

Energy Statement for Planning

Client: Calm Home Developments Ltd Suite 18, 4th Floor Amp House Dingwall Road Croydon CR0 2LX

Site Details: 35 Crescent Road Caterham CR3 6LE

Proposals: The construction of 4 residential terrace houses



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Report Details:

| Prepared by | Prepared by Checked by I | | Project | Revision | |
|------------------|---------------------------|------------|---------|----------|--|
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1 Introduction

This Energy Statement report has been prepared in support of the planning application for the construction of 4 residential terrace houses at 35 Crescent Road, Caterham, CR3 6LE.

Tandridge District Council Core Strategy (Policy CSP 14 Sustainable Construction) states:

Policy CSP 14

Sustainable Construction

The Council will encourage all residential development (either new build or conversion) to meet Code level 3 as set out in the published Code for Sustainable Homes. Commercial* development with a floor area of 500m² or greater will be encouraged to meet the BREEAM "Very Good" standard.

All new residential development (either new build or conversion) and commercial* development with a floor area of $500m^2$ or greater will be required to reach a minimum percentage saving in CO₂ emissions through the incorporation of on-site renewable energy (as set out in the table below). The requirement varies according to the type of development and in the case of dwellings, the size of development.

| Development Type | Percentage savings in Carbon Dioxide emissions through the provision of renewable energy technologies |
|-----------------------------------|---|
| Dwellings (1-9 units) | 10% |
| Dwellings (10 + units) | 20%** |
| Commercial* (500m ² +) | 10% |

Development over 5000m² will be expected to incorporate combined heat and power or similar technology.

Small scale renewable energy projects will be permitted except where there are overriding environmental, heritage, landscape, amenity or other constraints.

* Commercial includes all forms of non-residential development, for example social and leisure related development.

**Only where a developer can satisfy the Council why the higher target of 20% cannot be achieved will the lower target of 10% be applied.

Based on the above, the proposed dwelling will need to achieve a 10% saving in CO2 emissions through the provision of renewable technologies.

This report demonstrates how the dwellings will meet current L1A Building Regulation requirements for energy efficiency (baseline scenario) and, through an assessment of energy efficient measured and renewable technologies, demonstrates how the dwelling can achieve the required 10% saving in CO2 emissions.



2 Existing and Proposed Development

The site is located at 35 Crescent Road, Caterham, CR3 6LE. (see Figure 1).



As previously detailed, proposals are for the construction of 4 residential terrace houses at 35 Crescent Road, Caterham, CR3 6LE.

The dwellings will face in a Westerly direction.

Given the scale and nature of the site (in particular the adjacent buildings) this constrains the development proposals in terms of the layout, positioning and orientation of the proposed development.

Subsequently, these constraints will impact on the feasibility of certain renewable technologies (as discussed in Section 4 of this report).

Access and egress for the proposed development will be provided off Crescent Road which le ads from Godstone Road.



<u>3</u> <u>SAP 2012 and Building Regulations (2013)</u>

The Standard Assessment Procedure (SAP) 2012 is the UK Government methodology for assessing and calculating the energy performance of dwellings.

The SAP calculation takes into account a range of factors that contribute to energy efficiency, including:

- Materials used for the construction of the dwelling and the thermal insulation of building fabric (u-values1)
- Ventilation of the dwelling
- Efficiency and control of heating systems
- Fuel used to provide space heating,
- Lighting
- Heat recovery systems
- Renewable technologies

Approved Document Part L of current Building Regulations (2013) addresses the conservation of fuel and power. Part L is divided into four separate documents:

- Part L1A Newly Constructed Dwellings
- Part L1B Existing Dwellings
- Part L2A Newly Constructed Non Dwellings
- Part L2B Existing Non Dwellings

Part L1B sets out the minimum energy efficiency requirements for **new dwellings** and is based on the SAP methodology.

To comply with Part L1B, the SAP calculation should demonstrate how the dwellings will either meet or achieve a percentage reduction in the Dwelling Emission Rate (DER) under the required Target Emission Rate (TER).

¹ U-values (Thermal Transmittance) - the measure of the overall rate of heat transfer by all mechanisms under standard conditions, through a particular section of a construction. Lower u-values mean better thermal insulation



4 Baseline Scenario (Part L1A Compliance)

SAP modelling has been used to calculate the Building Regulations compliance threshold for the whole building. The Target Emission Rate forms the baseline from which any CO2 emissions reductions can be measured. Simply complying with the minimum standards for building fabric and services would not usually be sufficient to ensure a 'pass' as the limiting values are designed to allow a degree of flexibility in achieving the main CO2 limiting criterion. A sample of units has been modelled in full with numbers of each type and orientation being approximately proportionally representative of the whole.

Table 1: Baseline Area Weighted Average CO2 Results

| | Calculation |
|--|-------------|
| Target Emission Rate (kg CO2/m²/year) | 17.06 |
| Total Projected Baseline Emissions (kg CO2/year) | 12,212 |

The Baseline Target emission rate for the dwellings assessed is shown to be on average 17.06 (kg CO2/m²/year).

The total Baseline CO2 emissions for the dwellings assessed on average is shown to be 12,212 kg/year and this is to be used as the basis for the assessment.



5 Be Lean Energy Efficiency Improvement Scenario

Be Lean Proposed Strategy

- Minimise demand
- Energy Efficient controls
- Generate energy

The Energy Hierarchy

Useful improvements can be made at all levels, but maximum benefits will be achieved if we focus first on minimising total energy requirements, then look at making better use of the energy we currently use, before thinking about how best to generate it.





In order to ensure that the dwellings exceed the minimum standards as set out in Part L1A, the following measures have been improved and are as proposed:

Table 2: Fabric Standards (u-values W/m²K)

| | Part L1A Limiting Parameters | Notional Dwelling | Proposed Dwelling |
|------------------|------------------------------|----------------------------------|--|
| Walls | 0.30 | 0.18 | 0.2 |
| Ground Floor | 0.25 | 0.13 | 0.11 |
| Roof | 0.20 | 0.13 | 0.1 - 0.13 |
| Windows | 2.0 | 1.4 | 1.3 |
| Air test | 10 | 5 | 4 |
| Ventilation | NA | Natural | Natural |
| Thermal Bridging | NA | 0.05 | ACD 0.05 |
| Heating | 88% | 89% Gas Boiler | 89.6% Gas Boiler |
| Heating controls | NA | Time and temp zone, weather comp | Time and temp zone, delayed start thermostat |
| Lights | 75% | 100% | 100% |
| Thermal mass | NA | Medium | Low |

- Insulation good levels of insulation with u-values exceeding Part L1A requirements (see Table 1)
- Thermal Bridging Accredited Construction Details provide the continuity of insulation and therefore apply a significant improvement factor on the energy performance of a dwelling
- Ventilation design air permeability (DAP) of 4 m³/hm² (@50Pa) (noting that a DAP of 10 m³/hm² (@50Pa) or lower is the Part L1A minimum standard)
- Heating and Controls 89.6% efficient ErP class Gas Combi Boiler with time and temperature zone control and a delayed start thermostat
- Lighting the design of the dwelling allows for natural daylight which will reduce the energy use from internal lighting. All internal lighting will be low energy



The above specification has been incorporated into the baseline SAP calculation; the results are summarised in Table 3 (with the DER worksheet provided in Appendix B).

Table 3: Be Lean Energy Efficient Area Weighted Average

| | Be Lean Results |
|---|-----------------|
| Dwelling Emission Rate (DER) (kg CO2/m²/year) | 14.78 |
| Target Emission Rate (TER) (kg CO2/m²/year) | 17.06 |
| DER/TER Variance | -13.32% |
| Total TER Baseline CO2 Emissions (kg/year) | 12,212 |
| Total DER Baseline CO2 Emissions (kg/year) | 10,614 |

The Be Lean dwelling emission rate CO2 emissions are shown to be on average 14.78 (kg CO2/m²/year).

The total Be Lean CO2 emissions for all dwellings are shown to be in total 10,614kg/year.

Based on the Be Lean calculations, a 13.32% reduction in CO2 emissions can feasibly be achieved solely through improving the fabrics elements, air tightness.



6 Renewable Technology Review

As previously detailed, in order to meet the requirements of CSP 14 of the Core Strategy, the proposed dwellings will aim to achieve a 10% saving in CO2 emissions through the provision of on-site renewable technologies were feasible.

The baseline TER calculation indicates that the total CO2 emissions are 12,212 kg/year. Therefore, to achieve an overall 10% saving in CO2 emissions, we have conducted a renewable technology review below to assess the feasibility of certain renewable measures to achieve the council's target.

RENEWABLE TECHNOLOGIES

The Carbon Trust defines renewable energy as 'energy that occurs naturally and repeatedly in the environment. Therefore, it does not release any net greenhouse gases into the atmosphere'.

There are a range of renewable technologies - some which generate electricity (such as photovoltaic (PV) panels, wind turbines), some which generate heat (such as ground source heat pumps, solar thermal panels for water heating), and some which generate both electricity and heat (Micro Combined Heat and Power). All can afford different benefits in reducing CO2 emissions from a dwelling. However, their feasibility depends on a number of factors including:

- Orientation
- Space (inside and outside of the dwelling)
- Surrounding topography
- Wind speed (for wind turbines)

In determining the most feasible renewable technologies for the dwelling, the following have been reviewed:

- Wind turbines
- Ground Source Heat Pumps
- Air Source Heat Pumps
- Biomass
- Micro Combined Heat and Power
- Photovoltaic Panels
- Solar water heating



WIND TURBINES

Wind turbines are used to produce electricity. They can be either pole mounted (in a suitably exposed position) or building mounted; building mounted systems need a suitable wind resource, and subsequently both a structural survey and planning permission.

The immediate surrounding area is comprised mainly by residential dwellings and the topography of the site is also significantly uneven. As previously noted, the proposed development is situated in close proximity to other existing dwellings, wind turbines will also cause noise issues to the neighbouring properties within this development and are known to be visually unsightly.

As such, wind turbines are not considered to be a suitable or feasible renewable technology for this particular development.

GROUND SOURCE HEAT PUMP (GSHP)

GSHPs use naturally occurring underground low-level heat in areas with appropriate geological features.

Heat is transferred from the ground by either extracting and discharging (re-charging) water from/to the ground directly (open loop) or circulating water through pipes buried within the ground, (closed loop). The water is passed through a heat pump in order to transfer the heat from this water into a higher temperature water circuit used for heating purposes. The loop can be fitted horizontally (laid in a shallow trench) or vertically (in a borehole).

It is important to note that GSHPs require electricity to drive the pump and is therefore not considered a completely 'renewable' technology.

For a GSHP to be installed, there needs to be suitable outdoor space for digging a trench or borehole (and the associated digging machinery) to support the ground loop.

Based on the proposed site layout plan, there would potentially be enough space for the installation of either a horizontal or vertical GSHP system. However, such a system may require a re-working of scheme and layout in order to accommodate plant rooms and infrastructure. The need for in depth design analysis to assess geology and thermal dynamics would be costly and not guarantee feasibility. Scheme success is also highly dependent on expertise and design. System efficiencies degrade over the heating season. Other technologies are available and provide more immediate, straight forward and certain benefits.

As such a GSHP is deemed feasible for consideration in this development, however other technologies would be more suitable.



AIR SOURCE HEAT PUMP (ASHP)

ASHP systems absorbs heat from outside air at a low temperature into a fluid which is then passed through a compressor where its temperature is increased. There are two main types of ASHP systems:

- Air to Water distributes heat through the wet central heating
- Air to Air produces warm air which is circulated by fans

Like GSHPs, ASHPs require electricity to drive the pump and therefore is not a completely 'renewable' system.

For an ASHP system to be installed, there needs to be ample outdoor space for the external condensing unit; these units can also be noisy and blow out colder air to the neighbouring environment.

The plans indicate that there is potentially enough private space for the external condensing unit to the rear of the dwellings. However this would need to be checked with an ASHP installer.

An air source heat pump both external and inside does require a significant amount of space and this would need to be design into the development with a possible reworking of the scheme design. Space would need to be made for a hot water cylinder possibly to the first floor, which is fed from the ASHP. An air source heat pump does make some noise when operating, as both a fan and a compressor will be in motion, however new technologies are being developed to overcome this noise issue.

As such ASHPs are feasible for this development, however an ASHP installer should also review the feasibility of the system.

BIOMASS

Biomass systems burn wood pellets, chips or logs to provide heat in a single room, or to power central heating and hot water boilers.

There needs to be ample space available for both the boiler and the storage of fuel. There will also be regular deliveries of fuel and therefore adequate site access is required.

The biomass boiler system would require a substantial amount of space for large boiler plant plus storage of the wood chip fuel. The transport and delivery of fuel would also have to be considered in terms of impacts to site layout and impact on surroundings. Air quality is also a concern with biomass and the proximity of boiler flues between properties would be an issue and could result in very high outlets. Even with design to mitigate immediate local impact, damaging particulates would be released and cause 'downstream impacts'. There are supply chain drawbacks in terms of security of supply, transport CO2 emissions quality and provenance.

Therefore, biomass is deemed unsuitable for this development.



COMBINED HEAT AND POWER (CHP)

CHP is effectively an on-site small power plant providing both electrical power and thermal heat energy. It is an energy efficiency and low carbon measure rather than a renewable energy technology. A CHP system operates by burning a primary fuel (normally natural gas) by use of either a reciprocating engine or turbine, which in turn drives an alternator to generate electrical power. The heat emitted by the engine and exhaust gases is recovered and used to heat the building or to provide hot water.

The viability of CHP is dependent upon the building base load requirements for both heat and power. Buildings with high heat demands and constant power demands lend themselves to CHP. It is important that the unit is not oversized as this will lead to inefficient operation. Excess generated electricity can be exported to the grid when circumstances allow. The heat generated during this process is supplied to an appropriately matched heat demand that would otherwise be met by a conventional boiler. CHP systems are highly efficient, making use of the heat which would otherwise be wasted when generating electrical or mechanical power. This allows heat requirements to be met that would otherwise require additional fuel to be burnt.

Given there will not be a significant hot water demand at the development, it would not be justified to operate the CHP all year all round at this development. The commercial viability of this type of system therefore would not be suitable for this particular development.

Be Clean - DISTRICT HEATING

District Heating systems provide multiple buildings or dwellings with heat and hot water from a central boiler house, or 'energy centre'. The system can provide heating or cooling which is transferred from the energy centre through a network of highly insulated pipes carrying the heated water to each dwelling.

SOLAR PHOTOVOLTAIC (PV)

Solar PV cells (which are mounted together in panels or tiles on the roof) convert sunlight into electricity. The cells are made from layers of semiconducting material; when the light shines on the cell, an electric field is created across the layers. Although PV cells are most effective in bright sunlight, they can still generate electricity on a cloudy day. The power of a PV cell is measured in kilowatts peak (kWp). Each PV panel produces 0.25Watts to 0.35Watts depending on the manufacture.

In general, PV cells should be installed so that they are orientated in a southerly direction (to face between south-east and south-west), in an unshaded area. The site plan shows that PV on a horizontal angle to the rear flat roof is feasible for all dwellings.

Based on the proposed layout of the dwellings, and that there is no significant over-shading, PV is considered a feasible solution in contributing to the saving in CO2 emissions from the dwellings.



SOLAR HOT WATER

Solar hot water systems absorb energy from the sun and transfer this energy using heat exchangers to heat water. Systems should be roof mounted and oriented to face between a south-east and south-west direction.

There are three main types of solar heating (as defined by the Carbon Trust):

- Flat Plate Collectors a sheet of black metal that absorbs the sun's energy encases the collector system. Water is fed through the system in pipes which conduct the heat to the water
- Evacuated Tubes a series of parallel glass heat tubes grouped together, with each tube containing an absorber tube. Sunlight passes through the outer glass tube to heat the absorber tube which in doing so, the heat is transferred to water flowing through the tube
- Solar Matting a range of extruded hollow sections of flexible black material that can be used for solar collection. Water passes through the hollow tubes absorbing the heat from the sun

Based on the proposed layout of the dwellings, and that there is no significant over-shading, Solar Thermal would be a feasible solution in contributing to a saving in CO2 emissions from the dwellings. Solar PV provides a greater reduction in CO2 emissions compared to Solar Thermal based on the current SAP 2012.

Renewable Technology Summary

The renewable technology review indicates that the most feasible solution to achieve the 10% reduction in CO2 emissions from the dwellings (when compared with the baseline scenario) would be either the incorporation of an Air Source Heat Pump, Solar PV or solar thermal. All of these solutions would work, given the proposed layout of the dwellings and that there is no significant overshading.

For the purpose of showing a further reduction in CO2 via a renewable technology over Part L1a 2013 using SAP 2012, we have used Solar PV as the most suitable technology for this development.

The calculations to demonstrate how Solar PV can achieve the required 10% saving in CO2 emissions (when compared with the baseline scenario) are provided in Section 7 and Appendix C of this report.



7 <u>Be Green Renewable Technology Scenario</u>

In order to demonstrate how the dwellings can meet (or exceed) a 10% saving in CO2 emissions through the incorporation of on-site renewable energy, the baseline TER SAP calculation (as detailed in Section 4 and Appendix A of this report) has been re-run with Solar PV as the most feasible renewable energy solution.

For the purpose of this report, an average 0.3kWp PV system per dwelling has been incorporated, which equates to an overall 3.3kWp system across the whole development (at a 30° angle, facing south), noting that a 0.25kWp system is the smallest sized system. The results are summarised inTable 4 (with the baseline DER worksheet provided in Appendix C).

Table 4: SAP Calculation Results – Be Green – Solar PV Scenario

| | Be Green Results |
|---|------------------|
| Dwelling Emission Rate (DER) (kg CO2/m²/year) | 12.75 |
| Target Emission Rate (TER) (kg CO2/m²/year) | 17.06 |
| DER/TER Variance | -25.23% |
| Total TER Baseline CO2 Emissions (kg/year) | 12,212 |
| Total DER Baseline CO2 Emissions (kg/year) | 9,135 |

A comparison of the baseline calculation results, the energy efficiency scenario results and the results of the calculation with Solar PV included is shown in Table 5 below.

Table 5: Comparison of Calculations (Baseline, Be Lean and Be Green)

| | Baseline Calculation | Be Lean Calculation | Be Green Calculation |
|--|----------------------|---------------------|----------------------|
| Dwelling Emission Rate (DER) (kg CO2/m ² /year) | 7.06 | 14.78 | 12.75 |
| Target Emission Rate (TER) (kg CO2/m ² /year) | 17.06 | 17.06 | 17.06 |
| DER/TER Variance | 0.00% | -13.32% | -25.23% |
| Total DER Baseline CO2 Emissions (kg/year) | 12,212 | 12,212 | 12,212 |
| Total TER Baseline CO2 Emissions (kg/year) | 12,212 | 10,614 | 9,135 |



As required by the local council a minimum 10% saving in CO2 emissions is to be provided through energy efficient measures and through renewable technologies.

By including a 3.3kWp Solar PV System across the whole development, the total CO2 emissions are shown to be 9,135 Kg/ year.

This results in a 25.23% reduction in CO2 emissions Kg/year and therefore exceeds the requirement for a 10% reduction in CO2.

Based on the above, the dwellings can therefore feasibly achieve the targets set out in the Core Strategy.



8 Conclusion

There are proposals for the construction of 4 residential terrace houses at 35 Crescent Road, Caterham, CR3 6LE.

Under the Tandridge Council Core Strategy Policy CSP 14, the proposed dwellings will aim to achieve a minimum 10% saving in CO2 emissions through the provision of renewable technologies.

Given the scale and nature of the site (in particular the adjacent buildings), this constrains the development proposals in terms of the layout, positioning and orientation of the proposed development. Subsequently, these constraints will impact on the feasibility of certain renewable technologies.

A review of renewable technologies indicates that solar PV or an ASHP would be the most feasible solutions to meet the Core Strategy requirements, Solar PV has been used for the basis of the assessment. This would be combined with a high standard of energy efficient measures below.

The following Be Green has been used in the Energy Statement

• 3.3kWp Solar PV System (facing south between 30 – 45-degree angle)

This would be combined with the following Be Lean energy efficient measures

- Low fabric u-values
- High efficient heating system and controls
- High air tightness (air test of 4)

SAP 2012 has used to calculate both a baseline scenario (to meet Building Regulation requirements), a scenario with energy efficient measures and a scenario with Solar PV.

Through the incorporation of a 3.3kWp Solar PV system, this results in a 25.23% reduction in CO2 emissions and therefore exceeds the requirement for a 10% reduction in CO2 emissions.



