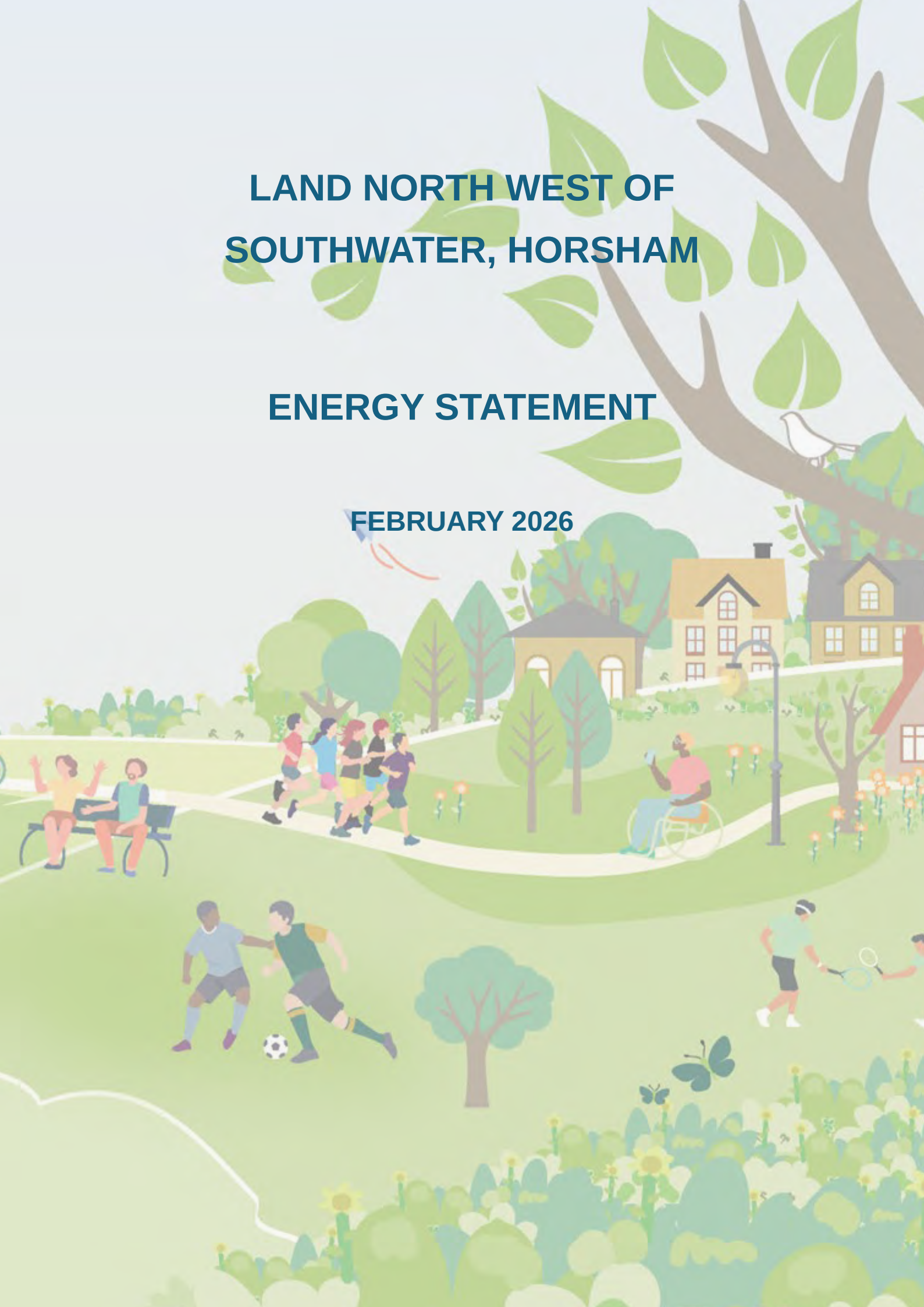
# LAND NORTH WEST OF SOUTHWATER, HORSHAM

# ENERGY STATEMENT

**FEBRUARY 2026**



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**Energy Statement**

Berkeley Homes (Strategic)

# Land North West of Southwater

Final

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February 2026

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## ABOUT HODKINSON CONSULTANCY

Our team of technical specialists offer advanced levels of expertise and experience to our clients. We have a wide experience of the construction and development industry and tailor teams to suit each individual project.

We are able to advise at all stages of projects from planning applications to handover.

Our emphasis is to provide innovative and cost-effective solutions that respond to increasing demands for quality and construction efficiency.

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# Executive Summary

The purpose of this energy statement is to set out an outline energy strategy for the Land North-West of Southwater, Horsham. It is anticipated that the site will be subject to advancing energy standards over time, with the applicant recognising the importance of considering these changes at the outset.

The site will deliver up to 1,000 homes. A significant provision of non-residential space is also proposed, including schools, community and retail spaces, and employment facilities. During the estimated prolonged build timeline of the scheme, policies and regulations are expected to escalate, enabling low-carbon developments to be delivered and the impacts of climate change to be mitigated. The development aims to provide “carbon ready” homes.

This outline energy statement aims to ensure a standards-based approach is adopted, as well as accounting for a development timeline that is likely to span multiple changes in regulation and policy.

Current national policy standards applicable to the energy strategy are Part L 2021 and Part O of Building Regulations. However, it is expected that the scheme is likely to be developed under the emerging Future Homes Standard (FHS). This is expected to require heating and hot water to be supplied by high efficiency heat pumps and solar PV provided on all new homes as default.

