 52 Holmes Rd, Camden, London, NW5

Certification tool

Calculation engine: SBEM

Calculation engine version: v5.2.g.3 Interface to calculation engine: iSBEM

interface to calculation engine. IODEM

Interface to calculation engine version: v5.2.g BRUKL compliance check version: v5.2.g.3

Owner Details

Name: Information not provided by the user Telephone number: Information not provided by the user Address: Information not provided by the user, Information

not provided by the user, Information not provided by the user

Certifier details

Name: D Lloyd

Telephone number: 02476 505600

Address: Abbey Park, Humber Road, Coventry, CV3 4AQ

Criterion 1: The calculated CO₂ emission rate for the building should not exceed the target

| CO ₂ emission rate from the notional building, kgCO ₂ /m ² .annum | 17.3 |
|--|---------------------|
| Target CO ₂ emission rate (TER), kgCO ₂ /m ² .annum | 17.3 |
| Building CO ₂ emission rate (BER), kgCO ₂ /m ² .annum | 11.3 |
| Are emissions from the building less than or equal to the target? | BER =< TER |
| Are as built details the same as used in the BER calculations? | Separate submission |

Criterion 2: The performance of the building fabric and the building services should achieve reasonable overall standards of energy efficiency

Values not achieving standards in the Non-Domestic Building Services Compliance Guide and Part L are displayed in red. Building fabric

| Element | Us-Limit | Ua-Calc | Ul-Calc | Surface where the maximum value occurs* | | | |
|--|----------|---------|---------|---|--|--|--|
| Wall** | 0.35 | 0.2 | 0.2 | LG a/su | | | |
| Floor | 0.25 | 0.15 | 0.2 | LG a/ci | | | |
| Roof | 0.25 | 0.2 | 0.2 | LG a/c | | | |
| Windows***, roof windows, and rooflights | 2.2 | 1.1 | 1.1 | LG a/e/g | | | |
| Personnel doors | 2.2 | - | ÷. | "No external personnel doors" | | | |
| Vehicle access & similar large doors | 1.5 | - | - | "No external vehicle access doors" | | | |
| High usage entrance doors | 3.5 | - | - | "No external high usage entrance doors" | | | |
| U _{e-Limit} = Limiting area-weighted average U-values [W/(m ² K)] U _{e-Celc} = Calculated area-weighted average U-values [W/(m ² K)] U _{i-Celc} = Calculated maximum individual element U-values [W/(m ² K)] | | | | | | | |

** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.

*** Display windows and similar glazing are excluded from the U-value check.

N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

| Air Permeability | Worst acceptable standard | This building |
|--------------------|---------------------------|---------------|
| m³/(h.m²) at 50 Pa | 10 | 5 |

Shell and Core

As designed

Building services

The standard values listed below are minimum values for efficiencies and maximum values for SFPs. Refer to the Non-Domestic Building Services Compliance Guide for details.

| Whole building lighting automatic monitoring & targeting with alarms for out-of-range values | | | |
|--|------|--|--|
| Whole building electric power factor achieved by power factor correction | <0.9 | | |

1- Heating

| | Heating efficiency | Cooling efficiency | Radiant efficiency | SFP [W/(l/s)] | HR efficiency | | |
|----------------|--------------------|---------------------------|--------------------|---------------|---------------|--|--|
| This system | 3 | (m) | - | - | - | | |
| Standard value | 2.5* N/A | | N/A | N/A | N/A | | |
| | | | | | | | |

Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system NO

* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps. For types <=12 kW output, refer to EN 14825 for limiting standards.

1- Hot Water

| | Water heating efficiency | Storage loss factor [kWh/litre per day] |
|----------------|-----------------------------------|---|
| This building | Hot water provided by HVAC system | - |
| Standard value | N/A | N/A |

Local mechanical ventilation, exhaust, and terminal units

| ID | System type in Non-domestic Building Services Compliance Guide | | | | | |
|----|---|--|--|--|--|--|
| Α | Local supply or extract ventilation units serving a single area | | | | | |
| в | Zonal supply system where the fan is remote from the zone | | | | | |
| С | Zonal extract system where the fan is remote from the zone | | | | | |
| D | Zonal supply and extract ventilation units serving a single room or zone with heating and heat recovery | | | | | |
| ε | Local supply and extract ventilation system serving a single area with heating and heat recovery | | | | | |
| F | Other local ventilation units | | | | | |
| G | Fan-assisted terminal VAV unit | | | | | |
| н | Fan coil units | | | | | |
| 1 | Zonal extract system where the fan is remote from the zone with grease filter | | | | | |