Appendices



Appendix A TER Worksheet - Baseline Scenario



| Property Reference | EE | | | Issued on Date | 01/03/2024 | | | |
|---------------------------------|---|-----------------|--|----------------|-------------|-----------|--|--|
| Assessment | F1 - EE | | | | | | | |
| Reference | | | | | | | | |
| Property | 35, Crescent Road, Cater | ham, CR3 6LE | | | | | | |
| SAP Rating | 85 B | DER | 15.26 | TER | 17.95 | | | |
| Environmental | | 88 B | % DER <ter< th=""><th></th><th colspan="4">14.96</th></ter<> | | 14.96 | | | |
| CO ₂ Emissions (t/ye | ear) | 1.04 | DFEE | 39.39 | TFEE | 48.98 | | |
| General Requireme | ents Compliance | Pass | % DFEE <tfe< th=""><th>E</th><th colspan="4">19.59</th></tfe<> | E | 19.59 | | | |
| Assessor Details | Mr. Peter Kinsella, Base Ener peter@baseenergy.co.uk | gy Services Ltd | , Tel: 0151 93 | 3 0328, | Assessor ID | L770-0002 | | |
| Client | | | | | | | | |





REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

| REGULATIONS COMPLIANCE REPORT - Approved | Document L1A, 2013 Edition, England | | | | | | | |
|---|---|----|--|--|--|--|--|--|
| DWELLING AS DESIGNED | | | | | | | | |
| End of terrace dwelling, total floor area 117 $\ensuremath{\mathtt{m}}^2$ | | | | | | | | |
| This report covers items included within the SAP calculations. It is not a complete report of regulations compliance. | | | | | | | | |
| la TER and DER Fuel for main heating:Mains gas Fuel factor:1.00 (mains gas) | | | | | | | | |
| Dwelling Carbon Dioxide Emission Rate (DE | K) 17.95 kgCO□/m² ER) 15.26 kgCO□/m²OK | | | | | | | |
| buching carbon brokic Emission actor (DER) 19755 Ageodym ok 1b TFEE and DFEE Target Fabric Energy Efficiency (TFEE) 49.0 kWh/m ² /yr Dublice Energy Efficiency (TFEE) 20.4 kWh/m ² /yr | | | | | | | | |
| 2 Fabric II-values | | | | | | | | |
| Element Average External wall 0.20 (max. 0.30) Party wall 0.00 (max. 0.20) | Highest 0.20 (max. 0.70) OK - OK | | | | | | | |
| Floor 0.11 (max. 0.25) | 0.11 (max. 0.70) OK | | | | | | | |
| Roof (no roof) Openings 1.30 (max. 2.00) | 1.30 (max. 3.30) OK | | | | | | | |
| 2a Thermal bridging Thermal bridging calculated from linear | thermal transmittances for each junction | | | | | | | |
| 3 Air permeability Air permeability at 50 pascals: Maximum | 4.00 (design value) 10.0 | OK | | | | | | |
| 4 Heating efficiency Main heating system: Data from database Vaillant ecoTEC exclusive 843 VUW 436/5- Combi boiler Efficiency: 89.6% SEDBUK2009 Minimum: 88.0% | 4 Heating efficiency Main heating system: Boiler system with radiators or underfloor - Mains gas Data from database Vaillant ecoTEC exclusive 843 VUW 436/5-7 (H-GB) Combi boiler Efficiency: 89.6% SEDBUK2009 Mainware 40.0% | | | | | | | |
| Secondary heating system: | None | | | | | | | |
| 5 Cylinder insulation Hot water storage | No cylinder | | | | | | | |
| 6 Controls Space heating controls: | Time and temperature zone control | OK | | | | | | |
| Hot water controls: | No cylinder | | | | | | | |
| Boiler interlock | Yes | OK | | | | | | |
| 7 Low energy lights Percentage of fixed lights with low-ener Minimum | gy fittings:100% 75% | OK | | | | | | |
| 8 Mechanical ventilation Not applicable | | | | | | | | |
| 9 Summertime temperature Overheating risk (Thames Valley): | Slight | OK | | | | | | |
| Based on: Overshading: Average | | | | | | | | |
| Windows facing North: | 2.86 m², No overhang | | | | | | | |
| Windows facing West: | 11.55 m², No overhang | | | | | | | |
| Blinds/curtains: | None | | | | | | | |
| 10 Key features Party wall U-value Exposed floor U-value | 0.00 W/m²K 0.11 W/m²K | | | | | | | |





CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014) CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

| 1. Overall dwelling dimensions | | | | | | | | | | |
|---|---------|--------------|-----------|----------|------|---|----------|-------------|--|--|
| | | | | | | | | | | |
| | | Area | Storey | height | | | Volume | | | |
| | | (m2) | | (m) | | | (m3) | | | |
| Ground floor | | 77.0000 (1b) | x | 2.4000 | (2b) | = | 184.8000 | (1b) - (3b) | | |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)(1n) | 77.0000 | | | | | | | (4) | | |
| Dwelling volume | | (3a)+(3b) |)+(3c)+(3 | d)+(3e). | (3n) | = | 184.8000 | (5) | | |

2. Ventilation rate

| | | | | | main heating | | secondary heating | | other | | total | r | n3 per hour | |
|-------------------------|-------------------------|--------------|------------|---------------|-----------------|--------|----------------------|------|----------|--------|-----------|----------|--------------|-------|
| Number of chimne | eys | | | | 0 | + | 0 | + | 0 | = | 0 | * 40 = | 0.0000 | (6a) |
| Number of open flues | | | | | 0 | + | 0 | + | 0 | = | 0 | * 20 = | 0.0000 | (6b) |
| Number of passive vents | | | | | | | | | | 0 | * 10 = | 30,0000 | (/a) (7b) | |
| Number of fluele | ve vents see dae fin | | | | | | | | | | 0 | * 40 = | 0 0000 | (7c) |
| Number of fidere | .55 gus III | | | | | | | | | | 0 | 10 | 0.0000 | (, 0) |
| | | | | | | | | | | | Ai | r change | es per hour | |
| Infiltration due | e to chimne | eys, flues a | and fans | = (6a)+(6b)+(| 7a)+(7b)+(| (7c) = | | | | 30 | .0000 / | (5) = | 0.1623 | (8) |
| Pressure test | | | | | | | | | | | | | Yes | |
| Measured/design | AP50 | | | | | | | | | | | | 4.0000 | |
| Infiltration rat | ie | | | | | | | | | | | | 0.3623 | (18) |
| Number of sides | sheltered | | | | | | | | | | | | 2 | (19) |
| Shelter factor | | | | | | | | | (20) = 1 | - [0. | 075 x (1 | 9)] = | 0.8500 | (20) |
| Infiltration rat | e adjusted | d to include | shelter fa | ctor | | | | | | (21) = | (18) x (2 | 20) = | 0.3080 | (21) |
| | | | | | | | | | | | | | | |
| | Jan | Feb | Mar | Apr | Mav | สมภ | Jul | Aug | Sep | 0ct | + | Nov | Dec | |
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.800 | 0 3.8000 | 3.70 | 00 4.000 | 0 4.3 | 3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.950 | 0 0.9500 | 0.92 | 50 1.000 | 0 1.0 | 0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | | | | | | | | | | | | | | |
| | 0.3927 | 0.3850 | 0.3773 | 0.3388 | 0.3311 | 0.292 | 6 0.2926 | 0.28 | 49 0.308 | 0.0 | 3311 | 0.3465 | 0.3619 | (22b) |
| Effective ac | 0.5771 | 0.5741 | 0.5712 | 0.5574 | 0.5548 | 0.542 | 8 0.5428 | 0.54 | 06 0.547 | 4 0.5 | 5548 | 0.5600 | 0.5655 | (25) |

| Flement Cross Openings Natārea II-valus à v II K-valus à | x K J/K |
|--|------------|
| Dicasono di dicaso de la contrada de | J/K |
| m2 m2 m2 W/m2K W/K kJ/m2K | |
| Window (Uw = 1.30) 14.4100 1.2357 17.8070 | (27) |
| Heat Loss Floor 1 77.0000 0.1100 8.4700 | (28b) |
| External Wall 1 50.6500 14.4100 36.2400 0.2000 7.2480 | (29a) |
| Total net area of external elements Aum(A, m2) 127.6500 | (31) |
| Fabric heat loss, $W/K = Sum (A \times U)$ (26)(30) + (32) = 33.5250 | (33) |
| Party Wall 1 53.0000 0.0000 0.0000 | (32) |
| - | |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 100. | 000 (35) |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) 12. | 215 (36) |
| Total fabric heat loss (33) + (36) = 45. | 465 (37) |
| | |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) | |
| Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov De | |
| (38)m 35.1939 35.0113 34.8323 33.9917 33.8345 33.1023 33.1023 32.9668 33.3843 33.8345 34.1526 34. | 852 (38) |
| Heat transfer coeff | |
| 80.8404 80.6578 80.4789 79.6383 79.4810 78.7489 78.7489 78.6133 79.0309 79.4810 79.7992 80. | 318 (39) |
| Average = Sum(39)m / 12 = 79. | 375 (39) |
| | |
| Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov De | |
| HLP 1.0499 1.0475 1.0452 1.0343 1.0322 1.0227 1.0227 1.0210 1.0264 1.0322 1.0364 1. | 407 (40) |
| HLP (average) 1. | 343 (40) |
| Days in month | |
| 31 28 31 30 31 30 31 31 30 31 30 | 31 (41) |

| 4. Water heating energy requirements (kWh/year) | | | | | | | | | | | | | |
|---|--------------------|---------------------|----------|----------|----------|---------|---------|----------|----------|------------|-------------|---------------------------|----------|
| Assumed occupa Average daily | ncy hot water u | se (litres/ | day) | | | | | | | | | 2.4035 (42 91.2825 (43 | 2) 3) |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| Daily hot wate | er use | | | | | | | | | | | | |
| | 100.4108 | 96.7595 | 93.1082 | 89.4569 | 85.8056 | 82.1543 | 82.1543 | 85.8056 | 89.4569 | 93.1082 | 96.7595 | 100.4108 (44 | 1) |
| Energy conte | 148.9063 | 130.2344 | 134.3902 | 117.1646 | 112.4223 | 97.0119 | 89.8957 | 103.1567 | 104.3887 | 121.6550 | 132.7959 | 144.2078 (45 | i) |
| Energy content | (annual) | | | | | | | | | Total = Su | um (45) m = | 1436.2293 (45 |) |
| Distribution 1 | .oss (46)m | $= 0.15 \times (4)$ | 5) m | | | | | | | | | | |
| | 22.3359 | 19.5352 | 20.1585 | 17.5747 | 16.8633 | 14.5518 | 13.4844 | 15.4735 | 15.6583 | 18.2482 | 19.9194 | 21.6312 (46 | 5) |
| Water storage | loss: | | | | | | | | | | | | |
| Total storage | loss | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (56 | S) |
| If cylinder co | ntains dedi | cated solar | storage | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (57 | 7) |
| Combi loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (61 | L) |





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| Total | heat req | uired for | water heati | ng calculate | ed for each | month | | | | | | 100 5050 | |
|--------|-----------|------------|--------------|--------------|-------------|----------|---------|---------|------------|-------------|--------------|-------------|----------------|
| | | 148.9063 | 130.2344 | 134.3902 11 | 7.1646 112 | .4223 | 97.0119 | 89.895/ | 103.156/ | 104.388/ | 121.6550 | 132./959 | 144.2078 (62) |
| Solar | input | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (63) |
| | | | | | | | | | Solar inpu | t (sum of n | uonths) = Su | um (63) m = | 0.0000 (63) |
| FGHRS | | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Output | from w/l | h | | | | | | | | | | | |
| | | 148.9063 | 130.2344 | 134.3902 | 117.1646 | 112.4223 | 97.0119 | 89.8957 | 103.1567 | 104.3887 | 121.6550 | 132.7959 | 144.2078 (64) |
| | | | | | | | | | Total p | er year (kW | h/year) = S | um(64)m = | 1436.2293 (64) |
| Heat g | ains from | n water he | ating, kWh/m | month | | | | | | | | | |
| 5 | | 49.5113 | 43.3029 | 44.6847 | 38.9572 | 37.3804 | 32.2564 | 29.8903 | 34.2996 | 34.7092 | 40.4503 | 44.1546 | 47.9491 (65) |

| 5. Internal g | ains (see Ta | uble 5 and 5 | 5a) | | | | | | | | | |
|---------------|--------------|--------------|--------------|-------------|-------------|-------------|----------|----------|----------|----------|----------|---------------|
| Metabolic gai | ns (Table 5) | , Watts | | | | | | | | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
| (66)m | 120.1737 | 120.1737 | 120.1737 | 120.1737 | 120.1737 | 120.1737 | 120.1737 | 120.1737 | 120.1737 | 120.1737 | 120.1737 | 120.1737 (66) |
| Lighting gain | s (calculate | ed in Append | dix L, equat | ion L9 or L | 9a), also s | ee Table 5 | | | | | | |
| | 19.2861 | 17.1297 | 13.9308 | 10.5465 | 7.8837 | 6.6557 | 7.1917 | 9.3481 | 12.5470 | 15.9313 | 18.5942 | 19.8221 (67) |
| Appliances ga | ins (calcula | ated in App | endix L, equ | ation L13 d | or L13a), a | lso see Tab | le 5 | | | | | |
| | 213.0566 | 215.2674 | 209.6961 19 | 7.8355 182 | 2.8636 168. | 7921 159.3 | 915 | 157.1806 | 162.7519 | 174.6125 | 189.5845 | 203.6559 (68) |
| Cooking gains | (calculated | d in Append: | ix L, equati | on L15 or L | 15a), also | see Table 5 | | | | | | |
| | 35.0174 | 35.0174 | 35.0174 | 35.0174 | 35.0174 | 35.0174 | 35.0174 | 35.0174 | 35.0174 | 35.0174 | 35.0174 | 35.0174 (69) |
| Pumps, fans | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 (70) |
| Losses e.g. e | vaporation (| negative va | alues) (Tabl | e 5) | | | | | | | | |
| | -96.1390 | -96.1390 | -96.1390 | -96.1390 | -96.1390 | -96.1390 | -96.1390 | -96.1390 | -96.1390 | -96.1390 | -96.1390 | -96.1390 (71) |
| Water heating | gains (Tabl | .e 5) | | | | | | | | | | |
| | 66.5475 | 64.4389 | 60.0601 | 54.1073 | 50.2425 | 44.8006 | 40.1752 | 46.1016 | 48.2073 | 54.3687 | 61.3259 | 64.4477 (72) |
| Total interna | l gains | | | | | | | | | | | |
| | 360.9423 | 358.8882 | 345.7392 | 324.5414 | 303.0418 | 282.3005 | 268.8105 | 274.6824 | 285.5583 | 306.9646 | 331.5566 | 349.9779 (73) |
| | | | | | | | | | | | | |

6. Solar gains

| [Jan] | Jan] | | Area m2 | | Solar flux g Table 6a Specific data W/m2 or Table 6b | | g fic data Table 6b | FF Specific data or Table 6c | | Access factor Table 6d | | Gains W | |
|----------------------------|---------------------|----------------------|----------------------|----------------------|--|----------------------|---------------------------|------------------------------------|----------------------|------------------------------|---------------------|---------------------|--------------|
| North West | | | 2.8600 11.5500 | | 10.6334 19.6403 | | 0.6300 0.6300 | 0 0 | .7000 .7000 | 0.770 | 00 | 9.2941 69.3268 | (74) (80) |
| Solar gains Total gains | 78.6209 439.5632 | 153.3795 512.2677 | 253.5247 599.2639 | 374.2119 698.7534 | 464.5036 767.5454 | 478.5617 760.8623 | 454.3230 723.1335 | 385.9741 660.6565 | 296.0453 581.6036 | 182.0649 489.0295 | 97.9079 429.4645 | 64.7590 414.7369 | (83) (84) |

| 7. Mean inte | rnal temperat | ure (heatin | g season) | | | | | | | | | | |
|--------------|---------------|-------------|-------------|-------------|-------------|---------|---------|---------|---------|-------------|---------|---------|------|
| Temperature | during heatin | g periods i | n the livin | g area from | Table 9, Th | nl (C) | | | | | | 21.0000 | (85) |
| Utilisation | factor for ga | ins for liv | ing area, n | il,m (see T | able 9a) | | | | | | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| tau | 26.4582 | 26.5181 | 26.5770 | 26.8575 | 26.9107 | 27.1609 | 27.1609 | 27.2077 | 27.0640 | 26.9107 | 26.8034 | 26.6921 | |
| alpha | 2.7639 | 2.7679 | 2.7718 | 2.7905 | 2.7940 | 2.8107 | 2.8107 | 2.8138 | 2.8043 | 2.7940 | 2.7869 | 2.7795 | |
| util living | area | | | | | | | | | | | | |
| 2 | 0.9692 | 0.9524 | 0.9165 | 0.8408 | 0.7224 | 0.5737 | 0.4456 | 0.4968 | 0.7130 | 0.8909 | 0.9552 | 0.9735 | (86) |
| MIT | 18.7790 | 19.0498 | 19.5128 | 20.0909 | 20.5532 | 20.8361 | 20.9410 | 20.9189 | 20.6833 | 20.0544 | 19.3117 | 18.7271 | (87) |
| Th 2 | 20.0420 | 20.0439 | 20.0459 | 20.0549 | 20.0566 | 20.0644 | 20.0644 | 20.0659 | 20.0614 | 20.0566 | 20.0531 | 20.0496 | (88) |
| util rest of | house | | | | | | | | | | | | |
| | 0.9647 | 0.9455 | 0.9042 | 0.8172 | 0.6811 | 0.5097 | 0.3617 | 0.4113 | 0.6555 | 0.8693 | 0.9476 | 0.9695 | (89) |
| MIT 2 | 17.0547 | 17.4468 | 18.1124 | 18.9314 | 19.5557 | 19.9133 | 20.0245 | 20.0075 | 19.7422 | 18.8998 | 17.8361 | 16.9839 | (90) |
| Living area | fraction | | | | | | | | ILA = | Living area | / (4) = | 0.3519 | (9I) |
| MIT | 17.6616 | 18.0109 | 18.6053 | 19.3395 | 19.9068 | 20.2381 | 20.3471 | 20.3282 | 20.0734 | 19.3061 | 18.3555 | 17.5974 | (92) |
| Temperature | adjustment | | | | | | | | | | | -0.1500 | |
| adjusted MIT | 17.5116 | 17.8609 | 18.4553 | 19.1895 | 19.7568 | 20.0881 | 20.1971 | 20.1782 | 19.9234 | 19.1561 | 18.2055 | 17.4474 | (93) |

| 8. | Space heating requirement |
|----|---------------------------|
| | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|----------------|-----------|-----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-------|
| Utilisation | 0.9476 | 0.9240 | 0.8780 | 0.7917 | 0.6667 | 0.5114 | 0.3741 | 0.4222 | 0.6460 | 0.8434 | 0.9268 | 0.9540 | (94) |
| Useful gains | 416.5107 | 473.3448 | 526.1675 | 553.2188 | 511.6888 | 389.1096 | 270.5394 | 278.9220 | 375.7181 | 412.4388 | 398.0466 | 395.6490 | (95) |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | (96) |
| Heat loss rate | e W | | | | | | | | | | | | |
| | 1068.0301 | 1045.4019 | 962.1469 | 819.4379 | 640.3603 | 432.1805 | 283.2639 | 297.0200 | 460.2276 | 680.0485 | 886.2061 | 1061.5389 | (97) |
| Month fracti | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 1.0000 | 1.0000 | 1.0000 | (97a) |
| Space heating | kWh | | | | | | | | | | | | |
| | 484.7305 | 384.4224 | 324.3686 | 191.6778 | 95.7316 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 199.1016 | 351.4748 | 495.4221 | (98) |
| Space heating | | | | | | | | | | | | 2526.9294 | (98) |
| Space heating | per m2 | | | | | | | | | (98) | / (4) = | 32.8173 (| (99) |