Key design principles and assessment parameters which will provide flexibility for the site to meet varying standards are set out. This includes the following:

> Installation of energy efficient design principles, such as high standards of building fabric, form factor analysis, and orientation of glazed areas;

> Careful alliance of the energy strategy with overheating mitigation. As one of the central aims for the applicant is to deliver high-quality buildings for both present day and future conditions, both energy and overheating measures must be considered in tandem to best deliver this;

> This will be a gas-free site and on current information it is likely that both heat pumps and PV panels will be used to achieve a significant reduction in $CO_2$ emissions against a Part L 2021 baseline. However, this report aims to ensure flexibility is retained in the outline energy strategy in regard to technological choices.

> Consideration of site-wide energy infrastructure.

As part of the Reserved Matters Application (RMA) for each development phase, a specific Energy Statement tailored to that phase will be prepared and will be tied to the requirements set out in this report. Potential measures are evaluated within this outline energy statement and a steer provided where appropriate on the likely direction that is being considered.

Initial energy assessments have been undertaken based on similar schemes, to give an indication of estimated carbon emissions from the proposed development. This has been assessed against a Part L 2021 baseline, using current assessment methodology. These estimates are summarised in Table *i*, below.

**Table *i*: Site Wide Carbon Dioxide Emissions and Cumulative Savings**

| Stage | Regulated Carbon Dioxide Emissions (Tonnes $CO_2$ per Annum) | Regulated Carbon Dioxide Savings | |
|---|---|---|---|
| | | Tonnes $CO_2$ per Annum | Percentage |
| Baseline: Part L 2021 Compliant Development | 1,237.6 | - | - |
| After ***Be Lean, Clean and Green*** Measures | 195.1 | 1,042.5 | 84.2% |
| **Cumulative On-Site Savings** | | 1,042.5 | 84.2% |

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# CONTENTS

# 1. INTRODUCTION

**1.1** This document has been prepared by Hodkinson Consultancy, a specialist energy and environmental consultancy for planning and development. This statement sets out an indicative energy strategy in support of the Outline planning application for the Land North-West of Southwater, Horsham, by Berkeley Strategic Land Ltd.

**1.2** The energy strategy has been considered in line with the energy hierarchy set out in the Horsham District Planning Framework of ***Lean***, ***Clean*** and ***Green***.

**1.3** The objectives of this report are to:

> To provide an adaptable and future proofed strategy to define energy efficient targets but also offer flexibility for compliance with future regulations and policy.

> Demonstrate how the Proposed Development has been assessed against the policy requirements of Horsham District Council, including the Horsham District Planning Framework (2015) and Draft Strategic Policy HA3: Land Northwest of Southwater.

> Identify the drivers relating to an energy efficient design over and above minimum compliance with current and future Building Regulations and energy targets.

> Identify the most cost-effective heating solutions to ensure the operational costs for residents are minimised.

# 2. DEVELOPMENT OVERVIEW

## Site Location

2.1 The proposed development site is located as shown in Figure 1 below. The red line is the proposed application boundary, and the blue line is the potential biodiversity net gain land.

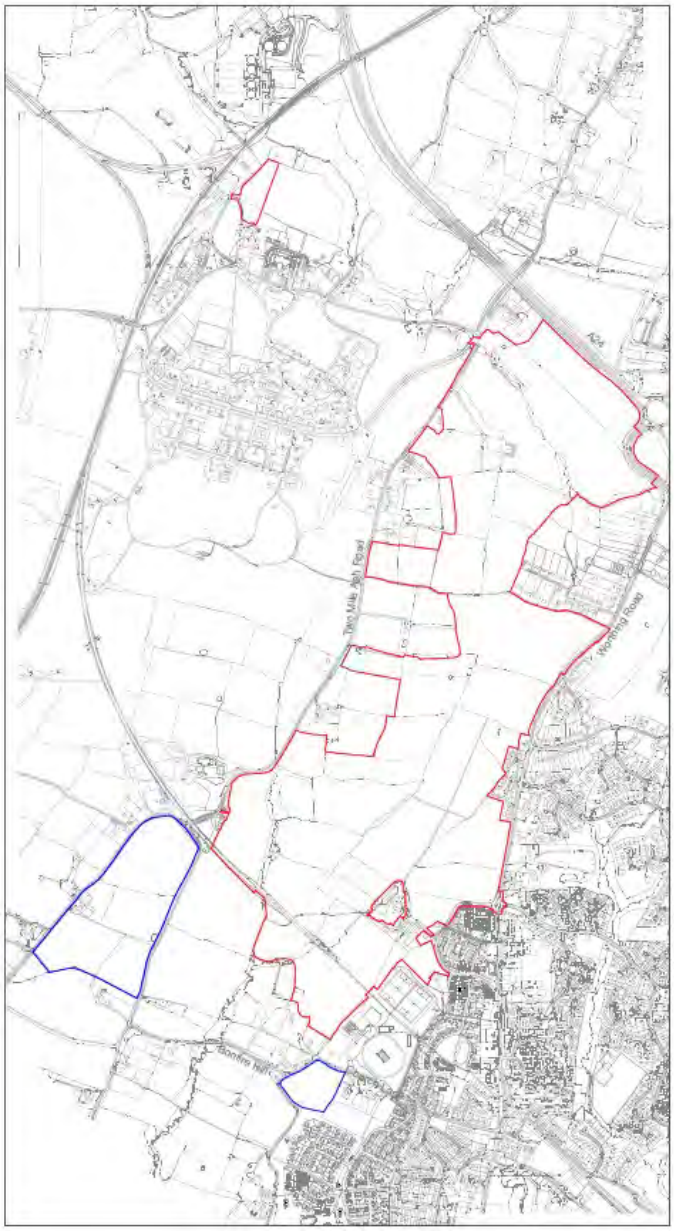



**Figure 1: Site Boundary – KPK Architects (January 2026)**

**2.2** The proposed development description is as follows:

*"Outline planning application, with all matters reserved (except for primary access to the highway) for a phased development comprising: the demolition of existing buildings and the construction of residential dwellings (including affordable housing) (Use Classes C2 and C3); a mixed-use neighbourhood centre (Use Classes E and F); education facilities (Use Class F1(a)); business and employment floorspace (Use Classes B2, B8 and E(g)); redevelopment of existing agricultural buildings including construction of a building for community use (Use Classes E and F2); improvements to public rights of way; sports pitches; gypsy and traveller pitches/plots; public open space; landscaping, and associated infrastructure."*

## Planning History

**2.3** An outline application for up to 1,500 homes, schools, employment facilities, community and retail spaces was submitted in 2022, but subsequently withdrawn prior to determination. The site layout configuration has changed since the previous application.