| Zone name | | SFP [W/(I/s)] | | | | | | | | | | | |
|-------------------|-----|---------------|-----|-----|---------------|-----|-----|-----|----|----------------|----------|--|--|
| ID of system type | Α | В | С | D | E | F | G | Н | I. | rik efficiency | | | |
| Standard value | 0.3 | 1.1 | 0.5 | 1.9 | 1.6 | 0.5 | 1.1 | 0.5 | 1 | Zone | Standard | | |
| LG a | - | - | - | - | - | - | - | - | - | - " | N/A | | |
| LGb | - | - | - | - | - | - | - | - | - | - | N/A | | |
| LG c | - | - | - | - | <u>ی</u> | - | - | • | - | - | N/A | | |
| LG d | - | - | - | | 5 4 5 | - | - | - | - | - | N/A | | |
| UG a | - | - | - | - | - | - | - | 5-2 | - | - | N/A | | |
| UG b | - | - | - | - | | | - | - | - | - | N/A | | |
| UG c | 1.5 | - | - | - | 19 2 9 | - | - | · . | - | - | N/A | | |
| UG d | - | - | - | | - | | - | - | - | - | N/A | | |

Shell and core configuration

| Zone | Assumed shell? |
|------|----------------|
| LG a | YES |
| LG b | YES |
| LG c | YES |
| LG d | YES |
| UG a | YES |
| UG b | YES |

Shell and core configuration

| Zone | Assumed shell? |
|------|----------------|
| UG c | NO |
| UG d | NO |

| General lighting and display lighting | Lumino | ous effic |] | |
|---------------------------------------|-----------|-----------|--------------|----------------------|
| Zone name | Luminaire | Lamp | Display lamp | General lighting [W] |
| Standard value | 60 | 60 | 22 | |
| LG a | 79 | - | | 300 |
| LGb | 83 | - | - | 70 |
| LG c | 83 | - | - | 40 |
| LG d | 80 | - | - | 880 |
| UG a | 80 | - | - | 740 |
| UG b | 83 | - | - | 40 |
| UG c | - | 52 | - | 90 |
| UG d | 73 | - | - | 126 |

Criterion 3: The spaces in the building should have appropriate passive control measures to limit solar gains

| Zone | Solar gain limit exceeded? (% | 6) Internal blinds used? |
|------|-------------------------------|--------------------------|
| LG a | NO (-59.8%) | NO |
| LG b | YES (+17.9%) | NO |
| LG c | N/A | N/A |
| LG d | NO (-5%) | NO |
| UG a | NO (-72.9%) | NO |
| UG b | NO (-7.4%) | NO |
| UG d | NO (-38.7%) | NO |

Criterion 4: The performance of the building, as built, should be consistent with the calculated BER

Separate submission

Criterion 5: The necessary provisions for enabling energy-efficient operation of the building should be in place

Separate submission

EPBD (Recast): Consideration of alternative energy systems

| Were alternative energy systems considered and analysed as part of the design process? | | |
|--|--|--|
| Is evidence of such assessment available as a separate submission? | | |
| Are any such measures included in the proposed design? | | |

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

| | Actual | Notional |
|---|--------|----------|
| Area (m²) | 447.1 | 447.1 |
| External area [m ²] | 977.1 | 977.1 |
| Weather | LON | LON |
| Infiltration [m ³ /hm ² @ 50Pa] | 5 | 3 |
| Average conductance [W/K] | 240.56 | 447.83 |
| Average U-value [W/m ² K] | 0.25 | 0.46 |
| Alpha value* [%] | 26.65 | 16.73 |

*Percentage of the building's average heat transfer coefficient which is due to thermal bridging

% Area Building Type

Building Use

| | A1/A2 Retail/Financial and Professional services |
|-----|---|
| | ASIA4/AS Rectaurants and Cafes/Drinking Est/Takeaways |
| 100 | B1 Offices and Workshop businesses |
| | B2 to B7 General industrial and Special Industrial Groups |
| | 88 Storage or Distribution |
| | C1 Hotels |
| | C2 Residential Inst. Hospitals and Care Fiomes |
| | C2 Residential Inst. Residential schools |
| | C2 Residential Inst. Universities and colleges |
| | C2A Secure Residential Inst. |
| | Residential spaces |
| | D1 Non-residential Inst.: Community/Day Centre |
| | D1 Non-residential Inst : Libraries, Museums, and Galleries |
| | D1 Non-residential Inst.: Education |
| | D1 Non-residential inst.: Primary Health Care Building |
| | D1 Non-residential Inst.: Crown and County Courts |
| | D2 General Assembly and Leisure, Night Clubs and Theatres |
| | Others: Passenger terminals |
| | Others: Emergency services |
| | Others: Miscellaneous 24hr activities |
| | Others: Car Parks 24 hrs |
| | Others - Stand alone utility block |