8c. Space cooling requirement

Not applicable

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





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| Fraction of s Fraction of s Efficiency of Efficiency of Space heating | pace heat fro pace heat fro main space secondary/s requirement | om secondar om main sys heating sys upplementa | ry/supplemer stem(s) stem 1 (in % ry heating s | ntary system 3) System, % | n (Table 11) | | | | | | | 0.0000 1.0000 90.5000 0.0000 2792.1872 | (201) (202) (206) (208) (211) |
|---|--|---|---|---------------------------------|--------------|-----------|----------|---|----------|--|----------|--|---|
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| Space heating | requirement 484.7305 | 384.4224 | 324.3686 | 191.6778 | 95.7316 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 199.1016 | 351,4748 | 495.4221 | (98) |
| Space heating | efficiency | (main heati | ing system 1 | .) | 00 5000 | 0.0000 | 0 0000 | 0.0000 | 0 0000 | 00 5000 | 00 5000 | 00 5000 | (210) |
| Space heating | fuel (main) | 90.5000 heating svs | 90.5000 stem) | 90.5000 | 90.5000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 90.5000 | 90.5000 | 90.5000 | (210) |
| | 535.6138 | 424.7761 | 358.4184 | 211.7986 | 105.7808 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 220.0018 | 388.3700 | 547.4278 | (211) |
| Water heating | requirement 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (215) |
| Water heating | | | | | | | | | | | | | |
| Water heating | requirement 148.9063 | 130.2344 | 134.3902 | 117.1646 | 112.4223 | 97.0119 | 89.8957 | 103.1567 | 104.3887 | 121.6550 | 132.7959 | 144.2078 | (64) |
| Efficiency of (217)m | water heate 88.8310 | r 88.7053 | 88.4289 | 87.8358 | 86.7538 | 83.8000 | 83.8000 | 83.8000 | 83.8000 | 87.8365 | 88.5584 | 83.8000 88.8976 | (216) (217) |
| Fuel for wate | er heating, k 167.6288 | Wh/month 146.8169 | 151.9755 | 133.3905 | 129.5877 | 115.7659 | 107.2742 | 123.0987 | 124.5689 | 138.5017 | 149.9529 | 162.2179 | (219) |
| Water heating Annual totals | fuel used kWh/year | | | | | | | | | | | 1650.7794 | (219) |
| Space heating | fuel - main | system | | | | | | | | | | 2792.1872 | (211) |
| Space heating | fuel - seco | ndary | | | | | | | | | | 0.0000 | (215) |
| Electricity f central he main heati | or pumps and ating pump ng flue fan | fans: | | | | | | | | | | 30.0000 45.0000 | (230c) (230e) |
| Total electri | city for the | above, kWh | n/year | | | | | | | | | 75.0000 | (231) |
| Total deliver | ed energy fo | (calculated r all uses | a in Appenai | LX L) | | | | | | | | 4858.5652 | (232) |
| | | | | | | | | | | | | | |
| 12a. Carbon d | ioxide emiss | ions - Indi | ividual heat | ing systems | including n | micro-CHP | | | | | | | |
| Space heating Space heating | - main syst - secondary | em 1 | | | | | | Energy kWh/year 2792.1872 0.0000 | Emiss | ion factor kg CO2/kWh 0.2160 0.0000 | 1 | Emissions kg CO2/year 603.1124 0.0000 | (261) (263) |

| | Flierdy | EMIISSION LACCOL | | FULSSIOUS | |
|---|-------------------------|------------------|-----|------------|-------|
| | kWh/year | kg CO2/kWh |] | g CO2/year | |
| Space heating - main system 1 | 2792.1872 | 0.2160 | | 603.1124 | (261) |
| Space heating - secondary | 0.0000 | 0.0000 | | 0.0000 | (263) |
| Water heating (other fuel) | 1650.7794 | 0.2160 | | 356.5683 | (264) |
| Space and water heating | | | | 959.6808 | (265) |
| Pumps and fans | 75.0000 | 0.5190 | | 38.9250 | (267) |
| Energy for lighting | 340.5986 | 0.5190 | | 176.7707 | (268) |
| Total CO2, kg/year | | | | 1175.3764 | (272) |
| Dwelling Carbon Dioxide Emission Rate (DER) | | | | 15.2600 | (273) |
| 16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY (| GENERATION TECHNOLOGIES | | | | |
| DER | | | | 15.2600 | ZC1 |
| Total Floor Area | | | TFA | 77.0000 | |
| Assumed number of occupants | | | N | 2.4035 | |
| CO2 emission factor in Table 12 for electricity displaced from grid | | | EF | 0.5190 | |
| CO2 emissions from appliances, equation (L14) | | | | 16.3965 | ZC2 |
| CO2 emissions from cooking, equation (L16) | | | | 2.2946 | ZC3 |
| Total CO2 emissions | | | | 33.9511 | ZC4 |
| Residual CO2 emissions offset from biofuel CHP | | | | 0.0000 | ZC5 |
| Additional allowable electricity generation, kWh/m²/year | | | | 0.0000 | ZC6 |
| Resulting CO2 emissions offset from additional allowable electricity generation | | | | 0.0000 | ZC7 |
| Net CO2 emissions | | | | 33.9511 | ZC8 |
| | | | | | |





CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014) CALCULATION OF TARGET EMISSIONS 09 Jan 2014

| 1. Overall dwelling dimensions | | | | | | |
|---|---------|--------------|--------|---------------|-----|----------------------|
| - | | | | | | |
| | | Area | Sto | rey height | | Volume |
| | | (m2) | | (m) | | (m3) |
| Ground floor | | 77.0000 (1b) | х | 2.4000 (2b) | = | 184.8000 (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)(1n) | 77.0000 | | | | | (4) |
| Dwelling volume | | (3a)+(3b |)+(3c) | +(3d)+(3e)(3n |) = | 184.8000 (5) |

2. Ventilation rate

| Number of chimne | ys | | | | main heating 0 | + | secondary heating 0 | + | other 0 = | tota | 1 m3 0 * 40 = | 9 per hour 0.0000 (6a) |
|--|-------------------------|---------------|---------------|---------------|----------------------|--------|---------------------------|---------------|--------------|------------|-----------------------------|-----------------------------|
| Number of open f | lues | | | | 0 | + | 0 | + | 0 = | (| 0 * 20 = | 0.0000 (6b) |
| Number of intern | nittent fam no worte | ns | | | | | | | | | 3 * 10 = | 30.0000 (7a) |
| Number of fluele | ss gas fir | res | | | | | | | | (| $0 \times 10 =$ 0 × 40 = | 0.0000 (7b) |
| | | | | | | | | | | ; | Air changes | per hour |
| Infiltration due Pressure test Measured/design | to chimne AP50 | eys, flues a | ind fans = | = (6a)+(6b)+ | (7a)+(7b)+(| 7c) = | | | | 30.0000 | / (5) = | 0.1623 (8) Yes 5.0000 |
| Infiltration rat Number of sides | e sheltered | | | | | | | | | | | 0.4123 (18) 2 (19) |
| Shelter factor | | | | | | | | | (20) = 1 - | [0.075 x | (19)] = | 0.8500 (20) |
| Infiltration rat | e adjusted | d to include | shelter fa | ctor | | | | | (21 |) = (18) x | (20) = | 0.3505 (21) |
| | | To b | M | | | | T] | | 0 | 0 | N | Dee |
| Wind speed | Jan 5 1000 | Feb 5 0000 | Mar 4 9000 | Apr 4 4000 | May 4 3000 | 3 8000 | 3 8000 | Aug 3 7000 | 4 0000 | 4 3000 | 4 5000 | 4 7000 (22) |
| Wind factor Adi infilt rate | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| , | 0.4469 | 0.4381 | 0.4293 | 0.3855 | 0.3768 | 0.3330 | 0.3330 | 0.3242 | 0.3505 | 0.3768 | 0.3943 | 0.4118 (22b) |
| Effective ac | 0.5998 | 0.5960 | 0.5922 | 0.5743 | 0.5710 | 0.5554 | 0.5554 | 0.5526 | 0.5614 | 0.5710 | 0.5777 | 0.5848 (25) |

| 3. Heat losses | and heat l | oss paramet | er | | | | | | | | | | |
|------------------|---------------|---------------|--------------|--------------------|------------|---------|---------|--------------|---------|---------|----------|----------|---------|
| Element | | | | Gross | Openings | Net | tArea | U-value | АхU | K- | -value | АхК | |
| | | | | m2 | m2 | | m2 | W/m2K | W/K | t 1 | cJ/m2K | kJ/K | |
| TER Opening Tvg | be $(Uw = 1.$ | 40) | | | | 14 | .4100 | 1.3258 | 19.1042 | | | | (27) |
| Heat Loss Floor | r 1 | - / | | | | 77 | .0000 | 0.1300 | 10.0100 | | | | (28b) |
| External Wall 1 | 1 | | | 50 6500 | 14 4100 | 36 | 2400 | 0 1800 | 6 5232 | | | | (29a) |
| Total net area | of externa | l elements : | Aum (A. m2) | 00.0000 | 11.1100 | 127 | 6500 | 0.1000 | 0.0202 | | | | (31) |
| Tobai a beat la | W/V = 0 | | (III) (III) | | | 127 | (26) (| 201 (221 - | 25 6274 | | | | (32) |
| rabiic neat ios | 55, W/A - 5 | uni (A X U) | | | | | (20)(| 30) + (32) - | 55.6574 | | | | (33) |
| Thormal maga no | arameter (T | MD - Cm / T | ED) in kT/m | 24 | | | | | | | | 250 0000 | (25) |
| Thermal hass po | arameter (r | Pir = Cin / 1 | eted weine | LIL Namondiu VI | | | | | | | | 10.1070 | (35) |
| Inermai bridges | s (Sum(L X | PSI) Calcul | ated using A | Appendix K) | | | | | | (22) | | 12.10/0 | (30) |
| Total fabric he | eat loss | | | | | | | | | (33) | + (36) = | 4/.8244 | (37) |
| | | | | 0 00 /0 | | | | | | | | | |
| Ventilation hea | at loss cal | culated mon | thiy (38)m | = 0.33 x (2) | 5) m x (5) | | | | | | | | |
| | Jan | Feb | Mar | Apr | мау | Jun | Jul | Aug | Sep | OCt | NOV | Dec | |
| (38)m | 36.5811 | 36.3446 | 36.1128 | 35.0243 | 34.8206 | 33.8725 | 33.8725 | 33.6969 | 34.2377 | 34.8206 | 35.2326 | 35.6634 | (38) |
| Heat transfer o | coeff | | | | | | | | | | | | |
| | 84.4054 | 84.1690 | 83.9372 | 82.8486 | 82.6450 | 81.6968 | 81.6968 | 81.5213 | 82.0620 | 82.6450 | 83.0570 | 83.4877 | (39) |
| Average = Sum (3 | 39)m / 12 = | | | | | | | | | | | 82.8477 | (39) |
| | | | | | | | | | | | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| HLP | 1.0962 | 1.0931 | 1.0901 | 1.0760 | 1.0733 | 1.0610 | 1.0610 | 1.0587 | 1.0657 | 1.0733 | 1.0787 | 1.0843 | (40) |
| HLP (average) | | | | | | | | | | | | 1.0759 | (40) |
| Davs in month | | | | | | | | | | | | | (/ |
| bayo in month | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | (41) |
| | 51 | 20 | 51 | 50 | 51 | 50 | 51 | 51 | 50 | 51 | 50 | 51 | (+ +) |

| 4. Water heati | ng energy r | equirements | (kWh/year) | | | | | | | | | | |
|---------------------------------|---------------------|-------------|-------------|--------------|----------|---------|---------|----------|----------|------------|-------------|-------------------|--------------|
| Assumed occupa Average daily | ancy hot water u | se (litres/ | day) | | | | | | | | | 2.4035 91.2825 | (42) (43) |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| Daily hot wate | er use | | | | | | | | | | | | |
| | 100.4108 | 96.7595 | 93.1082 | 89.4569 | 85.8056 | 82.1543 | 82.1543 | 85.8056 | 89.4569 | 93.1082 | 96.7595 | 100.4108 | (44) |
| Energy conte | 148.9063 | 130.2344 | 134.3902 | 117.1646 | 112.4223 | 97.0119 | 89.8957 | 103.1567 | 104.3887 | 121.6550 | 132.7959 | 144.2078 | (45) |
| Energy content | : (annual) | | | | | | | | | Total = Su | 1m (45) m = | 1436.2293 | (45) |
| Distribution 1 | Loss (46)m | = 0.15 x (4 | 5)m | | | | | | | | | | |
| | 22.3359 | 19.5352 | 20.1585 | 17.5747 | 16.8633 | 14.5518 | 13.4844 | 15.4735 | 15.6583 | 18.2482 | 19.9194 | 21.6312 | (46) |
| Water storage | loss: | | | | | | | | | | | | |
| Total storage | loss | | | | | | | | | | | | |
| - | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (56) |
| If cylinder co | ntains dedi | cated solar | storage | | | | | | | | | | |
| - | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (57) |
| Combi loss | 50.9589 | 44.5359 | 47.4469 | 44.1157 | 43.7256 | 40.5144 | 41.8649 | 43.7256 | 44.1157 | 47.4469 | 47.7170 | 50.9589 | (61) |
| Total heat rec | quired for w | ater heatin | g calculate | d for each n | month | | | | | | | | |



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| | 199.8652 | 174.7702 | 181.8371 | 161.2803 | 156.1478 | 137.5263 | 131.7607 | 146.8823 | 148.5044 | 169.1019 | 180.5129 | 195.1667 (62) |
|-----------------|-------------|-------------|----------|----------|----------|----------|----------|------------|-------------|-------------|-------------|----------------|
| Solar input | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (63) |
| | | | | | | | | Solar inpu | t (sum of m | onths) = Su | um (63) m = | 0.0000 (63) |
| Output from w/ | h | | | | | | | | | | | |
| - | 199.8652 | 174.7702 | 181.8371 | 161.2803 | 156.1478 | 137.5263 | 131.7607 | 146.8823 | 148.5044 | 169.1019 | 180.5129 | 195.1667 (64) |
| | | | | | | | | Total pe | r year (kWh | /year) = Su | um (64) m = | 1983.3557 (64) |
| Heat gains from | m water hea | ting, kWh/m | onth | | | | | | | | | |
| 2 | 62.2511 | 54.4369 | 56.5465 | 49.9862 | 48.3118 | 42.3850 | 40.3566 | 45.2310 | 45.7382 | 52.3120 | 56.0839 | 60.6888 (65) |

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

| Metabolic gai | ns (Table 5) | , Watts | | | | | | | | | | |
|---------------|--------------|--------------|--------------|-------------|-------------|-------------|----------|----------|----------|----------|----------|---------------|
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
| (66)m | 120.1737 | 120.1737 | 120.1737 | 120.1737 | 120.1737 | 120.1737 | 120.1737 | 120.1737 | 120.1737 | 120.1737 | 120.1737 | 120.1737 (66) |
| Lighting gain | s (calculate | ed in Append | dix L, equat | ion L9 or L | 9a), also s | ee Table 5 | | | | | | |
| | 19.2861 | 17.1297 | 13.9308 | 10.5465 | 7.8837 | 6.6557 | 7.1917 | 9.3481 | 12.5470 | 15.9313 | 18.5942 | 19.8221 (67) |
| Appliances ga | ins (calcula | ated in App | endix L, eq | ation L13 | or L13a), a | lso see Tab | Le 5 | | | | | |
| | 213.0566 | 215.2674 | 209.6961 19 | 7.8355 182 | 2.8636 168. | 7921 159.3 | 915 | 157.1806 | 162.7519 | 174.6125 | 189.5845 | 203.6559 (68) |
| Cooking gains | (calculated | i in Append: | ix L, equati | on L15 or L | 15a), also | see Table 5 | | | | | | |
| | 35.0174 | 35.0174 | 35.0174 | 35.0174 | 35.0174 | 35.0174 | 35.0174 | 35.0174 | 35.0174 | 35.0174 | 35.0174 | 35.0174 (69) |
| Pumps, fans | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 (70) |
| Losses e.g. e | vaporation (| negative va | alues) (Tabl | e 5) | | | | | | | | |
| | -96.1390 | -96.1390 | -96.1390 | -96.1390 | -96.1390 | -96.1390 | -96.1390 | -96.1390 | -96.1390 | -96.1390 | -96.1390 | -96.1390 (71) |
| Water heating | gains (Tabl | Le 5) | | | | | | | | | | |
| | 83.6708 | 81.0073 | 76.0033 | 69.4252 | 64.9352 | 58.8681 | 54.2427 | 60.7943 | 63.5252 | 70.3118 | 77.8943 | 81.5710 (72) |
| Total interna | l gains | | | | | | | | | | | |
| | 378.0656 | 375.4566 | 361.6824 | 339.8594 | 317.7346 | 296.3680 | 282.8780 | 289.3752 | 300.8763 | 322.9078 | 348.1250 | 367.1012 (73) |
| | | | | | | | | | | | | |

6. Solar gains

| [Jan] | | Area So m2 | | Solar flux g Table 6a Specific data W/m2 or Table 6b | | FF Specific data or Table 6c | | Access factor Table 6d | | Gains W | | | |
|----------------------------|---------------------|----------------------|----------------------|--|----------------------|------------------------------------|----------------------|------------------------------|----------------------|----------------------|---------------------|---------------------|--------------|
| North West | :h : | | 2.8 11.5 | 500 500 | 10.6334 19.6403 | | 0.6300 0.6300 | 0 | .7000 .7000 | 0.770 | 00 00 | 9.2941 69.3268 | (74) (80) |
| Solar gains Total gains | 78.6209 456.6865 | 153.3795 528.8361 | 253.5247 615.2071 | 374.2119 714.0713 | 464.5036 782.2381 | 478.5617 774.9298 | 454.3230 737.2010 | 385.9741 675.3493 | 296.0453 596.9216 | 182.0649 504.9727 | 97.9079 446.0329 | 64.7590 431.8602 | (83) (84) |

| 7. Mean inter | nal temperat | ure (heatin | g season) | | | | | | | | | |
|----------------|--------------|-------------|--------------|-------------|-------------|---------|---------|---------|---------|-------------|---------|--------------|
| Temperature d | uring heatin | g periods i | n the living | g area from | Table 9, Th | 11 (C) | | | | | | 21.0000 (85) |
| Utilisation f | actor for ga | ins for liv | ing area, n | il,m (see T | able 9a) | | | | | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
| tau | 63.3516 | 63.5296 | 63.7050 | 64.5421 | 64.7011 | 65.4520 | 65.4520 | 65.5930 | 65.1607 | 64.7011 | 64.3802 | 64.0480 |
| alpha | 5.2234 | 5.2353 | 5.2470 | 5.3028 | 5.3134 | 5.3635 | 5.3635 | 5.3729 | 5.3440 | 5.3134 | 5.2920 | 5.2699 |
| util living a | rea | | | | | | | | | | | |
| | 0.9981 | 0.9956 | 0.9860 | 0.9460 | 0.8341 | 0.6457 | 0.4822 | 0.5445 | 0.8193 | 0.9747 | 0.9960 | 0.9986 (86) |
| MIT | 19.8252 | 19.9787 | 20.2472 | 20.5958 | 20.8564 | 20.9722 | 20.9951 | 20.9910 | 20.9044 | 20.5456 | 20.1223 | 19.8009 (87) |
| Th 2 | 20.0040 | 20.0065 | 20.0089 | 20.0205 | 20.0227 | 20.0328 | 20.0328 | 20.0347 | 20.0289 | 20.0227 | 20.0183 | 20.0137 (88) |
| util rest of 3 | house | | | | | | | | | | | |
| | 0.9975 | 0.9941 | 0.9811 | 0.9271 | 0.7829 | 0.5601 | 0.3791 | 0.4358 | 0.7455 | 0.9624 | 0.9944 | 0.9981 (89) |
| MIT 2 | 18.4345 | 18.6602 | 19.0511 | 19.5510 | 19.8861 | 20.0150 | 20.0310 | 20.0311 | 19.9536 | 19.4923 | 18.8791 | 18.4060 (90) |
| Living area f | raction | | | | | | | | fLA = | Living area | / (4) = | 0.3519 (91) |
| MIT | 18.9239 | 19.1243 | 19.4721 | 19.9187 | 20.2276 | 20.3519 | 20.3703 | 20.3689 | 20.2882 | 19.8630 | 19.3166 | 18.8969 (92) |
| Temperature a | djustment | | | | | | | | | | | 0.0000 |
| adjusted MIT | 18.9239 | 19.1243 | 19.4721 | 19.9187 | 20.2276 | 20.3519 | 20.3703 | 20.3689 | 20.2882 | 19.8630 | 19.3166 | 18.8969 (93) |

8. Space heating requirement

| | Jan | Feb | Mar | Apr | Mav | Tun | .Tu] | Aug | Sen | Oct | Nov | Dec |
|----------------|-----------|-----------|-----------|----------|----------|----------|----------|----------|----------|----------|-----------|----------------|
| Utilisation | 0.9965 | 0.9922 | 0.9776 | 0.9248 | 0.7947 | 0.5894 | 0.4156 | 0.4743 | 0.7673 | 0.9598 | 0.9927 | 0.9974 (94) |
| Useful gains | 455.0859 | 524.7147 | 601.4352 | 660.3774 | 621.6209 | 456.7176 | 306.3553 | 320.2879 | 458.0055 | 484.6641 | 442.7872 | 430.7182 (95) |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 (96) |
| Heat loss rate | e W | | | | | | | | | | | |
| | 1234.3396 | 1197.2420 | 1088.8385 | 912.8858 | 704.7628 | 469.9080 | 308.0247 | 323.5509 | 507.8192 | 765.5405 | 1014.6758 | 1227.0134 (97) |
| Month fracti | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 1.0000 | 1.0000 | 1.0000 (97a) |
| Space heating | kWh | | | | | | | | | | | |
| | 579.7648 | 451.9383 | 362.6280 | 181.8060 | 61.8576 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 208.9721 | 411.7598 | 592.4436 (98) |
| Space heating | | | | | | | | | | | | 2851.1702 (98) |
| Space heating | per m2 | | | | | | | | | (98 |) / (4) = | 37.0282 (99) |