# 3. PLANNING POLICY

3.1 The following planning policies and requirements have informed the sustainable design of the proposed development.

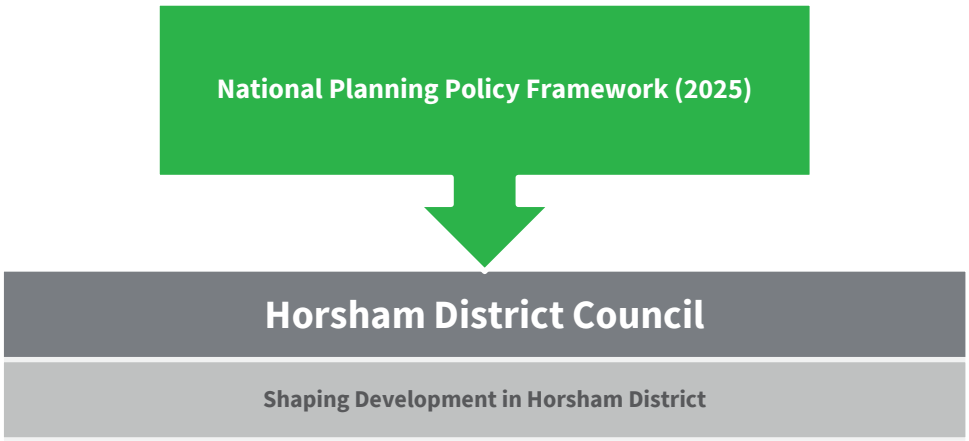



**Figure 2: Relevant Planning Policy Documents**

## National Policy: NPPF

3.2 The revised National Planning Policy Framework (NPPF) was published on the 7 February 2025 and sets out the Government's planning policies for England.

3.3 The NPPF provides a framework for achieving sustainable development, which has been summarised as "*meeting the needs of the present without compromising the ability of future generations to meet their own needs*" (Resolution 42/187 of the United Nations General Assembly). These address social progress, economic well-being and environmental protection. At the heart of the framework is a **presumption in favour of sustainable development**.

3.4 The document states that the planning system has three overarching objectives which are interdependent and need to be pursued in mutually supportive ways:

a) **An economic objective** – to help build a strong, responsive and competitive economy, by ensuring that sufficient land of the right types is available in the right places and at the right time to support growth, innovation and improved productivity; and by identifying and coordinating the provision of infrastructure;

b) **A social objective** – to support strong, vibrant and healthy communities, by ensuring that a sufficient number and range of homes can be provided to meet the needs of present and future generations; and by fostering a well-designed, beautiful and safe places, with

accessible services and open spaces that reflect current and future needs and support communities' health, social and cultural well-being; and

c) **An environmental objective** – to protect and enhance our natural, built and historic environment; including making effective use of land, improving biodiversity, using natural resources prudently, minimising waste and pollution, and mitigating and adapting to climate change, including moving to a low carbon economy.

# Local Policy: Horsham District Council

## Horsham District Planning Framework (2015)

**3.5** Full policy wording is shown in Appendix A, with a summary below:

**3.6** **Policy 35** sets out climate change mitigation principles related to construction, improved energy efficiency in dwellings, renewable systems, and travel.

**3.7** **Policies 36 and 37** outline the energy hierarchy that developments should pursue (Lean, Clean & Green) and seeks for district heating and cooling to be examined for certain sites.

## Emerging Local Plan (2021-38)

**3.8** Horsham District Council (HDC) is currently preparing a new Local Plan, the Horsham Local Plan 2023-2040 ("the Emerging Local Plan").

**3.9** The emerging Local Plan was submitted to the Secretary of State for examination on 26 July 2024 following a series of Regulation 18 and 19 consultations in 2020 and 2024 respectively.

**3.10** Stage 1 Hearings took place in December 2024. On 4 April 2025, the Planning Inspector wrote to HDC recommending the emerging Local Plan be withdrawn. On 18th August, HDC responded to the Inspector requesting the examination be continued and suggesting an additional hearing session to examine HDC's compliance with the Duty to Cooperate, with new evidence. The Inspector responded to the Council on 28th August informing the Council they would consider the new evidence prior to agreeing to resume the examination.

**3.11** On 11th November 2025, the Council wrote again to the Inspector following a change in position from Natural England withdrawing their water-neutrality based approach with the Sussex North Water Resource Zone, which has exerted a significant influence on shaping the emerging Local Plan. The Local Plan examination process is expected to recommence following a meeting with the Inspector in February 2026.

**3.12** As previously mentioned, the Site is subject of a draft allocation in the emerging Local Plan under draft Policy HA3 for a mixed-use development.

**3.13** Based on the above, this outline planning application seeks to meet the various requirements of Draft Strategic Policy HA3: Land Northwest of Southwater. The details of this Policy are outlined in Appendix A.