Energy Consumption by End Use [kWh/m²]

| | Actual | Notional |
|------------|--------|----------|
| Heating | 6.1 | 11.8 |
| Cooling | 0 | 0 |
| Auxiliary | 2.35 | 1.07 |
| Lighting | 15.25 | 20.28 |
| Hot water | 0.99 | 1.1 |
| Equipment* | 41.63 | 41.63 |
| TOTAL** | 24.69 | 34.24 |

* Energy used by equipment does not count towards the total for calculating emissions.
** Total is net of any electrical energy displaced by CHP generators, if applicable.

Energy Production by Technology [kWh/m²]

| | Actual | Notional |
|-----------------------|--------|----------|
| Photovoltaic systems | 3 | 0 |
| Wind turbines | 0 | 0 |
| CHP generators | 0 | 0 |
| Solar thermal systems | 0 | 0 |

Energy & CO₂ Emissions Summary

| | Actual | Notional |
|---|--------|----------|
| Heating + cooling demand [MJ/m ²] | 172.25 | 216.06 |
| Primary energy* [kWh/m ²] | 75.8 | 102.5 |
| Total emissions [kg/m ²] | 11.3 | 17.3 |

* Primary energy is net of any electrical energy displaced by CHP generators, if applicable.

| ŀ | IVAC Sys | stems Pei | formanc | е | | | | | | |
|-----|---------------|-------------------|-------------------|--------------------|--------------------|-------------------|---------------|---------------|------------------|------------------|
| Sy | stem Type | Heat dem MJ/m2 | Cool dem MJ/m2 | Heat con kWh/m2 | Cool con kWh/m2 | Aux con kWh/m2 | Heat SSEEF | Cool SSEER | Heat gen SEFF | Cool gen SEER |
| [5] | [] Central he | eating using |) water: rad | iators, [HS] | Heat pum | p (electric): | air source, | [HFT] Elec | tricity, [CF1 |] Electricity |
| | Actual | 58.8 | 113.5 | 6.1 | 0 | 2.3 | 2.68 | 0 | 3 | 0 |
| | Notional | 103.2 | 112.9 | 11.8 | 0 | 1.1 | 2.43 | 0 | | |

Key to terms

| Heat dem [MJ/m2] | = Heating energy demand |
|-------------------|---|
| Cool dem [MJ/m2] | = Cooling energy demand |
| Heat con [kWh/m2] | = Heating energy consumption |
| Cool con [kWh/m2] | = Cooling energy consumption |
| Aux con [kWh/m2] | = Auxiliary energy consumption |
| Heat SSEFF | = Heating system seasonal efficiency (for notional building, value depends on activity glazing class) |
| Cool SSEER | = Cooling system seasonal energy efficiency ratio |
| Heat gen SSEFF | = Heating generator seasonal efficiency |
| Cool gen SSEER | = Cooling generator seasonal energy efficiency ratio |
| ST | = System type |
| HS | = Heat source |
| HFT | = Heating fuel type |
| CFT | = Cooling fuel type |
| | |

Key Features

The BCO can give particular attention to items with specifications that are better than typically expected.

Building fabric

| Element | U _{4-Тур} | Ul-Min | Surface where the minimum value occurs* | | |
|--|--------------------|--------|---|--|--|
| Wall | 0.23 | 0.2 | LG a/su | | |
| Floor | 0.2 | 0.13 | LG d/f | | |
| Roof | 0.15 | 0.2 | LG a/c | | |
| Windows, roof windows, and rooflights | 1.5 | 1.1 | LG a/e/g | | |
| Personnel doors | 1.5 | - | "No external personnel doors" | | |
| Vehicle access & similar large doors | 1.5 | | "No external vehicle access doors" | | |
| High usage entrance doors | 1.5 | - | "No external high usage entrance doors" | | |
| U _{FTyp} = Typical individual element U-values [W/(m ² K)] U _{FMm} = Minimum individual element U-values [W/(m ² K)] | | | | | |
| * There might be more than one surface where the minimum U-value occurs. | | | | | |

| Air Permeability | Typical value | This building |
|--------------------|---------------|---------------|
| m³/(h.m²) at 50 Pa | 5 | 5 |