8c. Space cooling requirement Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP Fraction of space heat from secondary/supplementary system (Table 11) Fraction of space heat from main system(s)



Regs Region: England Elmhurst Energy Systems SAP2012 Calculator (Design System) version 4.14r19

Design SAP

elmhurst energy



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| Efficiency of Efficiency of Space heating | main space f secondary/su requirement | neating sys upplementa | stem 1 (in s ry heating s | %) system, % | | | | | | | | 93.4000 (206) 0.0000 (208) 3052.6448 (211) |
|---|---|---------------------------|------------------------------|-----------------|-------------|-----------|----------|----------|----------|----------|-----------|--|
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
| Space heating | requirement | | | | | | | | | | | |
| | 579.7648 | 451.9383 | 362.6280 | 181.8060 | 61.8576 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 208.9721 | 411.7598 | 592.4436 (98) |
| Space heating | efficiency (| (main heati | ing system 1 | .) | | | | | | | | |
| | 93.4000 | 93.4000 | 93.4000 | 93.4000 | 93.4000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 93.4000 | 93.4000 | 93.4000 (210) |
| Space heating | fuel (main h | eating sys | stem) | 104 (501 | 66 0007 | 0 0000 | 0 0000 | 0 0000 | 0 0000 | 000 7000 | 440.05.00 | (24 2070 (011) |
| Watan beating | 620.7332 | 483.8/40 | 388.2527 | 194.6531 | 66.2287 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 223./388 | 440.8563 | 634.30/9 (211) |
| water neating | 1 equirement | 0 0000 | 0 0000 | 0 0000 | 0 0000 | 0 0000 | 0 0000 | 0 0000 | 0 0000 | 0 0000 | 0 0000 | 0 0000 (215) |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (213) |
| Water heating | | | | | | | | | | | | |
| Water heating | requirement | | | | | | | | | | | |
| | 199.8652 | 174.7702 | 181.8371 | 161.2803 | 156.1478 | 137.5263 | 131.7607 | 146.8823 | 148.5044 | 169.1019 | 180.5129 | 195.1667 (64) |
| Efficiency of | water heater | <u>.</u> | | | | | | | | | | 80.3000 (216) |
| (217)m | 87.5762 | 87.3366 | 86.7557 | 85.3533 | 82.9290 | 80.3000 | 80.3000 | 80.3000 | 80.3000 | 85.5852 | 87.0625 | 87.6676 (217) |
| Fuel for wate | r heating, k | Wh/month | | | | | | | | | | |
| | 228.2187 | 200.1111 | 209.5968 | 188.9561 | 188.2911 | 171.2656 | 164.0855 | 182.9169 | 184.9370 | 197.5830 | 207.3372 | 222.6211 (219) |
| Water heating | fuel used | | | | | | | | | | | 2345.9200 (219) |
| Annual totals | kWh/year | | | | | | | | | | | |
| Space heating | fuel - main | system | | | | | | | | | | 3052.6448 (211) |
| Space heating | fuel - secor | ndary | | | | | | | | | | 0.0000 (215) |
| Electricity fo | | fana. | | | | | | | | | | |
| control ho | ting numn | Lans. | | | | | | | | | | 20 0000 (000- |
| main heatir | a fluo fan | | | | | | | | | | | 45 0000 (2300) |
| Total oloctri | ig ilue lan | aborro kWk | ./ | | | | | | | | | 75 0000 (2308) |
| Floatrigity fo | r lighting (| above, kwi | 1/year d in Annond: | T) | | | | | | | | 240 5086 (222) |
| Total delivere | d energy for | call uses | a ili Appella. | LA L) | | | | | | | | 5814 1634 (238) |
| rotar activer. | a energy roi | u11 4000 | | | | | | | | | | 001111001 (200) |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| 12a. Carbon di | oxide emissi | lons - Indi | ividual heat | ing systems | including n | micro-CHP | | | | | | |
| | | | | | | | | _ | | | | |

| kg CO2/kWh | lag (002 / 110 a m | |
|------------|--|---|
| | kg COZ/year | |
| 0.2160 | 659.3713 (| (261) |
| 0.0000 | 0.0000 (| (263) |
| 0.2160 | 506.7187 (| (264) |
| | 1166.0900 (| (265) |
| 0.5190 | 38.9250 | (267) |
| 0.5190 | 176.7707 (| (268) |
| | 1381.7857 (| (272) |
| | 15.1440 (| (272a) |
| | 1.0000 | |
| | 2.2957 (| (272b) |
| | 0.5055 (| (272c) |
| | 17.9500 | (273) |
| | 0.2160 0.0000 0.2160 0.2160 0.5190 0.5190 | kg C02/kWh kg C02/year 0.2160 659.3713 0.0000 0.0000 0.2160 506.7187 1166.0900 1166.0900 0.5190 176.7707 1381.7857 15.1440 1.0000 2.2957 0.5055 17.9500 |





Appendix B: DER Worksheet – Be Lean, With Energy Efficient Measures



| Property Reference | EE | | | Issued on Date | 01/03/2024 | | |
|---------------------------------|---|--|--|----------------|------------|-------|--|
| Assessment | F1 - EE | | | Prop Type Ref | | | |
| Reference | | | | | | | |
| Property | 35, Crescent Road, Cater | ham, CR3 6LE | | | | | |
| SAP Rating | | 85 B | DER | 15.26 | TER | 17.95 | |
| Environmental | | 88 B | % DER <ter< th=""><th></th><th>14.96</th><th></th></ter<> | | 14.96 | | |
| CO ₂ Emissions (t/ye | ear) | 1.04 | DFEE | 39.39 | TFEE | 48.98 | |
| General Requireme | ents Compliance | Pass | % DFEE <tfe< th=""><th>E</th><th>19.59</th><th>·</th></tfe<> | E | 19.59 | · | |
| Assessor Details | Mr. Peter Kinsella, Base Ener peter@baseenergy.co.uk | /r. Peter Kinsella, Base Energy Services Ltd, Tel: 0151 933 0328, eter@baseenergy.co.uk | | | | | |
| Client | | | | | | | |





REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

| REGULATIONS COMP | LIANCE REPORT - Approved | i Document L1A, 2013 Edition, England | | | | | | | | |
|---|---|--|--------|--|--|--|--|--|--|--|
| DWELLING AS DESIGNED End of terrace dwelling, total floor area 77 $\rm m^2$ | | | | | | | | | | |
| End of terrace d | welling, total floor are | ea 77 m² | | | | | | | | |
| This report cove It is not a comp | rs items included within lete report of regulation | n the SAP calculations. ons compliance. | | | | | | | | |
| la TER and DER Fuel for main he Fuel factor:1.00 | ating:Mains gas (mains gas) | | | | | | | | | |
| Dwelling Carbon | Oxide Emission Rate (TE Dioxide Emission Rate (D | R) 17.95 kgCOU/m² ER) 15.26 kgCOU/m²OK | | | | | | | | |
| 1b TFEE and DFEE Target Fabric En | ergy Efficiency (TFEE)4 | 9.0 kWh/m²/yr | | | | | | | | |
| Dweiling Fabile | Energy Efficiency (DFEE) | 55.4 KWII/III / YIOK | | | | | | | | |
| Element External wall Party wall | Average 0.20 (max. 0.30) 0.00 (max. 0.20) | Highest 0.20 (max. 0.70) OK - OK | | | | | | | | |
| Floor | 0.11 (max. 0.25) | 0.11 (max. 0.70) OK | | | | | | | | |
| Roof Openings | (no roof) 1.30 (max. 2.00) | 1.30 (max. 3.30) OK | | | | | | | | |
| 2a Thermal bridg Thermal bridging | ing calculated from linear | thermal transmittances for each junction | | | | | | | | |
| 3 Air permeabili Air permeability Maximum | ty at 50 pascals: | 4.00 (design value) 10.0 | OK | | | | | | | |
| 4 Heating effici Main heating sys Data from databa Vaillant ecoTEC Combi boiler Efficiency: 89.6 Minimum: 88.0% | ency tem: se exclusive 843 VUW 436/5 % SEDBUK2009 | Boiler system with radiators or underfloor - Mair -7 (H-GB) OK | ns gas | | | | | | | |
| Secondary heatin | g system: | None | | | | | | | | |
| 5 Cylinder insul Hot water storag | ation e | No cylinder | | | | | | | | |
| 6 Controls Space heating co | ntrols: | Time and temperature zone control | ОК | | | | | | | |
| Hot water contro | ls: | No cylinder | | | | | | | | |
| Boiler interlock | | Yes | OK | | | | | | | |
| 7 Low energy lig Percentage of fi Minimum | hts xed lights with low-ener | rgy fittings:100% 75% | OK | | | | | | | |
| 8 Mechanical ven Not applicable | tilation | | | | | | | | | |
| 9 Summertime tem Overheating risk | perature (Thames Valley): | Slight | OK | | | | | | | |
| Overshading: | | Average | | | | | | | | |
| Windows facing N | orth: | 2.86 m², No overhang | | | | | | | | |
| Windows facing W | lest: | 11.55 m², No overhang | | | | | | | | |
| Air change rate: Blinds/curtains: | | 6.00 ach None | | | | | | | | |
| 10 Key features | | | | | | | | | | |
| Party wall U-val Exposed floor U- | ue value | 0.00 W/m ² K 0.11 W/m ² K | | | | | | | | |





CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014) CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

| 1. Overall dwelling dimensions | | | | | | | | |
|---|---------|--------------|-----------|----------|------|---|----------|-------------|
| | | | | | | | | |
| | | Area | Storey | height | | | Volume | |
| | | (m2) | | (m) | | | (m3) | |
| Ground floor | | 77.0000 (1b) | x | 2.4000 | (2b) | = | 184.8000 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)(1n) | 77.0000 | | | | | | | (4) |
| Dwelling volume | | (3a)+(3b) |)+(3c)+(3 | d)+(3e). | (3n) | = | 184.8000 | (5) |

2. Ventilation rate

| | | | | | main heating | | secondary heating | | other | | total | r | n3 per hour | |
|------------------|-------------------------|--------------|------------|---------------|-----------------|--------|----------------------|------|----------|--------|-----------|----------|-------------|--------------|
| Number of chimne | eys | | | | 0 | + | 0 | + | 0 | = | 0 | * 40 = | 0.0000 | (6a) |
| Number of open f | lues | | | | 0 | + | 0 | + | 0 | = | 0 | * 20 = | 0.0000 | (6b) |
| Number of intern | nittent ia | ns | | | | | | | | | 0 | * 10 = | 30,0000 | (/a) (7b) |
| Number of fluele | ve vents see dae fin | | | | | | | | | | 0 | * 40 = | 0 0000 | (7c) |
| Number of fidere | .55 945 111 | | | | | | | | | | 0 | 10 | 0.0000 | (, 0) |
| | | | | | | | | | | | Ai | r change | es per hour | |
| Infiltration due | e to chimne | eys, flues a | and fans | = (6a)+(6b)+(| 7a)+(7b)+(| (7c) = | | | | 30 | .0000 / | (5) = | 0.1623 | (8) |
| Pressure test | | | | | | | | | | | | | Yes | |
| Measured/design | AP50 | | | | | | | | | | | | 4.0000 | |
| Infiltration rat | ie | | | | | | | | | | | | 0.3623 | (18) |
| Number of sides | sheltered | | | | | | | | | | | | 2 | (19) |
| Shelter factor | | | | | | | | | (20) = 1 | - [0. | 075 x (1 | 9)] = | 0.8500 | (20) |
| Infiltration rat | e adjusted | d to include | shelter fa | ctor | | | | | | (21) = | (18) x (2 | 20) = | 0.3080 | (21) |
| | | | | | | | | | | | | | | |
| | Jan | Feb | Mar | Apr | Mav | สมภ | Jul | Aug | Sep | 0ct | + | Nov | Dec | |
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.800 | 0 3.8000 | 3.70 | 00 4.000 | 0 4.3 | 3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.950 | 0 0.9500 | 0.92 | 50 1.000 | 0 1.0 | 0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | | | | | | | | | | | | | | |
| | 0.3927 | 0.3850 | 0.3773 | 0.3388 | 0.3311 | 0.292 | 6 0.2926 | 0.28 | 49 0.308 | 0.0 | 3311 | 0.3465 | 0.3619 | (22b) |
| Effective ac | 0.5771 | 0.5741 | 0.5712 | 0.5574 | 0.5548 | 0.542 | 8 0.5428 | 0.54 | 06 0.547 | 4 0.5 | 5548 | 0.5600 | 0.5655 | (25) |

| Flement Cross Openings Natārea II-valus à v II K-valus à | x K J/K |
|--|------------|
| Dicasono di dicaso de la contrada de | J/K |
| m2 m2 m2 W/m2K W/K kJ/m2K | |
| Window (Uw = 1.30) 14.4100 1.2357 17.8070 | (27) |
| Heat Loss Floor 1 77.0000 0.1100 8.4700 | (28b) |
| External Wall 1 50.6500 14.4100 36.2400 0.2000 7.2480 | (29a) |
| Total net area of external elements Aum(A, m2) 127.6500 | (31) |
| Fabric heat loss, $W/K = Sum (A \times U)$ (26)(30) + (32) = 33.5250 | (33) |
| Party Wall 1 53.0000 0.0000 0.0000 | (32) |
| - | |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 100. | 000 (35) |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) 12. | 215 (36) |
| Total fabric heat loss (33) + (36) = 45. | 465 (37) |
| | |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) | |
| Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov De | |
| (38)m 35.1939 35.0113 34.8323 33.9917 33.8345 33.1023 33.1023 32.9668 33.3843 33.8345 34.1526 34. | 852 (38) |
| Heat transfer coeff | |
| 80.8404 80.6578 80.4789 79.6383 79.4810 78.7489 78.7489 78.6133 79.0309 79.4810 79.7992 80. | 318 (39) |
| Average = Sum(39)m / 12 = 79. | 375 (39) |
| | |
| Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov De | |
| HLP 1.0499 1.0475 1.0452 1.0343 1.0322 1.0227 1.0227 1.0210 1.0264 1.0322 1.0364 1. | 407 (40) |
| HLP (average) 1. | 343 (40) |
| Days in month | |
| 31 28 31 30 31 30 31 31 30 31 30 | 31 (41) |

| 4. Water heati | ng energy r | equirements | (kWh/year) | | | | | | | | | | |
|---------------------------------|--------------------|---------------------|------------|----------|----------|---------|---------|----------|----------|------------|-------------|---------------------------|----------|
| Assumed occupa Average daily | ncy hot water u | se (litres/ | day) | | | | | | | | | 2.4035 (42 91.2825 (43 | 2) 3) |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| Daily hot wate | er use | | | | | | | | | | | | |
| | 100.4108 | 96.7595 | 93.1082 | 89.4569 | 85.8056 | 82.1543 | 82.1543 | 85.8056 | 89.4569 | 93.1082 | 96.7595 | 100.4108 (44 | 1) |
| Energy conte | 148.9063 | 130.2344 | 134.3902 | 117.1646 | 112.4223 | 97.0119 | 89.8957 | 103.1567 | 104.3887 | 121.6550 | 132.7959 | 144.2078 (45 | i) |
| Energy content | (annual) | | | | | | | | | Total = Su | um (45) m = | 1436.2293 (45 |) |
| Distribution 1 | .oss (46)m | $= 0.15 \times (4)$ | 5)m | | | | | | | | | | |
| | 22.3359 | 19.5352 | 20.1585 | 17.5747 | 16.8633 | 14.5518 | 13.4844 | 15.4735 | 15.6583 | 18.2482 | 19.9194 | 21.6312 (46 | 5) |
| Water storage | loss: | | | | | | | | | | | | |
| Total storage | loss | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (56 | S) |
| If cylinder co | ntains dedi | cated solar | storage | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (57 | 7) |
| Combi loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (61 | L) |





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| Total | heat req | uired for | water heati | ng calculate | ed for each | month | | | | | | 100 5050 | |
|--------|-----------|------------|--------------|--------------|-------------|----------|---------|---------|------------|-------------|--------------|-------------|----------------|
| | | 148.9063 | 130.2344 | 134.3902 11 | 7.1646 112 | .4223 | 97.0119 | 89.895/ | 103.156/ | 104.388/ | 121.6550 | 132./959 | 144.2078 (62) |
| Solar | input | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (63) |
| | | | | | | | | | Solar inpu | t (sum of n | uonths) = Su | um (63) m = | 0.0000 (63) |
| FGHRS | | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Output | from w/l | h | | | | | | | | | | | |
| | | 148.9063 | 130.2344 | 134.3902 | 117.1646 | 112.4223 | 97.0119 | 89.8957 | 103.1567 | 104.3887 | 121.6550 | 132.7959 | 144.2078 (64) |
| | | | | | | | | | Total p | er year (kW | h/year) = S | um(64)m = | 1436.2293 (64) |
| Heat g | ains from | n water he | ating, kWh/m | month | | | | | | | | | |
| 5 | | 49.5113 | 43.3029 | 44.6847 | 38.9572 | 37.3804 | 32.2564 | 29.8903 | 34.2996 | 34.7092 | 40.4503 | 44.1546 | 47.9491 (65) |

| 5. Internal g | ains (see Ta | uble 5 and 5 | 5a) | | | | | | | | | |
|---------------|--------------|--------------|--------------|-------------|-------------|-------------|----------|----------|----------|----------|----------|---------------|
| Metabolic gai | ns (Table 5) | , Watts | | | | | | | | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
| (66)m | 120.1737 | 120.1737 | 120.1737 | 120.1737 | 120.1737 | 120.1737 | 120.1737 | 120.1737 | 120.1737 | 120.1737 | 120.1737 | 120.1737 (66) |
| Lighting gain | s (calculate | ed in Append | dix L, equat | ion L9 or L | 9a), also s | ee Table 5 | | | | | | |
| | 19.2861 | 17.1297 | 13.9308 | 10.5465 | 7.8837 | 6.6557 | 7.1917 | 9.3481 | 12.5470 | 15.9313 | 18.5942 | 19.8221 (67) |
| Appliances ga | ins (calcula | ated in App | endix L, equ | ation L13 d | or L13a), a | lso see Tab | le 5 | | | | | |
| | 213.0566 | 215.2674 | 209.6961 19 | 7.8355 182 | 2.8636 168. | 7921 159.3 | 915 | 157.1806 | 162.7519 | 174.6125 | 189.5845 | 203.6559 (68) |
| Cooking gains | (calculated | d in Append: | ix L, equati | on L15 or L | 15a), also | see Table 5 | | | | | | |
| | 35.0174 | 35.0174 | 35.0174 | 35.0174 | 35.0174 | 35.0174 | 35.0174 | 35.0174 | 35.0174 | 35.0174 | 35.0174 | 35.0174 (69) |
| Pumps, fans | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 (70) |
| Losses e.g. e | vaporation (| negative va | alues) (Tabl | e 5) | | | | | | | | |
| | -96.1390 | -96.1390 | -96.1390 | -96.1390 | -96.1390 | -96.1390 | -96.1390 | -96.1390 | -96.1390 | -96.1390 | -96.1390 | -96.1390 (71) |
| Water heating | gains (Tabl | .e 5) | | | | | | | | | | |
| | 66.5475 | 64.4389 | 60.0601 | 54.1073 | 50.2425 | 44.8006 | 40.1752 | 46.1016 | 48.2073 | 54.3687 | 61.3259 | 64.4477 (72) |
| Total interna | l gains | | | | | | | | | | | |
| | 360.9423 | 358.8882 | 345.7392 | 324.5414 | 303.0418 | 282.3005 | 268.8105 | 274.6824 | 285.5583 | 306.9646 | 331.5566 | 349.9779 (73) |
| | | | | | | | | | | | | |