**3.14** Part 5 of this policy is relevant to this statement, as follows:

*"The masterplan and Sustainability Statement must demonstrate the delivery of net zero carbon, including demonstrating a fabric first approach to the construction of built development, and maximum use of on-site renewable energy technologies. This shall include a strategy to ensure that from 2025, all homes built on the site are designed as net-zero carbon through their expected lifetime."*

## Southwater Neighbourhood Development Plan (2019-31)

**3.15** The latest version of the Southwater Neighbourhood Development Plan (SNDP) was adopted in 2021. Full policy wording is shown in Appendix A. The pertinent policies to this development are **Policy SNP2 (Proposals for Residential Development)** and **Policy SNP16 (Design)**. Neither of these require targets to be met in excess of HDC adopted policy or building regulations.

# 4. METHODOLOGY AND BASELINE ASSESSMENT

**4.1** Current national policy standards applicable to the energy strategy are Part L 2021 and Part O of Building Regulations. However, it is expected that the scheme is likely to be developed under the emerging Future Homes Standard (FHS). This has been taken into account when developing the energy strategy. It is expected that the following will be required as part of the FHS:

> Heating and hot water supplied by high efficiency heat pumps;

> Solar PV provided on all new homes as default;

> Fabric energy efficiency standards similar to what is required under Part L 2021.

**4.2** As this is an outline assessment, initial energy assessments for residential dwellings and non-residential buildings have been completed based on other similar schemes, to provide an indicative idea of energy performance. However, this is subject to change at RMA stage, when final dwelling numbers and energy strategies would be known.

**4.3** Estimated energy demands for residential dwellings have been assessed using the Standard Assessment Procedure (SAP) and calculated using Part L 2021 methodology. The scheme is likely to be updated under future regulations (Future Homes Standard), and as such, assessment should be completed with the latest methodology at the time of each RMA. Results of the sample dwellings have been extrapolated to represent the total number of dwellings on the scheme, although this may be subject to change.

**4.4** The energy demand for non-residential buildings has been calculated using Simplified Building Energy Model (SBEM) software using the National Calculation Method.

**4.5** As this is an outline scheme, full details of the non-residential areas are not yet known. Results from the example calculations have been extrapolated to gain energy demand estimates for the outline scheme. This includes 4 assessments of the following use types:

> Schools

> Community Hub/Commercial

> Businesses/Employment Space

> Care Home

**4.6** The specification inputs that have been assumed as part of these sample calculations are summarised in Appendix B.

## Baseline Assessment

**4.7** Table 1, below, shows the baseline estimated Regulated $CO_2$ emissions for the development, based on Part L 2021 calculations. SAP and BRUKL worksheets supporting these calculations are shown in Appendices C and D respectively.

**Table 1: Carbon Dioxide Emissions Baseline (Part L 2021)**

| | Regulated [T $CO_2$/year] |
|---|---|
| Residential | 1,060.8 |
| Non-Residential | 176.8 |
| Total | 1,237.6 |

# 5. LEAN: FABRIC ENERGY EFFICIENCY

**5.1** The first stage of the energy hierarchy is "***Lean***", as outlined in Policy 36 of the Horsham District Planning Framework 2015. The aim at this stage of the energy hierarchy is to improve fabric energy efficiency measures first, to reduce the heating demands in buildings.

## Residential Strategy

### Build Form

**5.2** The development of an energy efficient building can be assisted significantly by design fundamentals such as shape, complexity, and orientation. The applicant is conscious of the need to promote individual building aesthetics, in order to establish a site character and enhance social value, but to do so in such a way which does not encourage unnecessary construction complexity in the build form which could result in a loss in energy performance. Designs which unnecessarily increase the surface area of the thermal envelope or push for extensive or elaborate detailing would not be maximising the energy efficiency from the build form.

**5.3** A building's form factor is an important indication of its inherent energy efficiency. It represents a relationship between its internal floor area and its total external surface area, with a lower value representing a more efficient build form.

**5.4** The National House Building Council (NHBC) issued a design guide on form factor in 2016 (*the challenge of shape and form*), with the below values shown in Figure 3 considered typical for the varying types of home. The applicant will consider this carefully in relation to the homes proposed at this site.

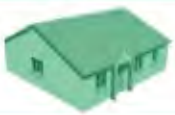
| | Type | Form Factor | Efficiency |
|---|---|---|---|
|  | End mid-floor apartment | 0.8 | Most efficient |
|  | Mid-terrace house | 1.7 | |
|  | Semi-detached house | 2.1 | |
|  | Detached house | 2.5 | |
|  | Bungalow | 3.0 | Least efficient |

**Figure 3: Form Factor (Source NHBC: The challenge of shape and form)**

## Energy Efficiency

**5.5** The focus on not embedding an overly complex design will particularly assist in minimising heat losses from thermal bridges. In well insulated buildings, as much as 30% of heat loss can occur through thermal bridges, which occur when highly conductive elements (e.g. metal studs) in the wall construction enable a low resistance escape route for heat. Some key starting points to ensure the design progresses on the right track from an early stage are set out below:

> Cantilevered balconies, where provided, are to be provided with structural thermal breaks. As the majority of buildings will be houses balconies should be a relatively uncommon feature;

> The insulation line is to be kept as continuous and unbroken as possible;

> Where highly conductive materials must penetrate the main insulation line for structural reasons, thermal pads will be utilised to mitigate heat transfer;

> No plot shall encounter significant insulation omissions, such as with exposed concrete floors or floor perimeters.

**5.6** Where industry-approved details are not used, bespoke modelling will be undertaken on key junction types such as window surrounds, balconies, parapets, and intermediate floors for all plot iterations. This will ensure an inadequate design does not become an inadequate junction.

**5.7** Outline principles such as maximising passive solar gains through carefully orienting buildings and minimising expansive glazed areas on facades which benefit least from this will be considered from the outset. As a general rule of thumb expansive glazed areas are best reserved for southerly facing orientations, but with the provision of sufficient shading to counteract summer overheating. Passive solar gains effectively provide 'free' heat, which is particularly beneficial within the winter months, and thus reduces the demands on the building heating system.