6. Solar gains

| [Jan] | | | Area m2 | | Solar flux Table 6a f W/m2 | | g fic data Table 6b | FF Specific data or Table 6c | | Access factor Table 6d | | Gains W | |
|----------------------------|---------------------|----------------------|----------------------|----------------------|----------------------------------|----------------------|---------------------------|------------------------------------|----------------------|------------------------------|---------------------|---------------------|--------------|
| North West | | | 2.8 11.5 | 600 500 | 10.6334 19.6403 | | 0.6300 0.6300 | 0 0 | .7000 .7000 | 0.770 | 00 | 9.2941 69.3268 | (74) (80) |
| Solar gains Total gains | 78.6209 439.5632 | 153.3795 512.2677 | 253.5247 599.2639 | 374.2119 698.7534 | 464.5036 767.5454 | 478.5617 760.8623 | 454.3230 723.1335 | 385.9741 660.6565 | 296.0453 581.6036 | 182.0649 489.0295 | 97.9079 429.4645 | 64.7590 414.7369 | (83) (84) |

| 7. Mean inte | rnal temperat | ure (heatin | g season) | | | | | | | | | | |
|--------------|---------------|-------------|-------------|-------------|-------------|---------|---------|---------|---------|-------------|---------|---------|------|
| Temperature | during heatin | g periods i | n the livin | g area from | Table 9, Th | nl (C) | | | | | | 21.0000 | (85) |
| Utilisation | factor for ga | ins for liv | ing area, n | il,m (see T | able 9a) | | | | | | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| tau | 26.4582 | 26.5181 | 26.5770 | 26.8575 | 26.9107 | 27.1609 | 27.1609 | 27.2077 | 27.0640 | 26.9107 | 26.8034 | 26.6921 | |
| alpha | 2.7639 | 2.7679 | 2.7718 | 2.7905 | 2.7940 | 2.8107 | 2.8107 | 2.8138 | 2.8043 | 2.7940 | 2.7869 | 2.7795 | |
| util living | area | | | | | | | | | | | | |
| 2 | 0.9692 | 0.9524 | 0.9165 | 0.8408 | 0.7224 | 0.5737 | 0.4456 | 0.4968 | 0.7130 | 0.8909 | 0.9552 | 0.9735 | (86) |
| MIT | 18.7790 | 19.0498 | 19.5128 | 20.0909 | 20.5532 | 20.8361 | 20.9410 | 20.9189 | 20.6833 | 20.0544 | 19.3117 | 18.7271 | (87) |
| Th 2 | 20.0420 | 20.0439 | 20.0459 | 20.0549 | 20.0566 | 20.0644 | 20.0644 | 20.0659 | 20.0614 | 20.0566 | 20.0531 | 20.0496 | (88) |
| util rest of | house | | | | | | | | | | | | |
| | 0.9647 | 0.9455 | 0.9042 | 0.8172 | 0.6811 | 0.5097 | 0.3617 | 0.4113 | 0.6555 | 0.8693 | 0.9476 | 0.9695 | (89) |
| MIT 2 | 17.0547 | 17.4468 | 18.1124 | 18.9314 | 19.5557 | 19.9133 | 20.0245 | 20.0075 | 19.7422 | 18.8998 | 17.8361 | 16.9839 | (90) |
| Living area | fraction | | | | | | | | ILA = | Living area | / (4) = | 0.3519 | (9I) |
| MIT | 17.6616 | 18.0109 | 18.6053 | 19.3395 | 19.9068 | 20.2381 | 20.3471 | 20.3282 | 20.0734 | 19.3061 | 18.3555 | 17.5974 | (92) |
| Temperature | adjustment | | | | | | | | | | | -0.1500 | |
| adjusted MIT | 17.5116 | 17.8609 | 18.4553 | 19.1895 | 19.7568 | 20.0881 | 20.1971 | 20.1782 | 19.9234 | 19.1561 | 18.2055 | 17.4474 | (93) |

| 8. | Space heating requirement |
|----|---------------------------|
| | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|----------------|-----------|-----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-------|
| Utilisation | 0.9476 | 0.9240 | 0.8780 | 0.7917 | 0.6667 | 0.5114 | 0.3741 | 0.4222 | 0.6460 | 0.8434 | 0.9268 | 0.9540 | (94) |
| Useful gains | 416.5107 | 473.3448 | 526.1675 | 553.2188 | 511.6888 | 389.1096 | 270.5394 | 278.9220 | 375.7181 | 412.4388 | 398.0466 | 395.6490 | (95) |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 | (96) |
| Heat loss rate | e W | | | | | | | | | | | | |
| | 1068.0301 | 1045.4019 | 962.1469 | 819.4379 | 640.3603 | 432.1805 | 283.2639 | 297.0200 | 460.2276 | 680.0485 | 886.2061 | 1061.5389 | (97) |
| Month fracti | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 1.0000 | 1.0000 | 1.0000 | (97a) |
| Space heating | kWh | | | | | | | | | | | | |
| | 484.7305 | 384.4224 | 324.3686 | 191.6778 | 95.7316 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 199.1016 | 351.4748 | 495.4221 | (98) |
| Space heating | | | | | | | | | | | | 2526.9294 | (98) |
| Space heating | per m2 | | | | | | | | | (98) | / (4) = | 32.8173 (| (99) |

8c. Space cooling requirement

Not applicable

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





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| Fraction of s Fraction of s Efficiency of Efficiency of Space heating | pace heat fro pace heat fro main space secondary/s requirement | om secondar om main sys heating sys upplementa | ry/supplemer stem(s) stem 1 (in % ry heating s | ntary system 3) System, % | n (Table 11) | | | | | | | 0.0000 1.0000 90.5000 0.0000 2792.1872 | (201) (202) (206) (208) (211) |
|---|--|---|---|---------------------------------|--------------|-----------|----------|---|----------|--|----------|--|---|
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| Space heating | requirement 484.7305 | 384.4224 | 324.3686 | 191.6778 | 95.7316 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 199.1016 | 351,4748 | 495.4221 | (98) |
| Space heating | efficiency | (main heati | ing system 1 | .) | 00 5000 | 0.0000 | 0 0000 | 0.0000 | 0 0000 | 00 5000 | 00 5000 | 00 5000 | (210) |
| Space heating | fuel (main) | 90.5000 heating svs | 90.5000 stem) | 90.5000 | 90.5000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 90.5000 | 90.5000 | 90.5000 | (210) |
| | 535.6138 | 424.7761 | 358.4184 | 211.7986 | 105.7808 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 220.0018 | 388.3700 | 547.4278 | (211) |
| Water heating | requirement 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (215) |
| Water heating | | | | | | | | | | | | | |
| Water heating | requirement 148.9063 | 130.2344 | 134.3902 | 117.1646 | 112.4223 | 97.0119 | 89.8957 | 103.1567 | 104.3887 | 121.6550 | 132.7959 | 144.2078 | (64) |
| Efficiency of (217)m | water heate 88.8310 | r 88.7053 | 88.4289 | 87.8358 | 86.7538 | 83.8000 | 83.8000 | 83.8000 | 83.8000 | 87.8365 | 88.5584 | 83.8000 88.8976 | (216) (217) |
| Fuel for wate | er heating, k 167.6288 | Wh/month 146.8169 | 151.9755 | 133.3905 | 129.5877 | 115.7659 | 107.2742 | 123.0987 | 124.5689 | 138.5017 | 149.9529 | 162.2179 | (219) |
| Water heating Annual totals | fuel used kWh/year | | | | | | | | | | | 1650.7794 | (219) |
| Space heating | fuel - main | system | | | | | | | | | | 2792.1872 | (211) |
| Space heating | fuel - seco | ndary | | | | | | | | | | 0.0000 | (215) |
| Electricity f central he main heati | or pumps and ating pump ng flue fan | fans: | | | | | | | | | | 30.0000 45.0000 | (230c) (230e) |
| Total electri | city for the | above, kWh | n/year | | | | | | | | | 75.0000 | (231) |
| Total deliver | ed energy fo | (calculated r all uses | a in Appenai | LX L) | | | | | | | | 4858.5652 | (232) |
| | | | | | | | | | | | | | |
| 12a. Carbon d | ioxide emiss | ions - Indi | ividual heat | ing systems | including n | micro-CHP | | | | | | | |
| Space heating Space heating | - main syst - secondary | em 1 | | | | | | Energy kWh/year 2792.1872 0.0000 | Emiss | ion factor kg CO2/kWh 0.2160 0.0000 | 1 | Emissions kg CO2/year 603.1124 0.0000 | (261) (263) |

| | Flierdy | EMISSION LACCOL | | FULSSIOUS | |
|---|-------------------------|-----------------|-----|------------|-------|
| | kWh/year | kg CO2/kWh |] | g CO2/year | |
| Space heating - main system 1 | 2792.1872 | 0.2160 | | 603.1124 | (261) |
| Space heating - secondary | 0.0000 | 0.0000 | | 0.0000 | (263) |
| Water heating (other fuel) | 1650.7794 | 0.2160 | | 356.5683 | (264) |
| Space and water heating | | | | 959.6808 | (265) |
| Pumps and fans | 75.0000 | 0.5190 | | 38.9250 | (267) |
| Energy for lighting | 340.5986 | 0.5190 | | 176.7707 | (268) |
| Total CO2, kg/year | | | | 1175.3764 | (272) |
| Dwelling Carbon Dioxide Emission Rate (DER) | | | | 15.2600 | (273) |
| 16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY (| GENERATION TECHNOLOGIES | | | | |
| DER | | | | 15.2600 | ZC1 |
| Total Floor Area | | | TFA | 77.0000 | |
| Assumed number of occupants | | | N | 2.4035 | |
| CO2 emission factor in Table 12 for electricity displaced from grid | | | EF | 0.5190 | |
| CO2 emissions from appliances, equation (L14) | | | | 16.3965 | ZC2 |
| CO2 emissions from cooking, equation (L16) | | | | 2.2946 | ZC3 |
| Total CO2 emissions | | | | 33.9511 | ZC4 |
| Residual CO2 emissions offset from biofuel CHP | | | | 0.0000 | ZC5 |
| Additional allowable electricity generation, kWh/m²/year | | | | 0.0000 | ZC6 |
| Resulting CO2 emissions offset from additional allowable electricity generation | | | | 0.0000 | ZC7 |
| Net CO2 emissions | | | | 33.9511 | ZC8 |
| | | | | | |





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SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014) CALCULATION OF TARGET EMISSIONS 09 Jan 2014

| 1. Overall dwelling dimensions | | | | | | |
|---|---------|--------------|--------|---------------|-----|----------------------|
| - | | | | | | |
| | | Area | Sto | rey height | | Volume |
| | | (m2) | | (m) | | (m3) |
| Ground floor | | 77.0000 (1b) | х | 2.4000 (2b) | = | 184.8000 (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)(1n) | 77.0000 | | | | | (4) |
| Dwelling volume | | (3a)+(3b |)+(3c) | +(3d)+(3e)(3n |) = | 184.8000 (5) |

2. Ventilation rate

| Number of chimne | ys | | | | main heating 0 | + | secondary heating 0 | + | other 0 = | tota | 1 m3 0 * 40 = | 9 per hour 0.0000 (6a) |
|--|-------------------------|---------------|---------------|---------------|----------------------|--------|---------------------------|---------------|--------------|---------------|-----------------------------|-----------------------------|
| Number of open f | lues | | | | 0 | + | 0 | + | 0 = | (| 0 * 20 = | 0.0000 (6b) |
| Number of intern | nittent fam no worte | ns | | | | | | | | | 3 * 10 = | 30.0000 (7a) |
| Number of fluele | ss gas fir | res | | | | | | | | (| $0 \times 10 =$ 0 × 40 = | 0.0000 (7b) |
| | | | | | | | | | | ; | Air changes | per hour |
| Infiltration due Pressure test Measured/design | to chimne AP50 | eys, flues a | ind fans = | = (6a)+(6b)+ | (7a)+(7b)+(| 7c) = | | | | 30.0000 | / (5) = | 0.1623 (8) Yes 5.0000 |
| Infiltration rat Number of sides | e sheltered | | | | | | | | | | | 0.4123 (18) 2 (19) |
| Shelter factor | | | | | | | | | (20) = 1 - | [0.075 x | (19)] = | 0.8500 (20) |
| Infiltration rat | e adjusted | d to include | shelter fa | ctor | | | | | (21 | (18) = (18) x | (20) = | 0.3505 (21) |
| | | To b | M | | | | T] | | 0 | 0 | N | Dee |
| Wind speed | Jan 5 1000 | Feb 5 0000 | Mar 4 9000 | Apr 4 4000 | May 4 3000 | 3 8000 | 3 8000 | Aug 3 7000 | 4 0000 | 4 3000 | 4 5000 | 4 7000 (22) |
| Wind factor Adi infilt rate | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| , | 0.4469 | 0.4381 | 0.4293 | 0.3855 | 0.3768 | 0.3330 | 0.3330 | 0.3242 | 0.3505 | 0.3768 | 0.3943 | 0.4118 (22b) |
| Effective ac | 0.5998 | 0.5960 | 0.5922 | 0.5743 | 0.5710 | 0.5554 | 0.5554 | 0.5526 | 0.5614 | 0.5710 | 0.5777 | 0.5848 (25) |

| 3. Heat losses | and heat l | oss paramet | er | | | | | | | | | | |
|------------------|---------------|---------------|--------------|--------------------|------------|---------|---------|--------------|---------|---------|----------|----------|---------|
| Element | | | | Gross | Openings | Net | tArea | U-value | АхU | K- | -value | АхК | |
| | | | | m2 | m2 | | m2 | W/m2K | W/K | t 1 | cJ/m2K | kJ/K | |
| TER Opening Tvg | be $(Uw = 1.$ | 40) | | | | 14 | .4100 | 1.3258 | 19.1042 | | | | (27) |
| Heat Loss Floor | r 1 | - / | | | | 77 | .0000 | 0.1300 | 10.0100 | | | | (28b) |
| External Wall 1 | 1 | | | 50 6500 | 14 4100 | 36 | 2400 | 0 1800 | 6 5232 | | | | (29a) |
| Total net area | of externa | l elements : | Aum (A. m2) | 00.0000 | 11.1100 | 127 | 6500 | 0.1000 | 0.0202 | | | | (31) |
| Tobai a beat la | W/V = 0 | | (III) (III) | | | 127 | (26) (| 201 (221 - | 25 6274 | | | | (32) |
| rabiic neat ios | 55, W/A - 5 | uni (A X U) | | | | | (20)(| 30) + (32) - | 55.6574 | | | | (33) |
| Thormal maga no | arameter (T | MD - Cm / T | ED) in kT/m | 25 | | | | | | | | 250 0000 | (25) |
| Thermal hass po | arameter (r | Pir = Cin / 1 | eted weine | LIL Namondiu VI | | | | | | | | 10.1070 | (35) |
| Inermai bridges | s (Sum(L X | PSI) Calcul | ated using A | Appendix K) | | | | | | (22) | | 12.10/0 | (30) |
| Total fabric he | eat loss | | | | | | | | | (33) | + (36) = | 4/.8244 | (37) |
| | | | | 0 00 /0 | | | | | | | | | |
| Ventilation hea | at loss cal | culated mon | thiy (38)m | = 0.33 x (2) | 5) m x (5) | | | | | | | | |
| | Jan | Feb | Mar | Apr | мау | Jun | Jul | Aug | Sep | OCt | NOV | Dec | |
| (38)m | 36.5811 | 36.3446 | 36.1128 | 35.0243 | 34.8206 | 33.8725 | 33.8725 | 33.6969 | 34.2377 | 34.8206 | 35.2326 | 35.6634 | (38) |
| Heat transfer o | coeff | | | | | | | | | | | | |
| | 84.4054 | 84.1690 | 83.9372 | 82.8486 | 82.6450 | 81.6968 | 81.6968 | 81.5213 | 82.0620 | 82.6450 | 83.0570 | 83.4877 | (39) |
| Average = Sum (3 | 39)m / 12 = | | | | | | | | | | | 82.8477 | (39) |
| | | | | | | | | | | | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| HLP | 1.0962 | 1.0931 | 1.0901 | 1.0760 | 1.0733 | 1.0610 | 1.0610 | 1.0587 | 1.0657 | 1.0733 | 1.0787 | 1.0843 | (40) |
| HLP (average) | | | | | | | | | | | | 1.0759 | (40) |
| Davs in month | | | | | | | | | | | | | (/ |
| bayo in month | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | (41) |
| | 51 | 20 | 51 | 50 | 51 | 50 | 51 | 51 | 50 | 51 | 50 | 51 | (+ +) |

| 4. Water heati | ng energy r | equirements | (kWh/year) | | | | | | | | | | |
|---------------------------------|---------------------|-------------|-------------|--------------|----------|---------|---------|----------|----------|------------|-------------|-------------------|--------------|
| Assumed occupa Average daily | ancy hot water u | se (litres/ | day) | | | | | | | | | 2.4035 91.2825 | (42) (43) |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| Daily hot wate | er use | | | | | | | | | | | | |
| | 100.4108 | 96.7595 | 93.1082 | 89.4569 | 85.8056 | 82.1543 | 82.1543 | 85.8056 | 89.4569 | 93.1082 | 96.7595 | 100.4108 | (44) |
| Energy conte | 148.9063 | 130.2344 | 134.3902 | 117.1646 | 112.4223 | 97.0119 | 89.8957 | 103.1567 | 104.3887 | 121.6550 | 132.7959 | 144.2078 | (45) |
| Energy content | : (annual) | | | | | | | | | Total = Su | 1m (45) m = | 1436.2293 | (45) |
| Distribution 1 | Loss (46)m | = 0.15 x (4 | 5)m | | | | | | | | | | |
| | 22.3359 | 19.5352 | 20.1585 | 17.5747 | 16.8633 | 14.5518 | 13.4844 | 15.4735 | 15.6583 | 18.2482 | 19.9194 | 21.6312 | (46) |
| Water storage | loss: | | | | | | | | | | | | |
| Total storage | loss | | | | | | | | | | | | |
| - | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (56) |
| If cylinder co | ntains dedi | cated solar | storage | | | | | | | | | | |
| - | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (57) |
| Combi loss | 50.9589 | 44.5359 | 47.4469 | 44.1157 | 43.7256 | 40.5144 | 41.8649 | 43.7256 | 44.1157 | 47.4469 | 47.7170 | 50.9589 | (61) |
| Total heat rec | quired for w | ater heatin | g calculate | d for each n | month | | | | | | | | |



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| | 199.8652 | 174.7702 | 181.8371 | 161.2803 | 156.1478 | 137.5263 | 131.7607 | 146.8823 | 148.5044 | 169.1019 | 180.5129 | 195.1667 (62) |
|-----------------|-------------|-------------|----------|----------|----------|----------|----------|------------|-------------|-------------|-------------|----------------|
| Solar input | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (63) |
| | | | | | | | | Solar inpu | t (sum of m | onths) = Su | um (63) m = | 0.0000 (63) |
| Output from w/ | h | | | | | | | | | | | |
| - | 199.8652 | 174.7702 | 181.8371 | 161.2803 | 156.1478 | 137.5263 | 131.7607 | 146.8823 | 148.5044 | 169.1019 | 180.5129 | 195.1667 (64) |
| | | | | | | | | Total pe | r year (kWh | /year) = Su | um (64) m = | 1983.3557 (64) |
| Heat gains from | m water hea | ting, kWh/m | onth | | | | | | | | | |
| 2 | 62.2511 | 54.4369 | 56.5465 | 49.9862 | 48.3118 | 42.3850 | 40.3566 | 45.2310 | 45.7382 | 52.3120 | 56.0839 | 60.6888 (65) |

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

| Metabolic gai | ns (Table 5) | , Watts | | | | | | | | | | |
|---------------|--------------|--------------|--------------|-------------|-------------|-------------|----------|----------|----------|----------|----------|---------------|
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
| (66)m | 120.1737 | 120.1737 | 120.1737 | 120.1737 | 120.1737 | 120.1737 | 120.1737 | 120.1737 | 120.1737 | 120.1737 | 120.1737 | 120.1737 (66) |
| Lighting gain | s (calculate | ed in Append | dix L, equat | ion L9 or L | 9a), also s | ee Table 5 | | | | | | |
| | 19.2861 | 17.1297 | 13.9308 | 10.5465 | 7.8837 | 6.6557 | 7.1917 | 9.3481 | 12.5470 | 15.9313 | 18.5942 | 19.8221 (67) |
| Appliances ga | ins (calcula | ated in App | endix L, eq | ation L13 | or L13a), a | lso see Tab | Le 5 | | | | | |
| | 213.0566 | 215.2674 | 209.6961 19 | 7.8355 182 | 2.8636 168. | 7921 159.3 | 915 | 157.1806 | 162.7519 | 174.6125 | 189.5845 | 203.6559 (68) |
| Cooking gains | (calculated | i in Append: | ix L, equati | on L15 or L | 15a), also | see Table 5 | | | | | | |
| | 35.0174 | 35.0174 | 35.0174 | 35.0174 | 35.0174 | 35.0174 | 35.0174 | 35.0174 | 35.0174 | 35.0174 | 35.0174 | 35.0174 (69) |
| Pumps, fans | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 (70) |
| Losses e.g. e | vaporation (| negative va | alues) (Tabl | e 5) | | | | | | | | |
| | -96.1390 | -96.1390 | -96.1390 | -96.1390 | -96.1390 | -96.1390 | -96.1390 | -96.1390 | -96.1390 | -96.1390 | -96.1390 | -96.1390 (71) |
| Water heating | gains (Tabl | Le 5) | | | | | | | | | | |
| | 83.6708 | 81.0073 | 76.0033 | 69.4252 | 64.9352 | 58.8681 | 54.2427 | 60.7943 | 63.5252 | 70.3118 | 77.8943 | 81.5710 (72) |
| Total interna | l gains | | | | | | | | | | | |
| | 378.0656 | 375.4566 | 361.6824 | 339.8594 | 317.7346 | 296.3680 | 282.8780 | 289.3752 | 300.8763 | 322.9078 | 348.1250 | 367.1012 (73) |
| | | | | | | | | | | | | |

6. Solar gains

| [Jan] | | | A | m2 | Solar flux Table 6a W/m2 | Speci or | g fic data Table 6b | Specific or Tabi | FF data le 6c | Acces facto Table 6 | ss or öd | Gains W | |
|----------------------------|---------------------|----------------------|----------------------|----------------------|--------------------------------|----------------------|---------------------------|----------------------|----------------------|---------------------------|---------------------|---------------------|--------------|
| North West | | | 2.8 11.5 | 500 500 | 10.6334 19.6403 | | 0.6300 0.6300 | 0 | .7000 .7000 | 0.770 | 00 00 | 9.2941 69.3268 | (74) (80) |
| Solar gains Total gains | 78.6209 456.6865 | 153.3795 528.8361 | 253.5247 615.2071 | 374.2119 714.0713 | 464.5036 782.2381 | 478.5617 774.9298 | 454.3230 737.2010 | 385.9741 675.3493 | 296.0453 596.9216 | 182.0649 504.9727 | 97.9079 446.0329 | 64.7590 431.8602 | (83) (84) |

| 7. Mean inter | nal temperat | ure (heatin | g season) | | | | | | | | | |
|----------------|--------------|-------------|--------------|-------------|-------------|---------|---------|---------|---------|-------------|---------|--------------|
| Temperature d | uring heatin | g periods i | n the living | g area from | Table 9, Th | 11 (C) | | | | | | 21.0000 (85) |
| Utilisation f | actor for ga | ins for liv | ing area, n | il,m (see T | able 9a) | | | | | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
| tau | 63.3516 | 63.5296 | 63.7050 | 64.5421 | 64.7011 | 65.4520 | 65.4520 | 65.5930 | 65.1607 | 64.7011 | 64.3802 | 64.0480 |
| alpha | 5.2234 | 5.2353 | 5.2470 | 5.3028 | 5.3134 | 5.3635 | 5.3635 | 5.3729 | 5.3440 | 5.3134 | 5.2920 | 5.2699 |
| util living a | rea | | | | | | | | | | | |
| | 0.9981 | 0.9956 | 0.9860 | 0.9460 | 0.8341 | 0.6457 | 0.4822 | 0.5445 | 0.8193 | 0.9747 | 0.9960 | 0.9986 (86) |
| MIT | 19.8252 | 19.9787 | 20.2472 | 20.5958 | 20.8564 | 20.9722 | 20.9951 | 20.9910 | 20.9044 | 20.5456 | 20.1223 | 19.8009 (87) |
| Th 2 | 20.0040 | 20.0065 | 20.0089 | 20.0205 | 20.0227 | 20.0328 | 20.0328 | 20.0347 | 20.0289 | 20.0227 | 20.0183 | 20.0137 (88) |
| util rest of 3 | house | | | | | | | | | | | |
| | 0.9975 | 0.9941 | 0.9811 | 0.9271 | 0.7829 | 0.5601 | 0.3791 | 0.4358 | 0.7455 | 0.9624 | 0.9944 | 0.9981 (89) |
| MIT 2 | 18.4345 | 18.6602 | 19.0511 | 19.5510 | 19.8861 | 20.0150 | 20.0310 | 20.0311 | 19.9536 | 19.4923 | 18.8791 | 18.4060 (90) |
| Living area f | raction | | | | | | | | fLA = | Living area | / (4) = | 0.3519 (91) |
| MIT | 18.9239 | 19.1243 | 19.4721 | 19.9187 | 20.2276 | 20.3519 | 20.3703 | 20.3689 | 20.2882 | 19.8630 | 19.3166 | 18.8969 (92) |
| Temperature a | djustment | | | | | | | | | | | 0.0000 |
| adjusted MIT | 18.9239 | 19.1243 | 19.4721 | 19.9187 | 20.2276 | 20.3519 | 20.3703 | 20.3689 | 20.2882 | 19.8630 | 19.3166 | 18.8969 (93) |

8. Space heating requirement

| | Jan | Feb | Mar | Apr | Mav | Tun | .Tu] | Aug | Sen | Oct | Nov | Dec |
|----------------|-----------|-----------|-----------|----------|----------|----------|----------|----------|----------|----------|-----------|----------------|
| Utilisation | 0.9965 | 0.9922 | 0.9776 | 0.9248 | 0.7947 | 0.5894 | 0.4156 | 0.4743 | 0.7673 | 0.9598 | 0.9927 | 0.9974 (94) |
| Useful gains | 455.0859 | 524.7147 | 601.4352 | 660.3774 | 621.6209 | 456.7176 | 306.3553 | 320.2879 | 458.0055 | 484.6641 | 442.7872 | 430.7182 (95) |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 (96) |
| Heat loss rate | e W | | | | | | | | | | | |
| | 1234.3396 | 1197.2420 | 1088.8385 | 912.8858 | 704.7628 | 469.9080 | 308.0247 | 323.5509 | 507.8192 | 765.5405 | 1014.6758 | 1227.0134 (97) |
| Month fracti | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 1.0000 | 1.0000 | 1.0000 (97a) |
| Space heating | kWh | | | | | | | | | | | |
| | 579.7648 | 451.9383 | 362.6280 | 181.8060 | 61.8576 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 208.9721 | 411.7598 | 592.4436 (98) |
| Space heating | | | | | | | | | | | | 2851.1702 (98) |
| Space heating | per m2 | | | | | | | | | (98 |) / (4) = | 37.0282 (99) |

8c. Space cooling requirement Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP Fraction of space heat from secondary/supplementary system (Table 11) Fraction of space heat from main system(s)



Regs Region: England Elmhurst Energy Systems SAP2012 Calculator (Design System) version 4.14r19

Design SAP

elmhurst energy



CALCULATION OF TARGET EMISSIONS 09 Jan 2014

| Efficiency of Efficiency of Space heating | main space f secondary/su requirement | neating sys upplementa | stem 1 (in s ry heating s | %) system, % | | | | | | | | 93.4000 (206) 0.0000 (208) 3052.6448 (211) |
|---|---|---------------------------|------------------------------|-----------------|-------------|-----------|----------|----------|----------|----------|-----------|--|
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
| Space heating | requirement | | | | | | | | | | | |
| | 579.7648 | 451.9383 | 362.6280 | 181.8060 | 61.8576 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 208.9721 | 411.7598 | 592.4436 (98) |
| Space heating | efficiency (| (main heati | ing system 1 | .) | | | | | | | | |
| | 93.4000 | 93.4000 | 93.4000 | 93.4000 | 93.4000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 93.4000 | 93.4000 | 93.4000 (210) |
| Space heating | fuel (main h | eating sys | stem) | 104 (501 | 66 0007 | 0 0000 | 0 0000 | 0 0000 | 0 0000 | 000 7000 | 440.05.00 | (24 2070 (011) |
| Watan beating | 620.7332 | 483.8/40 | 388.2527 | 194.6531 | 66.2287 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 223./388 | 440.8563 | 634.30/9 (211) |
| water neating | 1 equirement | 0 0000 | 0 0000 | 0 0000 | 0 0000 | 0 0000 | 0 0000 | 0 0000 | 0 0000 | 0 0000 | 0 0000 | 0 0000 (215) |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (213) |
| Water heating | | | | | | | | | | | | |
| Water heating | requirement | | | | | | | | | | | |
| | 199.8652 | 174.7702 | 181.8371 | 161.2803 | 156.1478 | 137.5263 | 131.7607 | 146.8823 | 148.5044 | 169.1019 | 180.5129 | 195.1667 (64) |
| Efficiency of | water heater | <u>.</u> | | | | | | | | | | 80.3000 (216) |
| (217)m | 87.5762 | 87.3366 | 86.7557 | 85.3533 | 82.9290 | 80.3000 | 80.3000 | 80.3000 | 80.3000 | 85.5852 | 87.0625 | 87.6676 (217) |
| Fuel for wate | r heating, k | Wh/month | | | | | | | | | | |
| | 228.2187 | 200.1111 | 209.5968 | 188.9561 | 188.2911 | 171.2656 | 164.0855 | 182.9169 | 184.9370 | 197.5830 | 207.3372 | 222.6211 (219) |
| Water heating | fuel used | | | | | | | | | | | 2345.9200 (219) |
| Annual totals | kWh/year | | | | | | | | | | | |
| Space heating | fuel - main | system | | | | | | | | | | 3052.6448 (211) |
| Space heating | fuel - secor | ndary | | | | | | | | | | 0.0000 (215) |
| Electricity fo | | fana. | | | | | | | | | | |
| control ho | ting numn | Lans. | | | | | | | | | | 20 0000 (000- |
| main heatir | a fluo fan | | | | | | | | | | | 45 0000 (2300) |
| Total oloctri | ig ilue lan | aborro kWk | ./ | | | | | | | | | 75 0000 (2308) |
| Floatrigity fo | r lighting (| above, kwi | 1/year d in Annond: | T) | | | | | | | | 240 5086 (222) |
| Total delivere | d energy for | call uses | a ili Appella. | LA L) | | | | | | | | 5814 1634 (238) |
| rotar activer. | a energy roi | u11 4000 | | | | | | | | | | 001111001 (200) |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| 12a. Carbon di | oxide emissi | lons - Indi | ividual heat | ing systems | including n | micro-CHP | | | | | | |
| | | | | | | | | _ | | | | |

| kg CO2/kWh | lag (002 / 110 a m | |
|------------|--|---|
| | kg COZ/year | |
| 0.2160 | 659.3713 (| (261) |
| 0.0000 | 0.0000 (| (263) |
| 0.2160 | 506.7187 (| (264) |
| | 1166.0900 (| (265) |
| 0.5190 | 38.9250 | (267) |
| 0.5190 | 176.7707 (| (268) |
| | 1381.7857 (| (272) |
| | 15.1440 (| (272a) |
| | 1.0000 | |
| | 2.2957 (| (272b) |
| | 0.5055 (| (272c) |
| | 17.9500 | (273) |
| | 0.2160 0.0000 0.2160 0.2160 0.5190 0.5190 | kg C02/kWh kg C02/year 0.2160 659.3713 0.0000 0.0000 0.2160 506.7187 1166.0900 1166.0900 0.5190 176.7707 1381.7857 15.1440 1.0000 2.2957 0.5055 17.9500 |





Appendix C: DER Worksheet – Be Green Option with Renewable Technology



| Property Reference | PV | | | | Issued on Date | 01/03/2024 |
|---------------------------|--|-----------------|---|---------------|----------------|------------|
| Assessment | F1 - PV | | | Prop Type Ref | | |
| Reference | | | | | | |
| Property | 35, Crescent Road, Caterh | nam, CR3 6LE | | | | |
| SAP Rating | | 87 B | DER | 13.52 | TER | 17.95 |
| Environmental | | 90 B | % DER <ter< th=""><th></th><th>24.66</th><th></th></ter<> | | 24.66 | |
| CO₂ Emissions (t/yea | ar) | 0.90 | DFEE | 39.39 | TFEE | 48.98 |
| General Requiremer | nts Compliance | Pass | % DFEE <tfe< th=""><th>E</th><th>19.59</th><th></th></tfe<> | E | 19.59 | |
| Assessor Details | Mr. Peter Kinsella, Base Energ peter@baseenergy.co.uk | gy Services Ltd | , Tel: 0151 933 | 0328, | Assessor ID | L770-0002 |
| Client | | | | | | |





REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

| REGULATIONS COM | PLIANCE REPORT - Approved | d Document L1A, 2013 Edition, England | |
|---|---|---|-------|
| DWELLING AS DESI | IGNED | | |
| End of terrace of | dwelling, total floor are | ea 117 m² | |
| This report cove It is not a comp | ers items included within plete report of regulation | n the SAP calculations. ons compliance. | |
| la TER and DER Fuel for main he Fuel factor:1.00 | eating:Mains gas) (mains gas) | | |
| Dwelling Carbon | Dioxide Emission Rate (DE | ER) 13.52 kgCOU/m²OK | |
| 1b TFEE and DFEE Target Fabric En Dwelling Fabric | E nergy Efficiency (TFEE)4 Energy Efficiency (DFEE) | 9.0 kWh/m²/yr 39.4 kWh/m²/yrOK | |
| 2 Fabric U-value Element External wall | es Average 0.20 (max. 0.30) | Highest 0.20 (max. 0.70) OK | |
| Party wall Floor | 0.00 (max. 0.20) 0.11 (max. 0.25) | - OK 0.11 (max. 0.70) OK | |
| Roof Openings | (no roof) 1.30 (max. 2.00) | 1.30 (max. 3.30) OK | |
| 2a Thermal bridg Thermal bridging | ging g calculated from linear | thermal transmittances for each junction | |
| 3 Air permeabil: | ity | | |
| Air permeability Maximum | y at 50 pascals: | 4.00 (design value) 10.0 | OK |
| 4 Heating effic: Main heating sys Data from databa Vaillant ecoTEC Combi boiler Efficiency: 89.6 Minimum: 88.0% | iency stem: see exclusive 843 VUW 436/5 5% SEDBUK2009 | Boiler system with radiators or underfloor - Main: -7 (H-GB) OK | s gas |
| Secondary heatin | ng system: | None | |
| 5 Cylinder insul Hot water storad | lation ge | No cylinder | |
| 6 Controls | | | |
| Space heating co | ontrols: | Time and temperature zone control | OK |
| Hot water contro | ols: | No cylinder | |
| Boiler interloc | k | Yes | ОК |
| 7 Low energy lic Percentage of f Minimum | ghts ixed lights with low-ener | rgy fittings:100% 75% | ок |
| 8 Mechanical ver Not applicable | ntilation | | |
| 9 Summertime ter Overheating rish Based on: | mperature k (Thames Valley): | Slight | ок |
| Overshading: Windows facing M | North: | Average 2.86 m², No overhang | |
| Windows facing M | West: | 11.55 m², No overhang 6.00 ach | |
| Blinds/curtains | : | None | |
| 10 Key features | | | |
| Party wall U-val | lue -value | 0.00 W/m ² K | |
| Photovoltaic ar: | ray | 0.30 kW | |





CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014) CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

| 1. Overall dwelling dimensions | | | | | | | | |
|---|---------|--------------|-----------|----------|------|---|----------|-------------|
| | | | | | | | | |
| | | Area | Storey | height | | | Volume | |
| | | (m2) | | (m) | | | (m3) | |
| Ground floor | | 77.0000 (1b) | x | 2.4000 | (2b) | = | 184.8000 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)(1n) | 77.0000 | | | | | | | (4) |
| Dwelling volume | | (3a)+(3b) |)+(3c)+(3 | d)+(3e). | (3n) | = | 184.8000 | (5) |

2. Ventilation rate

| | | | | | main heating | | secondary heating | | other | | total | r | n3 per hour | |
|------------------|-------------------------|--------------|------------|---------------|-----------------|--------|----------------------|------|----------|--------|-----------|----------|-------------|--------------|
| Number of chimne | eys | | | | 0 | + | 0 | + | 0 | = | 0 | * 40 = | 0.0000 | (6a) |
| Number of open f | lues | | | | 0 | + | 0 | + | 0 | = | 0 | * 20 = | 0.0000 | (6b) |
| Number of intern | nittent ia | ns | | | | | | | | | 0 | * 10 = | 30,0000 | (/a) (7b) |
| Number of fluele | ve vents see dae fin | | | | | | | | | | 0 | * 40 = | 0 0000 | (7c) |
| Number of fidere | .55 gus III | | | | | | | | | | 0 | 10 | 0.0000 | (, 0) |
| | | | | | | | | | | | Ai | r change | es per hour | |
| Infiltration due | e to chimne | eys, flues a | and fans | = (6a)+(6b)+(| 7a)+(7b)+(| (7c) = | | | | 30 | .0000 / | (5) = | 0.1623 | (8) |
| Pressure test | | | | | | | | | | | | | Yes | |
| Measured/design | AP50 | | | | | | | | | | | | 4.0000 | |
| Infiltration rat | ie | | | | | | | | | | | | 0.3623 | (18) |
| Number of sides | sheltered | | | | | | | | | | | | 2 | (19) |
| Shelter factor | | | | | | | | | (20) = 1 | - [0. | 075 x (1 | 9)] = | 0.8500 | (20) |
| Infiltration rat | e adjusted | d to include | shelter fa | ctor | | | | | | (21) = | (18) x (2 | 20) = | 0.3080 | (21) |
| | | | | | | | | | | | | | | |
| | Jan | Feb | Mar | Apr | Mav | สมภ | Jul | Aug | Sep | 0ct | + | Nov | Dec | |
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.800 | 0 3.8000 | 3.70 | 00 4.000 | 0 4.3 | 3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.950 | 0 0.9500 | 0.92 | 50 1.000 | 0 1.0 | 0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | | | | | | | | | | | | | | |
| | 0.3927 | 0.3850 | 0.3773 | 0.3388 | 0.3311 | 0.292 | 6 0.2926 | 0.28 | 49 0.308 | 0.0 | 3311 | 0.3465 | 0.3619 | (22b) |
| Effective ac | 0.5771 | 0.5741 | 0.5712 | 0.5574 | 0.5548 | 0.542 | 8 0.5428 | 0.54 | 06 0.547 | 4 0.5 | 5548 | 0.5600 | 0.5655 | (25) |

| Flement Cross Openings Natārea II-valus à v II K-valus à | x K J/K |
|---|------------|
| Dicasono di dicaso de la contrada de | J/K |
| m2 m2 m2 W/m2K W/K kJ/m2K | |
| Window (Uw = 1.30) 14.4100 1.2357 17.8070 | (27) |
| Heat Loss Floor 1 77.0000 0.1100 8.4700 | (28b) |
| External Wall 1 50.6500 14.4100 36.2400 0.2000 7.2480 | (29a) |
| Total net area of external elements Aum(A, m2) 127.6500 | (31) |
| Fabric heat loss, $W/K = Sum (A \times U)$ (26)(30) + (32) = 33.5250 | (33) |
| Party Wall 1 53.0000 0.0000 0.0000 | (32) |
| - | |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 100. | 000 (35) |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) 12. | 215 (36) |
| Total fabric heat loss (33) + (36) = 45. | 465 (37) |
| | |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) | |
| Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov De | |
| (38)m 35.1939 35.0113 34.8323 33.9917 33.8345 33.1023 33.1023 32.9668 33.3843 33.8345 34.1526 34. | 852 (38) |
| Heat transfer coeff | |
| 80.8404 80.6578 80.4789 79.6383 79.4810 78.7489 78.7489 78.6133 79.0309 79.4810 79.7992 80. | 318 (39) |
| Average = Sum(39)m / 12 = 79. | 375 (39) |
| | |
| Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov De | |
| HLP 1.0499 1.0475 1.0452 1.0343 1.0322 1.0227 1.0227 1.0210 1.0264 1.0322 1.0364 1. | 407 (40) |
| HLP (average) 1. | 343 (40) |
| Days in month | |
| - 31 28 31 30 31 30 31 31 30 31 30 31 30 31 30 | 31 (41) |

| 4. Water heating energy requirements (kWh/year) | | | | | | | | | | | | | | |
|---|--------------------|---------------------|----------|----------|----------|---------|---------|----------|----------|------------|-------------|-----------|------|--|
| Assumed occupa Average daily | ncy hot water u | use (litres/ | 'dav) | | | | | | | | | 2.4035 | (42) | |
| | | | | | | | | | | | | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | | |
| Daily hot water use | | | | | | | | | | | | | | |
| | 100.4108 | 96.7595 | 93.1082 | 89.4569 | 85.8056 | 82.1543 | 82.1543 | 85.8056 | 89.4569 | 93.1082 | 96.7595 | 100.4108 | (44) | |
| Energy conte | 148.9063 | 130.2344 | 134.3902 | 117.1646 | 112.4223 | 97.0119 | 89.8957 | 103.1567 | 104.3887 | 121.6550 | 132.7959 | 144.2078 | (45) | |
| Energy content | (annual) | | | | | | | | | Total = Su | um (45) m = | 1436.2293 | (45) | |
| Distribution 1 | .oss (46)m | $= 0.15 \times (4)$ | 5) m | | | | | | | | | | | |
| | 22.3359 | 19.5352 | 20.1585 | 17.5747 | 16.8633 | 14.5518 | 13.4844 | 15.4735 | 15.6583 | 18.2482 | 19.9194 | 21.6312 | (46) | |
| Water storage | loss: | | | | | | | | | | | | | |
| Total storage | loss | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (56) | |
| If cylinder co | ntains dedi | cated solar | storage | | | | | | | | | | | |
| - | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (57) | |
| Combi loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) | |