## Insulation Standards

**5.8** High standards of fabric efficiency will be targeted in all buildings, with all element U-values exceeding the expected minimum performance standards in the respective Part L iterations which apply at the time of build. Indicative specifications have been used in this Outline Energy Statement, although more defined strategies will be presented in subsequent RMAs. An indicative specification for the residential development is presented in Table 2, below.

**5.9** A summary of the specification inputs used for the initial calculations is presented in Appendix B.

**Table 2: Indicative Build Specification - Residential**

| Element | Indicative Specification |
|---|---|
| External Walls | 0.15 – 0.19 W/m$^2$K |
| Party Walls | 0.00 W/m$^2$K (fully filled and sealed) |
| Ground Floors | 0.10 – 0.13 W/m$^2$K |
| Main Roofs | 0.09 – 0.16 W/m$^2$K |
| Glazing U-value | 0.80 – 1.20 W/m$^2$K |
| Air Tightness | Houses: 3.0 – 5.0 m$^3$/h.m$^2$<br>Apartments: 2.0 – 3.5 m$^3$/h.m$^2$ |

## Ventilation & Air Tightness

**5.10** The air tightness of the buildings will be greatly assisted by the build form and fabric efficiency principles which the applicant will embed into all designs. Ensuring a high level of air tightness is beneficial for the following reasons:

> Reduces heat loss as a result of draughts through gaps in the building fabric;

> Prevents infiltration of humidity from internal warm air into cooler external building fabric.

**5.11** Often the greatest risk to a high level of air tightness in a building comes during construction, where the air tightness layer can become compromised. The applicant will ensure close monitoring of site contractors to minimise this risk. This could include the following steps:

> Preparation and application of a works sequencing plan. This would reduce the likelihood of fit-out works (such as plumbing and electrics) being undertaken at periods during the construction where damage to the air tightness layer is less likely to occur;

> Consideration of service voids within cavities. This removes the need to 'create' them through localised gaps in the building fabric which could also damage the air tightness layer;

> Use of preliminary air tests prior to internal fixings being applied. This would help identify and address leakages earlier and with greater ease.

**5.12** Mechanical Ventilation Heat Recovery (MVHR) is likely to be installed in all apartments. These systems will remove stale air and odours from kitchens and wet rooms, whilst retaining the heat within the home. The performance of these systems will be assisted by the higher levels of air tightness which are achievable in apartments.

**5.13** The provision of MVHR to houses will be investigated, however it may be determined that natural ventilation or decentralised mechanical extract ventilation (dMEV) could provide the ventilation needs more efficiently whilst still enabling the appropriate energy and carbon standards to be achieved.

**5.14** Space within ceilings could be reserved in all houses to allow for centralised systems to be installed should it be shown to be beneficial in terms of energy and running cost savings.

## Thermal Comfort

**5.15** The residential dwellings will need to meet the requirements of Part O of Building Regulations. This would either be assessed by the Simplified Method or dynamic modelling. Further detail of the proposed strategies will be presented as part of each RMA.

**5.16** Minimising the risk of overheating is important to ensure that buildings are adapted to climate change and remain comfortable to occupy in the future. Principles identified through focusing on build form and thermal mass will prevent excesses heat building up in periods of extreme heat. Further measures are also to be considered to reduce risk further still. These are likely to include:

> Solar control glazing. A g-value of around 0.5 may be appropriate for the houses, with g-values in the range of 0.35 to 0.5 more likely for apartments. Importantly, it is recognised that a balanced approach which ensures carbon and comfort are not siloed but instead work together needs to be followed. Ideally, this g-value should not become so low that it offsets much of the energy efficiency gains from the fabric specification (due to stilting passive winter heat gains);

> Positioning of bedrooms. These are the most sensitive rooms to overheating risk, and so orienting them away from a southerly or westerly direction where possible will be investigated;

> Shading to a significant proportion of the windows from the presence of balconies for apartments. The balconies will provide solar shading during the summer months when the sun is high in the sky, but allow the beneficial winter solar gains when the sun is lower in the sky. Other overhangs will also be investigated;

> High performance MVHR systems to all apartments will assist in background ventilation and may be provided with summer bypass. Cross ventilation should be achievable in most houses;

> Openable windows to allow for purging of internal heat. Typical openability constraints (such as air quality and noise) are not likely to apply for most homes, so this should present an effective means of mitigating overheating risk.

**5.17** Separate mechanical cooling systems will only be considered if the combination of passive measures is insufficient to alleviate any overheating risk.

### Appliances & Smart Technology

**5.18** It is expected that smart technology will play an increasing role in the efficient operation of future buildings. With an increasing number of devices coming with connectivity features, energy consumption can be managed more efficiently ensuring that wastage is minimised.

**5.19** It is expected that smart technology will be increasingly integrated into domestic appliances. These could be coupled with time-of-use energy tariffs to enable energy consumption to occur at times when grid carbon content is low, e.g. dishwashers running automatically during the night.

**5.20** As technology advances, increasingly efficient appliances will be available to the market. By installing high efficiency appliances in dwellings, e.g. induction hobs for cooking or heat pump tumble dryers, unregulated energy demand (and the associated carbon emissions) will be reduced.

**5.21** All white goods are expected to have high energy efficiency ratings that will reduce energy consumption.

## Non-residential Strategy

**5.22** The applicant is proposing to provide a significant amount of non-residential floorspace across the development site. Many of the precise uses will not become clear until the RMA stage, however the outline application provides for the following uses (GIA):

> Educational – a 1 Form-Entry Primary school, a nursery to accommodate a minimum of 60 spaces, and a 6 Form-Entry secondary school.

> Up to 17,000 $m^2$ Business/Employment space (Use Class B2, B8 and E(g)).

> Up to 2,000 $m^2$ neighbourhood centre, comprising commercial and community space (Use Class E and F).

**5.23** It is also proposed to redevelop the barns area in the site but this can be reviewed at the relevant Reserved Matters Applications.

**5.24** In terms of the outline energy strategy, this can be better differentiated as those spaces which are treated in such a way that requires a full Part L assessment and those which can be exempt on the basis of low energy demands. The latter would typically apply to large storage/factory spaces, with all other non-residential uses (described here as fully heated areas) likely to necessitate a full Part L assessment (and thus meet all required metrics of the building regulations Part L).

**5.25** Because of the outline nature of this strategy, it is currently unclear whether the applicant will be fitting out certain non-residential spaces or delivering as shells.

## Fully Heated Areas

**5.26** It is likely that most of the fully heated non-residential spaces (e.g. offices, retails units and community areas) will utilise heat pumps. This is because a greater demand for cooling and the lower demand for hot water aligns with a heat pump's conventional operating parameters.

**5.27** As hot water demands in such spaces tend to be low, it may prove more appropriate to deliver hot water from localised direct electric systems, rather than from a hot water cylinder linked to a heat pump. The relatively low hot water demands would still be met using clean grid electricity, therefore keeping carbon emissions low.

**5.28** Notable exceptions (where hot water demands are relatively high) could include large kitchens or gyms, such as for small areas of the schools. Where included in a specific RMA phase, a hot water strategy will be considered at this stage.

**5.29** Ventilation systems which include heat recovery functions (MVHR) will be considered. When combined with a high standard of air tightness this can provide a significant reduction on the space heating demands from the heating equipment.

**5.30** One of the largest regulated energy uses in these spaces is likely to be the lighting. It is currently unclear how much lighting will be provided by the applicant to these spaces. Should some lighting be provided, the intention would be to ensure any fittings are highly efficient LEDs, with controls which react to occupancy/movement and change as a result of daylight levels (where the building design permits sufficient daylight entry).

**5.31** Fabric standards to fully heated spaces are expected to be similar to those utilised in the homes (as set out in Table 2). The energy-related BREEAM requirements for the targeted BREEAM standard will be achieved, therefore providing further evidence of the energy strategy performance.

## Reduced Heating Areas

**5.32** The exact uses of the employment space are yet to be determined. However this could include some industrial and logistical uses. These tend to be larger units and are often only heated to temperatures sufficient to avoid condensation or frost problems. It is likely that such buildings would qualify for the low energy exemptions within Part L of the Building Regulations, meaning that the compliance metrics that the other non-residential spaces must achieve do not apply. The cleanest form of heating is the heat that is never generated in the first place, so the low heating needs of these buildings demonstrates an important low carbon principle.

**5.33** Nonetheless, electrical demands from lighting and machinery are likely to be significant. Plant and lighting installations with high efficiencies and a strong track record of reliability will therefore be prioritised. The provision of rooflights covering up to 15% of the total roof area would assist in reducing lighting demands. Further natural lighting concepts such as translucent cladding could be provided on units of these types.

**5.34** Where these units have accompanying office space, these areas will likely utilise low or zero carbon heating sources and meet the requirements of the applicable standards and policies at the time of build. Insulating standards for these areas are expected to be similar to those proposed for other non-residential buildings across the site. Any glazed areas will be specified appropriately to balance both energy and overheating considerations.

**5.35** The provision of large roof spaces from these employment units also presents an opportunity to install sizeable arrays of PV panels, an opportunity the applicant intends to maximise by potentially offering this endeavour to all prospective tenants. It is a central element of the energy strategy for these buildings that the roof space is utilised as much as possible and actively contributes to the performance of the building. No usable area of the roof shall remain without some secondary purpose, either to act as a provider of natural light into the building or to house renewable generating plant.

**5.36** Sophisticated energy monitoring of the units will allow for analysis of how energy is used following completion of the building. This will assist in minimising any performance gap identified and ensure users are interacting positively with the building.

# 6. CLEAN: EFFICIENT ENERGY SUPPLY

**6.1** The next stage of the energy hierarchy is "***Clean***", which considers how to supply energy efficiently to buildings. This can include the consideration of decentralised heat networks where feasible. In addition to high standards of fabric efficiency, the applicant is committed to the delivery of future-proofed heating systems in all buildings.

## Heat Network

**6.2** There are no planned or existing heat networks in close proximity to the site that the scheme could connect to. Therefore, the potential for the development to incorporate a site-wide heat network has been examined. The advantage of heat networks is that on certain appropriate sites it can be more beneficial, in terms of cost and $CO_2$ emissions, for residents to receive their heat from a communal system with a centralised heat source (known as an energy centre). This would replace the need for heat sources to be located individually within each building and could also reduce the overall site electricity demand.

**6.3** What makes a development appropriate for a site-wide heat network are the following elements:

> Number of customers and total heat load;

> Density of heating demand.

**6.4** Essentially, the demand for heat needs to be both significant enough and concentrated enough for the additional outlay (both capital and operational) on a heat network to be offset by economy of scale. There is no absolute threshold for this point, but costs tend not to appear favourable on conventional (i.e. gas-led) heat networks with fewer than 200-300 connected properties for higher density sites. Heat pump-led networks tend to have higher thresholds for suitability.

**6.5** The heat demand density across this site is expected to be low given the nature and location of development. Heat networks are much more suitable on higher density developments, especially where further high-density development is expected next to the site in the near future.