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| Total | heat req | uired for | water heati | ng calculate | ed for each | month | 07 0110 | 00 0057 | 100 1567 | 104 2007 | 101 6550 | 100 7050 | 144 0070 (60) |
|--|-----------|------------|-------------|--------------|-------------|----------|---------|---------|----------|-------------|--------------|-------------|----------------|
| | | 148.9063 | 130.2344 | 134.3902 11 | 7.1646 112 | .4223 | 97.0119 | 89.895/ | 103.150/ | 104.388/ | 121.6550 | 132./959 | 144.2078 (62) |
| Solar | input | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (63) |
| Solar input (sum of months) = Sum(63)m = | | | | | | | | | | | | 0.0000 (63) | |
| FGHRS | | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| Output | from w/ | h | | | | | | | | | | | |
| - | | 148.9063 | 130.2344 | 134.3902 | 117.1646 | 112.4223 | 97.0119 | 89.8957 | 103.1567 | 104.3887 | 121.6550 | 132.7959 | 144.2078 (64) |
| | | | | | | | | | Total p | er year (kW | 'h/year) = S | um(64)m = | 1436.2293 (64) |
| Heat o | ains fro | m water he | ating, kWh/ | month | | | | | | | | | |
| neue g | 41110 110 | 49.5113 | 43.3029 | 44.6847 | 38.9572 | 37.3804 | 32.2564 | 29.8903 | 34.2996 | 34.7092 | 40.4503 | 44.1546 | 47.9491 (65) |

| 5. Internal g | ains (see Ta | uble 5 and 5 | 5a) | | | | | | | | | |
|---------------|--------------|--------------|--------------|-------------|-------------|-------------|----------|----------|----------|----------|----------|---------------|
| Metabolic gai | ns (Table 5) | , Watts | | | | | | | | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
| (66)m | 120.1737 | 120.1737 | 120.1737 | 120.1737 | 120.1737 | 120.1737 | 120.1737 | 120.1737 | 120.1737 | 120.1737 | 120.1737 | 120.1737 (66) |
| Lighting gain | s (calculate | ed in Append | dix L, equat | ion L9 or L | 9a), also s | ee Table 5 | | | | | | |
| | 19.2861 | 17.1297 | 13.9308 | 10.5465 | 7.8837 | 6.6557 | 7.1917 | 9.3481 | 12.5470 | 15.9313 | 18.5942 | 19.8221 (67) |
| Appliances ga | ins (calcula | ated in App | endix L, equ | ation L13 d | or L13a), a | lso see Tab | le 5 | | | | | |
| | 213.0566 | 215.2674 | 209.6961 19 | 7.8355 182 | 2.8636 168. | 7921 159.3 | 915 | 157.1806 | 162.7519 | 174.6125 | 189.5845 | 203.6559 (68) |
| Cooking gains | (calculated | d in Append: | ix L, equati | on L15 or L | 15a), also | see Table 5 | | | | | | |
| | 35.0174 | 35.0174 | 35.0174 | 35.0174 | 35.0174 | 35.0174 | 35.0174 | 35.0174 | 35.0174 | 35.0174 | 35.0174 | 35.0174 (69) |
| Pumps, fans | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 (70) |
| Losses e.g. e | vaporation (| negative va | alues) (Tabl | e 5) | | | | | | | | |
| | -96.1390 | -96.1390 | -96.1390 | -96.1390 | -96.1390 | -96.1390 | -96.1390 | -96.1390 | -96.1390 | -96.1390 | -96.1390 | -96.1390 (71) |
| Water heating | gains (Tabl | .e 5) | | | | | | | | | | |
| | 66.5475 | 64.4389 | 60.0601 | 54.1073 | 50.2425 | 44.8006 | 40.1752 | 46.1016 | 48.2073 | 54.3687 | 61.3259 | 64.4477 (72) |
| Total interna | l gains | | | | | | | | | | | |
| | 360.9423 | 358.8882 | 345.7392 | 324.5414 | 303.0418 | 282.3005 | 268.8105 | 274.6824 | 285.5583 | 306.9646 | 331.5566 | 349.9779 (73) |
| | | | | | | | | | | | | |

6. Solar gains

| [Jan] | Jan] | | Area m2 | | Solar flux Table 6a W/m2 | Speci or | g fic data Table 6b | Specific or Tabi | FF data le 6c | Acces facto Table 6 | ss or id | Gains W | |
|----------------------------|---------------------|----------------------|----------------------|----------------------|--------------------------------|----------------------|---------------------------|----------------------|----------------------|---------------------------|---------------------|---------------------|--------------|
| North West | | 2.8 11.5 | 600 500 | 10.6334 19.6403 | | 0.6300 0.6300 | 0 0 | .7000 .7000 | 0.770 | 00 | 9.2941 69.3268 | (74) (80) | |
| Solar gains Total gains | 78.6209 439.5632 | 153.3795 512.2677 | 253.5247 599.2639 | 374.2119 698.7534 | 464.5036 767.5454 | 478.5617 760.8623 | 454.3230 723.1335 | 385.9741 660.6565 | 296.0453 581.6036 | 182.0649 489.0295 | 97.9079 429.4645 | 64.7590 414.7369 | (83) (84) |

| 7. Mean inte | rnal temperat | ure (heating | g season) | | | | | | | | | | |
|----------------------|-----------------------|--------------|--------------|-------------|-------------|---------|---------|---------|------------------|------------------------|--------------------|--------------------|--------------|
| Temperature | during heating | g periods i | n the living | g area from | Table 9, Th | nl (C) | | | | | | 21.0000 | (85) |
| Utilisation | factor for ga | ins for liv | ing area, n | il,m (see T | able 9a) | | | | | | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| tau | 26.4582 | 26.5181 | 26.5770 | 26.8575 | 26.9107 | 27.1609 | 27.1609 | 27.2077 | 27.0640 | 26.9107 | 26.8034 | 26.6921 | |
| alpha | 2.7639 | 2.7679 | 2.7718 | 2.7905 | 2.7940 | 2.8107 | 2.8107 | 2.8138 | 2.8043 | 2.7940 | 2.7869 | 2.7795 | |
| util living | area | | | | | | | | | | | | |
| - | 0.9692 | 0.9524 | 0.9165 | 0.8408 | 0.7224 | 0.5737 | 0.4456 | 0.4968 | 0.7130 | 0.8909 | 0.9552 | 0.9735 | (86) |
| MIT | 18.7790 | 19.0498 | 19.5128 | 20.0909 | 20.5532 | 20.8361 | 20.9410 | 20.9189 | 20.6833 | 20.0544 | 19.3117 | 18.7271 | (87) |
| Th 2 | 20.0420 | 20.0439 | 20.0459 | 20.0549 | 20.0566 | 20.0644 | 20.0644 | 20.0659 | 20.0614 | 20.0566 | 20.0531 | 20.0496 | (88) |
| util rest of | house | | | | | | | | | | | | |
| | 0.9647 | 0.9455 | 0.9042 | 0.8172 | 0.6811 | 0.5097 | 0.3617 | 0.4113 | 0.6555 | 0.8693 | 0.9476 | 0.9695 | (89) |
| MIT 2 Living area | 17.0547 fraction | 17.4468 | 18.1124 | 18.9314 | 19.5557 | 19.9133 | 20.0245 | 20.0075 | 19.7422 fLA = | 18.8998 Living area | 17.8361 / (4) = | 16.9839 0.3519 | (90) (91) |
| MIT Temperature | 17.6616 adjustment | 18.0109 | 18.6053 | 19.3395 | 19.9068 | 20.2381 | 20.3471 | 20.3282 | 20.0734 | 19.3061 | 18.3555 | 17.5974 -0.1500 | (92) |
| adjusted MIT | 17.5116 | 17.8609 | 18.4553 | 19.1895 | 19.7568 | 20.0881 | 20.1971 | 20.1782 | 19.9234 | 19.1561 | 18.2055 | 17.4474 | (93) |

8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|----------------|-----------|-----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-------------|-------|
| Utilisation | 0.9476 | 0.9240 | 0.8780 | 0.7917 | 0.6667 | 0.5114 | 0.3741 | 0.4222 | 0.6460 | 0.8434 | 0.9268 | 0.9540 (| (94) |
| Useful gains | 416.5107 | 473.3448 | 526.1675 | 553.2188 | 511.6888 | 389.1096 | 270.5394 | 278.9220 | 375.7181 | 412.4388 | 398.0466 | 395.6490 (| (95) |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 (| (96) |
| Heat loss rate | e W | | | | | | | | | | | | |
| | 1068.0301 | 1045.4019 | 962.1469 | 819.4379 | 640.3603 | 432.1805 | 283.2639 | 297.0200 | 460.2276 | 680.0485 | 886.2061 | 1061.5389 (| (97) |
| Month fracti | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 1.0000 | 1.0000 | 1.0000 / | (97a) |
| Space heating | kWh | | | | | | | | | | | | |
| | 484.7305 | 384.4224 | 324.3686 | 191.6778 | 95.7316 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 199.1016 | 351.4748 | 495.4221 (| (98) |
| Space heating | | | | | | | | | | | | 2526.9294 | (98) |
| Space heating | per m2 | | | | | | | | | (98) | / (4) = | 32.8173 (| 99) |

8c. Space cooling requirement

Not applicable

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





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| Fraction of sp Fraction of sp Efficiency of Efficiency of Space heating | raction of space heat from secondary/supplementary system (Table 11) raction of space heat from main system(s) fficiency of main space heating system 1 (in %) fficiency of secondary/supplementary heating system, % pace heating requirement Lap Eeb Mar Por May Jun Jul Pug Sep Oct Now Dec | | | | | | | | | | | | | |
|--|---|---|--|---|--|-------------|------------|---|----------|--|----------------|---|--|--|
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | | |
| Space heating | requirement 484.7305 | 384.4224 | 324.3686 | 191.6778 | 95.7316 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 199.1016 | 351.4748 | 495.4221 | (98) | |
| Space heating | efficiency 90.5000 | (main heati 90.5000 | ing system 1) 90.5000 | 90.5000 | 90.5000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 90.5000 | 90.5000 | 90.5000 | (210) | |
| Space heating | fuel (main) 535.6138 | heating sys 424.7761 | stem) 358.4184 | 211.7986 | 105.7808 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 220.0018 | 388.3700 | 547.4278 | (211) | |
| Water heating | requirement 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (215) | |
| Water heating Water heating | requirement | | | | | | | | | | | | | |
| Efficiency of | 148.9063 water heate | 130.2344 r | 134.3902 | 117.1646 | 112.4223 | 97.0119 | 89.8957 | 103.1567 | 104.3887 | 121.6550 | 132.7959 | 144.2078 83.8000 | (64) (216) | |
| (217)m Fuel for wate | 88.8310 | 88.7053 | 88.4289 | 87.8358 | 86.7538 | 83.8000 | 83.8000 | 83.8000 | 83.8000 | 87.8365 | 88.5584 | 88.8976 | (217) | |
| Water heating | 167.6288 fuel used | 146.8169 | 151.9755 | 133.3905 | 129.5877 | 115.7659 | 107.2742 | 123.0987 | 124.5689 | 138.5017 | 149.9529 | 162.2179 1650.7794 | (219) (219) | |
| Annual totals Space heating Space heating | kWh/year fuel - main fuel - seco | system ndary | | | | | | | | | | 2792.1872 0.0000 | (211) (215) | |
| Electricity for central hear main heating Total electric Electricity for | or pumps and ating pump ng flue fan city for the or lighting | above, kWH (calculated | n/year d in Appendi: | к L) | | | | | | | | 30.0000 45.0000 75.0000 340.5986 | (230c) (230e) (231) (232) | |
| Energy saving PV Unit 0 (0. Total delivere | /generation 80 * 0.30 * ed energy fo | technologi 1080 * 1.0 9r all uses | es (Appendic 0) = | es M ,N an | d Q) | | | | | -259.0859 | | -259.0859 4599.4793 | (233) (238) | |
| 12a. Carbon d: | ioxide emiss | ions - Indi | vidual heat | ing systems | including : | micro-CHP | | | | | | | | |
| Space heating Space heating Water heating Space and watt Pumps and fan Energy for lig | - main syst - secondary (other fuel er heating s ghting | em 1 ,) | | | | | | Energy kWh/year 2792.1872 0.0000 1650.7794 75.0000 340.5986 | Emiss | ion factor kg CO2/kWh 0.2160 0.0000 0.2160 0.5190 0.5190 | k | Emissions g CO2/year 603.1124 0.0000 356.5683 959.6808 38.9250 176.7707 | (261) (263) (264) (265) (267) (268) | |
| Energy saving PV Unit Total CO2, kg, Dwelling Carbo | g/generation /year on Dioxide E | technolog: mission Rat | ies te (DER) | | | | | -259.0859 | | 0.5190 | | -134.4656 1040.9109 13.5200 | (269) (272) (273) | |
| 16 CO2 EMISSIC DER Total Floor A: Assumed numbe: CO2 emissions CO2 emissions Total CO2 emi Residual CO2 emi Residual CO2 emiss: Resulting CO2 Net CO2 emiss: | ONS ASSOCIAT rea r of occupan factor in Ta from applia from cookin ssions emissions of lowable elec emissions o ions | ED WITH APP ts ble 12 for nces, equat g, equation fset from h tricity ger ffset from | PLIANCES AND electricity tion (L14) n (L16) Diofuel CHP meration, KWM additional a | COOKING AN displaced h/m²/year illowable e | D SITE-WIDE from grid lectricity o | ELECTRICITY | (GENERATIO | N TECHNOLOGI | ES | | TFA N EF | 13.5200 77.0000 2.4035 0.5190 16.3965 2.2946 32.2111 0.0000 0.0000 0.0000 32.2111 | ZC1 ZC2 ZC3 ZC4 ZC5 ZC6 ZC7 ZC8 | |





CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014) CALCULATION OF TARGET EMISSIONS 09 Jan 2014

| | - | | | | | |
|---|---------|--------------|----------|---------------|-----|----------------------|
| 1. Overall dwelling dimensions | | | | | | |
| | | | | | | |
| | | Area | Stor | ey height | | Volume |
| | | (m2) | | (m) | | (m3) |
| Ground floor | | 77.0000 (1b) | х | 2.4000 (2b) | = | 184.8000 (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)(1n) | 77.0000 | | | | | (4) |
| Dwelling volume | | (3a)+(3b | o)+(3c)· | +(3d)+(3e)(3n |) = | 184.8000 (5) |

2. Ventilation rate

| Number of chimne | ys | | | | main heating 0 | + | secondary heating 0 | + | other 0 = | tota | 1 m3 0 * 40 = | 9 per hour 0.0000 (6a) |
|--|-------------------------|---------------|---------------|---------------|----------------------|--------|---------------------------|---------------|--------------|---------------|-----------------------------|-----------------------------|
| Number of open f | lues | | | | 0 | + | 0 | + | 0 = | (| 0 * 20 = | 0.0000 (6b) |
| Number of intern | nittent fam no worte | ns | | | | | | | | | 3 * 10 = | 30.0000 (7a) |
| Number of fluele | ss gas fir | res | | | | | | | | (| $0 \times 10 =$ 0 × 40 = | 0.0000 (7b) |
| | | | | | | | | | | ; | Air changes | per hour |
| Infiltration due Pressure test Measured/design | to chimne AP50 | eys, flues a | ind fans = | = (6a)+(6b)+ | (7a)+(7b)+(| 7c) = | | | | 30.0000 | / (5) = | 0.1623 (8) Yes 5.0000 |
| Infiltration rat Number of sides | e sheltered | | | | | | | | | | | 0.4123 (18) 2 (19) |
| Shelter factor | | | | | | | | | (20) = 1 - | [0.075 x | (19)] = | 0.8500 (20) |
| Infiltration rat | e adjusted | d to include | shelter fa | ctor | | | | | (21 | (18) = (18) x | (20) = | 0.3505 (21) |
| | | To b | M | | | | T] | | 0 | 0 | N | Dee |
| Wind speed | Jan 5 1000 | Feb 5 0000 | Mar 4 9000 | Apr 4 4000 | May 4 3000 | 3 8000 | 3 8000 | Aug 3 7000 | 4 0000 | 4 3000 | 4 5000 | 4 7000 (22) |
| Wind factor Adi infilt rate | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| , | 0.4469 | 0.4381 | 0.4293 | 0.3855 | 0.3768 | 0.3330 | 0.3330 | 0.3242 | 0.3505 | 0.3768 | 0.3943 | 0.4118 (22b) |
| Effective ac | 0.5998 | 0.5960 | 0.5922 | 0.5743 | 0.5710 | 0.5554 | 0.5554 | 0.5526 | 0.5614 | 0.5710 | 0.5777 | 0.5848 (25) |

| 3. Heat losses | and heat l | oss paramet | er | | | | | | | | | | |
|------------------|---------------|---------------|--------------|--------------------|------------|---------|---------|--------------|---------|---------|----------|----------|---------|
| Element | | | | Gross | Openings | Net | tArea | U-value | АхU | K- | -value | АхК | |
| | | | | m2 | m2 | | m2 | W/m2K | W/K | t 1 | kJ/m2K | kJ/K | |
| TER Opening Tvg | be $(Uw = 1.$ | 40) | | | | 14 | .4100 | 1.3258 | 19.1042 | | | | (27) |
| Heat Loss Floor | r 1 | - / | | | | 77 | .0000 | 0.1300 | 10.0100 | | | | (28b) |
| External Wall 1 | 1 | | | 50 6500 | 14 4100 | 36 | 2400 | 0 1800 | 6 5232 | | | | (29a) |
| Total net area | of externa | l elements : | Aum (A. m2) | 00.0000 | 11.1100 | 127 | 6500 | 0.1000 | 0.0202 | | | | (31) |
| Tobai a beat la | W/V = 0 | | (III) (III) | | | 127 | (26) (| 201 (221 - | 25 6274 | | | | (32) |
| rabiic neat ios | 55, W/A - 5 | uni (A X U) | | | | | (20)(| 30) + (32) - | 55.6574 | | | | (33) |
| Thormal maga no | arameter (T | MD - Cm / T | ED) in kT/m | 25 | | | | | | | | 250 0000 | (25) |
| Thermal hass po | arameter (r | Pir = Cin / 1 | eted weine | LIL Namondiu VI | | | | | | | | 10.1070 | (35) |
| Inermai bridges | s (Sum(L X | PSI) Calcul | ated using A | Appendix K) | | | | | | (22) | | 12.10/0 | (30) |
| Total fabric he | eat loss | | | | | | | | | (33) | + (36) = | 4/.8244 | (37) |
| | | | | 0 00 /0 | | | | | | | | | |
| Ventilation hea | at loss cal | culated mon | thiy (38)m | = 0.33 x (2) | 5) m x (5) | | | | | | | | |
| | Jan | Feb | Mar | Apr | мау | Jun | Jul | Aug | Sep | OCt | NOV | Dec | |
| (38)m | 36.5811 | 36.3446 | 36.1128 | 35.0243 | 34.8206 | 33.8725 | 33.8725 | 33.6969 | 34.2377 | 34.8206 | 35.2326 | 35.6634 | (38) |
| Heat transfer o | coeff | | | | | | | | | | | | |
| | 84.4054 | 84.1690 | 83.9372 | 82.8486 | 82.6450 | 81.6968 | 81.6968 | 81.5213 | 82.0620 | 82.6450 | 83.0570 | 83.4877 | (39) |
| Average = Sum (3 | 39)m / 12 = | | | | | | | | | | | 82.8477 | (39) |
| | | | | | | | | | | | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| HLP | 1.0962 | 1.0931 | 1.0901 | 1.0760 | 1.0733 | 1.0610 | 1.0610 | 1.0587 | 1.0657 | 1.0733 | 1.0787 | 1.0843 | (40) |
| HLP (average) | | | | | | | | | | | | 1.0759 | (40) |
| Davs in month | | | | | | | | | | | | | (/ |
| bayo in month | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | (41) |
| | 51 | 20 | 51 | 50 | 51 | 50 | 51 | 51 | 50 | 51 | 50 | 51 | (+ +) |

| 4. Water heat | ing energy r | equirements | (kWh/year) | | | | | | | | | | |
|--|---------------------|---------------------|-------------|--------------|----------|---------|---------|----------|----------|----------|-----------|-------------------|--------------|
| Assumed occupa Average daily | ancy hot water u | se (litres/ | 'day) | | | | | | | | | 2.4035 91.2825 | (42) (43) |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| Daily hot wate | er use | | | | | | | | | | | | |
| | 100.4108 | 96.7595 | 93.1082 | 89.4569 | 85.8056 | 82.1543 | 82.1543 | 85.8056 | 89.4569 | 93.1082 | 96.7595 | 100.4108 | (44) |
| Energy conte | 148.9063 | 130.2344 | 134.3902 | 117.1646 | 112.4223 | 97.0119 | 89.8957 | 103.1567 | 104.3887 | 121.6550 | 132.7959 | 144.2078 | (45) |
| Energy content (annual) Total = Sum(45)m = | | | | | | | | | | | 1436.2293 | (45) | |
| Distribution 3 | loss (46)m | $= 0.15 \times (4)$ | 5)m | | | | | | | | | | |
| | 22.3359 | 19.5352 | 20.1585 | 17.5747 | 16.8633 | 14.5518 | 13.4844 | 15.4735 | 15.6583 | 18.2482 | 19.9194 | 21.6312 | (46) |
| Water storage | loss: | | | | | | | | | | | | |
| Total storage | loss | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (56) |
| If cylinder co | ontains dedi | cated solar | storage | | | | | | | | | | |
| - | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (57) |
| Combi loss | 50.9589 | 44.5359 | 47.4469 | 44.1157 | 43.7256 | 40.5144 | 41.8649 | 43.7256 | 44.1157 | 47.4469 | 47.7170 | 50.9589 | (61) |
| Total heat red | quired for w | ater heatin | g calculate | d for each n | month | | | | | | | | |