**6.6** A heat network is therefore not considered appropriate on a site-wide basis for the following reasons:

> Whilst the total heat demand may be high, the density of development across the built area of site is low. This will significantly reduce operational efficiency of a network (due to long pipe runs) and increase running costs. Residents are likely to encounter heating costs which are higher than if they utilised individual building-level systems;

> The location is not close to other large and higher developments or sites which could easily be added to a shared heat network to reduce the impact of this disadvantage. The high costs and low

efficiencies associated with a site-wide network would likely therefore be locked in for a long period of time.

**6.7** Importantly, it is reiterated that the likely provision of low temperature wet distribution systems in all homes across the site will not rule out the possibility of an external heat network connection at a later date. Therefore, dwellings are future-proofed both for low carbon heating and the possibility of a heat network. The appropriateness of the latter would be subject to an in-depth feasibility study to ensure residents would not be incurring unreasonable heating costs and that the network could be ran efficiently.

## Individual Heating Systems

**6.8** The technological development of heating systems is fast-paced, and as such it would be inappropriate to specify a specific type for the full site at this stage. Nonetheless, certain future-proofing methods are considered likely to be incorporated, including the following:

> All homes are likely to be provided with low temperature wet heating systems. Importantly, this allows for flexibility in the selection of heat source and enables retrofitting of different technologies in the future should this be deemed appropriate;

> Space within all plots for the location of a hot water cylinder will also be allowed for as a future-proofing measure.

**6.9** A summary of heating technologies and systems under consideration is provided, below.

**Heat Pumps**

**6.10** Heat pumps are one of the more likely technologies to be used across the development. Heat pumps generate heat via compression of a refrigerant which has extracted ambient heat from a naturally replenishing source, therefore making it a renewable technology. This is typically air, ground, or water based. The compressive action raises the temperature of the refrigerant and allows it to provide very efficient heating.

**6.11** Water source heat pumps (WSHPs) are very site specific, relying on access to suitable surface water supplies or accessible groundwater. Their use at this development is considered unlikely.

**6.12** Ground source heat pumps (GSHPs) may be investigated, as certain benefits related to operational efficiencies could be demonstrable and they are less site specific than WSHPs. A ground source heat pump is a renewable heating system that extracts low-temperature energy stored in the ground using buried pipework, ad compresses the energy to a higher temperature. The heat pumps provide dwellings with 100% of the heating and hot water demand all year round. Ground temperature is consistent throughout the year (in contrast to air which fluctuates), and so high efficiencies are maintained in winter during the height of the heating system demands.

**6.13** An example GSHP that may be suitable for the scheme is the Kensa Networked Heat Pumps. This is where multiple heat pumps that are in different buildings share the same ground array, but have separate unconnected load side systems in each dwelling. The benefits of this include no need for a central plant room, reduction in heat losses and overheating, and no metering or split-billing. Each occupier pays for their heating via their own electricity bill and has freedom of choice on what supplier they use.

**6.14** It is considered most likely that should heat pumps be used on this development then air source heat pumps (ASHPs) will be opted for. This is predominantly due to the ubiquitous nature of suitable air supply for a heat pump, as well as the reduced design and installation complexity when compared with WSHPs or GSHPs.

**6.15** The use of heat pumps in homes and non-residential buildings will be evaluated for each RMA. As well as being very efficient, heat pumps also benefit from the decarbonisation progress of the electricity grid. Increasing $CO_2$ savings into the future would be locked in so long as the grid continued on its projected trajectory.

**6.16** There are several variants of the ASHP set-up. The most conventional arrangement can be delivered either in a monobloc or split form, with the former housing all heat pump equipment (minus the hot water cylinder) in an outside unit and the latter requiring an additional unit internally as well.

**6.17** An exhaust air heat pump (EAHP) provides an alternative set-up to this arrangement. The central advantage of this system is that it requires no external plant, with all equipment housed within the home. EAHPs also act as a centralised ventilation system, removing the need to install a separate system for this. They are, however, a much more uncommon presence within the UK due to the more specialised nature of the equipment and limited supply chain. They would be unlikely to be used in houses or non-residential spaces, but may present an option in some flats where siting an external unit is proving difficult.

# 7. RENEWABLE ENERGY TECHNOLOGIES

**7.1** A full range of renewable energy technology measures would be considered as part of each RMA.

**7.2** As part of the Future Homes Standard, it is expected that solar PV would be required on all dwellings as default. Whilst final details of this is not yet known, the area of PV required is expected to be equivalent to 40% of the dwelling's ground floor area.

**7.3** For the purpose of the initial calculations, it is assumed that 40% of the ground floor area is utilised for PV, and that 8m$^2$ is required per kWp of PV (accounting for size of panels and spacing between). For apartments, it is assumed the PV would be located on horizontal roofs. For houses, it is assumed PV is located on roofs with a 30degree pitch, and facing an east/west orientation. This is a conservative estimate. At the detailed design stage, PV should be optimised on South facing roofs as much as possible to gain optimum output from the PV array.

**7.4** As mentioned previously, it is likely that heat pump technology would be utilised for heating and hot water provision to the scheme.

**7.5** Potential site-wide renewable concepts are discussed in the next chapter.

## $CO_2$ Emissions Summary

**7.6** Table 3, below, summarises the potential $CO_2$ emissions reductions that could be achieved for the proposed scheme. This is presented over a Part L 2021 baseline. SAP and BRUKL worksheets supporting these calculations are shown in appendices C and D respectively.

**7.7** The strategy included in the calculations for this summarised in Appendix B.

**Table 3: Regulated Carbon Dioxide Emissions**

| Stage | Carbon Dioxide Emissions (Tonnes $CO_2$ per Annum) | | |
|---|---|---|---|
| | Residential | Non-residential | Cumulative |
| Baseline: Part L 2021 Compliant Development | 1060.8 | 176.8 | 1237.6 |
| Proposed Strategy | 166.4 | 148.1 | 195.1 |
| **Total Emissions Reduction** | **894.4** | **28.7** | **1,042.5** |
| **Percentage Reduction** | **84.3%** | **16.2%** | **84.2%** |

# 8. NET ZERO CARBON & SITE CONCEPTS

**8.1** Strategic policy HA3 of the Emerging Local Plan seeks for '*a strategy to ensure that from 2025, all homes built on the site are designed as net-zero carbon through their expected lifetime*.'