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| | 199.8652 | 174.7702 | 181.8371 | 161.2803 | 156.1478 | 137.5263 | 131.7607 | 146.8823 | 148.5044 | 169.1019 | 180.5129 | 195.1667 (62) |
|-----------------|-------------|-------------|----------|----------|----------|----------|----------|------------|-------------|--------------|-------------|----------------|
| Solar input | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (63) |
| | | | | | | | | Solar inpu | t (sum of m | nonths) = Su | um (63) m = | 0.0000 (63) |
| Output from w/ | h | | | | | | | | | | | |
| - | 199.8652 | 174.7702 | 181.8371 | 161.2803 | 156.1478 | 137.5263 | 131.7607 | 146.8823 | 148.5044 | 169.1019 | 180.5129 | 195.1667 (64) |
| | | | | | | | | Total pe | r year (kWh | n/year) = Su | um (64) m = | 1983.3557 (64) |
| Heat gains from | m water hea | ting, kWh/m | onth | | | | | | | | | |
| | 62.2511 | 54.4369 | 56.5465 | 49.9862 | 48.3118 | 42.3850 | 40.3566 | 45.2310 | 45.7382 | 52.3120 | 56.0839 | 60.6888 (65) |

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

| Table 5), Wa | atts | | | | | | | | | | | |
|--------------|--|---|---|--|---|---|--|--|--|--|---|---|
| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| 0.1737 12 | 0.1737 | 120.1737 | 120.1737 | 120.1737 | 120.1737 | 120.1737 | 120.1737 | 120.1737 | 120.1737 | 120.1737 | 120.1737 (6 | 6) |
| alculated i | n Appendi: | x L, equation | on L9 or L9a |), also see | e Table 5 | | | | | | | |
| 9.2861 1 | 7.1297 | 13.9308 | 10.5465 | 7.8837 | 6.6557 | 7.1917 | 9.3481 | 12.5470 | 15.9313 | 18.5942 | 19.8221 (0 | ŝ7) |
| (calculated | in Appen | dix L, equa | tion L13 or | L13a), als | o see Table | e 5 | | | | | | |
| 3.0566 215 | .2674 20 | 9.6961 197 | .8355 182.8 | 3636 168.7 | 921 159.39 | 15 | 157.1806 | 162.7519 | 174.6125 | 189.5845 | 203.6559 (6 | 58) |
| lculated in | Appendix | L, equation | n L15 or L15 | a), also se | ee Table 5 | | | | | | | |
| 5.0174 3 | 5.0174 | 35.0174 | 35.0174 | 35.0174 | 35.0174 | 35.0174 | 35.0174 | 35.0174 | 35.0174 | 35.0174 | 35.0174 (6 | i9) |
| 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 (7 | 70) |
| ration (neg | ative valu | ues) (Table | 5) | | | | | | | | | |
| 6.1390 -9 | 6.1390 | -96.1390 | -96.1390 | -96.1390 | -96.1390 | -96.1390 | -96.1390 | -96.1390 | -96.1390 | -96.1390 | -96.1390 (7 | 71) |
| ns (Table 5 |) | | | | | | | | | | | |
| 3.6708 8 | 1.0073 | 76.0033 | 69.4252 | 64.9352 | 58.8681 | 54.2427 | 60.7943 | 63.5252 | 70.3118 | 77.8943 | 81.5710 (* | 12) |
| ins | | | | | | | | | | | | |
| 8.0656 37 | 5.4566 | 361.6824 | 339.8594 | 317.7346 | 296.3680 | 282.8780 | 289.3752 | 300.8763 | 322.9078 | 348.1250 | 367.1012 (7 | /3) |
| | Table 5), W. Jan 0.1737 12 alculated i 9.2861 1 (calculated 3.0566 215 lculated in 5.0174 3 3.0000 ration (neg 6.1390 -9 ns (Table 5 3.6708 8 ins 8.0656 37 | Table 5), Watts Jan Feb 0.1737 120.1737 alculated in Appendi 9.2861 17.1297 (calculated in Appen 3.0566 215.2674 20 Jculated in Appendix 5.0174 35.0174 3.0000 3.0000 ration (negative val 6.1390 -96.1390 ns (Table 5) 3.6708 81.0073 ins 8.0656 375.4566 | Table 5), Watts Jan Feb Mar 0.1737 120.1737 120.1737 alculated in Appendix L, equati 17.1297 13.9308 (calculated in Appendix L, equati 3.0566 215.2674 209.6961 197 lculated in Appendix L, equatio 5.0174 35.0174 35.0174 3.0000 3.0000 3.0000 3.0000 3.0000 ration (negative values) (Table 6.1390 -96.1390 ns (Table 5) 3.6708 81.0073 76.0033 ins 8.0656 375.4566 361.6824 361.6824 | Table 5), Watts Jan Feb Mar Apr 0.1737 120.1737 120.1737 120.1737 alculated in Appendix L, equation L9 or L98 9.2861 17.1297 13.9308 10.5465 (calculated in Appendix L, equation L13 or L13 or 13.9308 10.5465 (calculated in Appendix L, equation L13 or L15 or L15 5.0174 35.0174 35.0174 3.0000 3.0000 3.0000 3.0000 3.0000 ration (negative values) (Table 5) 3.6708 81.0073 76.0033 69.4252 ins 8.0656 375.4566 361.6824 339.8594 | Table 5), Watts Jan Feb Mar Apr May 0.1737 120.1737 120.1737 120.1737 120.1737 alculated in Appendix L, equation L9 or L9a), also see 9.2861 17.1297 13.9308 10.5465 7.8837 (calculated in Appendix L, equation L13 or L13a), also see 13.9306 21.5467 7.8837 (calculated in Appendix L, equation L13 or L13a), also see 5.0174 35.0174 35.0174 35.0174 3.0000 3.0000 3.0000 3.0000 3.0000 3.0000 3.0000 ration (negative values) (Table 5) -96.1390 -96.1390 -96.1390 -96.1390 3.0708 81.0073 76.0033 69.4252 64.9352 ins 8.0656 375.4566 361.6824 339.8594 317.7346 | Table 5), Watts Mar Apr May Jun Jan Feb Mar Apr May Jun 0.1737 120.1737 120.1737 120.1737 120.1737 120.1737 alculated in Appendix L, equation L9 or L9a), also see Table 5 9.2861 17.1297 13.9308 10.5465 7.8837 6.6557 (calculated in Appendix L, equation L13 or L13a), also see Table 5 9.0566 215.2674 209.6961 197.8355 182.8636 168.7921 159.39 culated in Appendix L, equation L15 or L15a), also see Table 5 5.0174 35.0174 35.0174 35.0174 35.0174 3.0000 3.0000 3.0000 3.0000 3.0000 3.0000 ration (negative values) (Table 5) -96.1390 -96.1390 -96.1390 -96.1390 3.0708 81.0073 76.0033 69.4252 64.9352 58.8681 ins 8.0656 375.4566 361.6824 339.8594 317.7346 296.3680 | Table 5), Watts Mar Apr May Jun Jul Jan Feb Mar Apr May Jun Jul Jan Feb Mar Apr May Jun Jul Jan Feb Mar Apr May Jun Jul Jan 120.1737 120.1737 120.1737 120.1737 120.1737 120.1737 Jalculated in Appendix L, equation L9 or L9a), also see Table 5 5 5.0566 215.2674 209.6961 197.8355 182.8636 168.7921 159.3915 Culated in Appendix L, equation L15 or L15a), also see Table 5 5.0174 35.0174 | Table 5), Watts Mar Apr May Jun Jul Aug Jan Feb Mar Apr May Jun Jul Aug Jan Feb Mar Apr May Jun Jul Aug Jon 1737 120.1737 120.1737 120.1737 120.1737 120.1737 120.1737 alculated in Appendix L, equation L9 or L9a), also see Table 5 5 5.0174 35.0174 35.0174 159.3915 157.1806 lculated in Appendix L, equation L15 or L15a), also see Table 5 5 5.0174 35 | Table 5), Watts Mar Apr May Jun Jul Aug Sep Jan Feb Mar Apr May Jun Jul Aug Sep Jan Feb Mar Apr May Jun Jul Aug Sep Jon 1737 120. | Table 5), Watts Mar Apr May Jun Jul Aug Sep Oct Jan Feb Mar Apr May Jun Jul Aug Sep Oct Jon 1737 120.1737 | Table 5), Watts Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Jon 1737 120.1737 | Table 5), Watts Mar Apr May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Jon 1737 120.1737 |

6. Solar gains

| [Jan] | | Area m2 | | Solar flux g Table 6a Specific data W/m2 or Table 6b | | FF Specific data or Table 6c | | Access factor Table 6d | | Gains W | | | |
|----------------------------|---------------------|----------------------|----------------------|--|----------------------|------------------------------------|----------------------|--------------------------------|----------------------|----------------------|---------------------|---------------------|--------------|
| North West | | | 2.8600 11.5500 | | 10.6334 19.6403 | | 0.6300 0.6300 | 0.6300 0.7000 0.6300 0.7000 | | 0.7700 0.7700 | | 9.2941 69.3268 | (74) (80) |
| Solar gains Total gains | 78.6209 456.6865 | 153.3795 528.8361 | 253.5247 615.2071 | 374.2119 714.0713 | 464.5036 782.2381 | 478.5617 774.9298 | 454.3230 737.2010 | 385.9741 675.3493 | 296.0453 596.9216 | 182.0649 504.9727 | 97.9079 446.0329 | 64.7590 431.8602 | (83) (84) |

| 7. Mean inter | nal temperat | ure (heating | g season) | | | | | | | | | |
|----------------|--------------|--------------|--------------|-------------|-------------|---------|---------|---------|---------|-------------|---------|--------------|
| Temperature d | uring heatin | g periods in | n the living | g area from | Table 9, Th | 11 (C) | | | | | | 21.0000 (85) |
| Utilisation f | actor for ga | ins for liv | ing area, n | il,m (see T | able 9a) | | | | | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
| tau | 63.3516 | 63.5296 | 63.7050 | 64.5421 | 64.7011 | 65.4520 | 65.4520 | 65.5930 | 65.1607 | 64.7011 | 64.3802 | 64.0480 |
| alpha | 5.2234 | 5.2353 | 5.2470 | 5.3028 | 5.3134 | 5.3635 | 5.3635 | 5.3729 | 5.3440 | 5.3134 | 5.2920 | 5.2699 |
| util living a | rea | | | | | | | | | | | |
| | 0.9981 | 0.9956 | 0.9860 | 0.9460 | 0.8341 | 0.6457 | 0.4822 | 0.5445 | 0.8193 | 0.9747 | 0.9960 | 0.9986 (86) |
| MIT | 19.8252 | 19.9787 | 20.2472 | 20.5958 | 20.8564 | 20.9722 | 20.9951 | 20.9910 | 20.9044 | 20.5456 | 20.1223 | 19.8009 (87) |
| Th 2 | 20.0040 | 20.0065 | 20.0089 | 20.0205 | 20.0227 | 20.0328 | 20.0328 | 20.0347 | 20.0289 | 20.0227 | 20.0183 | 20.0137 (88) |
| util rest of 3 | house | | | | | | | | | | | |
| | 0.9975 | 0.9941 | 0.9811 | 0.9271 | 0.7829 | 0.5601 | 0.3791 | 0.4358 | 0.7455 | 0.9624 | 0.9944 | 0.9981 (89) |
| MIT 2 | 18.4345 | 18.6602 | 19.0511 | 19.5510 | 19.8861 | 20.0150 | 20.0310 | 20.0311 | 19.9536 | 19.4923 | 18.8791 | 18.4060 (90) |
| Living area f | raction | | | | | | | | fLA = | Living area | / (4) = | 0.3519 (91) |
| MIT | 18.9239 | 19.1243 | 19.4721 | 19.9187 | 20.2276 | 20.3519 | 20.3703 | 20.3689 | 20.2882 | 19.8630 | 19.3166 | 18.8969 (92) |
| Temperature a | djustment | | | | | | | | | | | 0.0000 |
| adjusted MIT | 18.9239 | 19.1243 | 19.4721 | 19.9187 | 20.2276 | 20.3519 | 20.3703 | 20.3689 | 20.2882 | 19.8630 | 19.3166 | 18.8969 (93) |

8. Space heating requirement

| | Jan | Feb | Mar | Apr | Mav | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|-------------------------------------|-----------|-----------|-----------|----------|----------|----------|----------|----------|----------|--------------|-----------|----------------|
| Utilisation | 0.9965 | 0.9922 | 0.9776 | 0.9248 | 0.7947 | 0.5894 | 0.4156 | 0.4743 | 0.7673 | 0.9598 | 0.9927 | 0.9974 (94) |
| Useful gains | 455.0859 | 524.7147 | 601.4352 | 660.3774 | 621.6209 | 456.7176 | 306.3553 | 320.2879 | 458.0055 | 484.6641 | 442.7872 | 430.7182 (95) |
| Ext temp. | 4.3000 | 4.9000 | 6.5000 | 8.9000 | 11.7000 | 14.6000 | 16.6000 | 16.4000 | 14.1000 | 10.6000 | 7.1000 | 4.2000 (96) |
| Heat loss rate W | | | | | | | | | | | | |
| | 1234.3396 | 1197.2420 | 1088.8385 | 912.8858 | 704.7628 | 469.9080 | 308.0247 | 323.5509 | 507.8192 | 765.5405 | 1014.6758 | 1227.0134 (97) |
| Month fracti | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 1.0000 | 1.0000 | 1.0000 (97a) |
| Space heating | kWh | | | | | | | | | | | |
| | 579.7648 | 451.9383 | 362.6280 | 181.8060 | 61.8576 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 208.9721 | 411.7598 | 592.4436 (98) |
| Space heating | | | | | | | | | | | | 2851.1702 (98) |
| Space heating per m2 (98) / (4) = 3 | | | | | | | | | | 37.0282 (99) | | |

8c. Space cooling requirement Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP Fraction of space heat from secondary/supplementary system (Table 11) Fraction of space heat from main system(s)



Design SAP

elmhurst energy



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| Efficiency of main space heating system 1 (in %) Efficiency of secondary/supplementary heating system, % Space heating requirement 30 | | | | | | | | | | | | 93.4000 (206) 0.0000 (208) 3052.6448 (211) |
|---|----------------|-------------|--------------|--------------|-------------|------------|----------|----------|----------|------------|----------|--|
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
| Space heating | requirement | | | | | | | | | | | |
| Conce beating | 5/9./648 | 451.9383 | 362.6280 | 181.8060 | 61.85/6 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 208.9721 | 411./598 | 592.4436 (98) |
| space nearing | 93.4000 | 93.4000 | 93.4000 | 93.4000 | 93.4000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 93.4000 | 93.4000 | 93.4000 (210) |
| Space heating | fuel (main h | eating sys | stem) | | | | | | | | | |
| | 620.7332 | 483.8740 | 388.2527 | 194.6531 | 66.2287 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 223.7388 | 440.8563 | 634.3079 (211) |
| Water heating | requirement | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (215) |
| Wator boating | | | | | | | | | | | | |
| Water heating | requirement | | | | | | | | | | | |
| nater neatring | 199.8652 | 174.7702 | 181.8371 | 161.2803 | 156.1478 | 137.5263 | 131.7607 | 146.8823 | 148.5044 | 169.1019 | 180.5129 | 195.1667 (64) |
| Efficiency of | water heater | : | | | | | | | | | | 80.3000 (216) |
| (217)m | 87.5762 | 87.3366 | 86.7557 | 85.3533 | 82.9290 | 80.3000 | 80.3000 | 80.3000 | 80.3000 | 85.5852 | 87.0625 | 87.6676 (217) |
| Fuel for wate | er heating, kW | Wh/month | 200 5069 | 199 0561 | 100 2011 | 171 2656 | 164 0955 | 192 0160 | 19/ 0370 | 107 5020 | 207 2272 | 222 6211 (210) |
| Water heating | fuel used | 200.1111 | 209.3900 | 100.9301 | 100.2911 | 1/1.2000 | 104.0000 | 102.9109 | 104.9570 | 197.3030 | 201.3372 | 2345 9200 (219) |
| Annual totals | kWh/vear | | | | | | | | | | | |
| Space heating | fuel - main | system | | | | | | | | | | 3052.6448 (211) |
| Space heating | fuel - secon | dary | | | | | | | | | | 0.0000 (215) |
| Distantation 6 | | E | | | | | | | | | | |
| Electricity I | or pumps and | Ians: | | | | | | | | | | |
| centrar ne | acing pump | | | | | | | | | | | 30.0000 (230c) 45.0000 (230c) |
| Total electri | city for the | above kWh | h/wear | | | | | | | | | 75 0000 (231) |
| Flectricity f | or lighting (| calculate | d in Annend: | ix T.) | | | | | | | | 340 5986 (232) |
| Total deliver | ed energy for | all uses | a in Appena. | IX D) | | | | | | | | 5814.1634 (238) |
| | | | | | | | | | | | | , |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| 12a Cambon d | ionido omioni | ono Todá | inidual beat | ing quater | including | ni ana CUD | | - | | | | |
| iza. Carbon d | LUXIGE EMISSI | .ons - indi | iviqual neat | Ling systems | THCINGING : | MIGTO-CHP | | | | | | |
| | | | | | | | | Enomers | Emica | ion footon | | Emicaciona |

| | Energy | Emission factor | Emissions | |
|--|-----------|-----------------|-------------|--------|
| | kWh/year | kg CO2/kWh | kg CO2/year | |
| Space heating - main system 1 | 3052.6448 | 0.2160 | 659.3713 | (261) |
| Space heating - secondary | 0.0000 | 0.0000 | 0.0000 | (263) |
| Water heating (other fuel) | 2345.9200 | 0.2160 | 506.7187 | (264) |
| Space and water heating | | | 1166.0900 | (265) |
| Pumps and fans | 75.0000 | 0.5190 | 38.9250 | (267) |
| Energy for lighting | 340.5986 | 0.5190 | 176.7707 | (268) |
| Total CO2, kg/m2/year | | | 1381.7857 | (272) |
| Emissions per m2 for space and water heating | | | 15.1440 | (272a) |
| Fuel factor (mains gas) | | | 1.0000 | |
| Emissions per m2 for lighting | | | 2.2957 | (272b) |
| Emissions per m2 for pumps and fans | | | 0.5055 | (272c) |
| Target Carbon Dioxide Emission Rate (TER) = $(15.1440 \times 1.00) + 2.2957 + 0.5055$, rounded to | 2 d.p. | | 17.9500 | (273) |
| | | | | |