**8.2** The applicant is confident that a significant reduction in operational regulated $CO_2$ emissions against the 2021 baseline standard will be delivered for all homes with the strategies which will be set out at the RMA stages. It is expected all homes will be provided with renewable technologies, which in most cases will be heat pumps or PV panels. This will mean that the new homes will be "zero carbon ready" and capable of complying with the anticipated Future Homes Standard.

**8.3** Delivering a zero carbon home is difficult to achieve. The expectation is that fully zero carbon ready homes can only become zero carbon homes when the electricity grid is fully decarbonised.

## Concepts

**8.4** The size and large timescales of the proposed development of the Land North West of Southwater allows an appraisal into the feasibility of a number of infrastructural concepts. All concepts will require bespoke feasibility studies if considered to be taken further. It is worth stating that all Building Regulations and $CO_2$ reduction standards are expected be met at all stages of the build and do not depend on the presence of any of the concepts introduced in this section.

### Hydrogen

**8.5** Whilst hydrogen is being considered as an alternative heating source to gas, it is not anticipated to become a substitute for gas heating in homes. As such, it is very unlikely hydrogen would be utilised on the scheme. As mentioned, the intention would be to deliver a gas-free scheme.

### Wind Power

**8.6** Wind power from large turbines (generally 1MW turbines upwards) provides the largest contribution to the UK renewables mix in terms of capacity and generation. Large turbines are also a more efficient form of generation than for instance PV panels, with capacity factors (actual generation over a prolonged time period vs maximum potential generation) for large turbines in the 30-40% range, compared to only 10-20% for PV panels. A 1MW turbine could be expected to generate around 3,000 MWh/yr, which would make a sizeable contribution towards the site's total energy requirements when fully built out.

**8.7** An update to planning rules in September 2023 has removed some of the previous restrictions that had been in place for onshore wind power to be built. However, the development of this technology would still need to be approved by Horsham District Council, and would require a detailed feasibility study and active stakeholder engagement. This is not currently envisaged due to constraints of the local landscape and the potential impact on the existing village.

**Energy Storage**

**8.8** Energy storage will be utilised in most dwellings through the use of hot water cylinders.

**8.9** The use of battery electricity storage could also be explored, depending on the feasibility at the time of submission of RMAs. The use of batteries could help to reduce resident energy bills, by using any excess energy from solar panels at night or cloudy days. It can also help demand on the national grid by shifting energy demand from peak hours by using store energy at these times.

**PV Generation – Surplus Supply**

**8.10** All homes are likely to be linked to a renewable technology. It is expected that all homes would include a building-level heat pump, and likely PV panels too. Outside of the considerations of Part L and planning policy, other advantages could be realised with the installation of PV arrays. These could include energy security and running cost savings across wider utility needs.

**8.11** The buying and selling of electricity is strictly regulated. As such it would be very challenging to implement a set-up where surplus electricity generated from PV arrays on commercial and communal roof spaces could be sold to individual dwellings. However, an opportunity to use this in landlord areas or to sell to other commercial customers on the development site may arise. The applicant will evaluate whether a case could be made for installing large arrays on communal or commercial roof spaces to enable this to occur.

# 9. SUMMARY

**9.1** The purpose of this energy statement is to set out an outline energy strategy for the Land North-West of Southwater, Horsham. It is anticipated that the site will be subject to advancing energy standards over time, with the applicant recognising the importance of considering these changes at the outset.

**9.2** The site will deliver up to 1,000 homes. A significant provision of non-residential space is also proposed, including schools, community and retail spaces, and employment facilities. During the estimated prolonged build timeline of the scheme, policies and regulations are expected to escalate, enabling low-carbon developments to be delivered and the impacts of climate change to be mitigated. The development aims to provide “carbon ready” homes.

**9.3** This outline energy statement aims to ensure a standards-based approach is adopted, as well as accounting for a development timeline that is likely to span multiple changes in regulation and policy.

**9.4** Current national policy standards applicable to the energy strategy are Part L 2021 and Part O of Building Regulations. However, it is expected that the scheme is likely to be developed under the emerging Future Homes Standard (FHS). This is expected to require heating and hot water to be supplied by high efficiency heat pumps and solar PV provided on all new homes as default.

**9.5** Key design principles and assessment parameters which will provide flexibility for the site to meet varying standards are set out. This includes the following:

> Installation of energy efficient design principles, such as high standards of building fabric, form factor analysis, and orientation of glazed areas;

> Careful alliance of the energy strategy with overheating mitigation. As one of the central aims for the applicant is to deliver high-quality buildings for both present day and future conditions, both energy and overheating measures must be considered in tandem to best deliver this;

> This will be a gas-free site and on current information it is likely that both heat pumps and PV panels will be used to achieve a significant reduction in CO2 emissions against a Part L 2021 baseline. However, this report aims to ensure flexibility is retained in the outline energy strategy in regard to technological choices.

> Consideration of site-wide energy infrastructure.

**9.6** As part of the RMA application for each phase a specific Energy Statement will be prepared for that phase tied to the principles set out in this report. Potential measures are evaluated within this outline energy statement and a steer provided where appropriate on the likely direction that is being considered.

**9.7** Initial energy assessments have been undertaken based on similar schemes, to give an indication of estimated carbon emissions from the proposed development. This has been assessed against a Part L 2021 baseline, using current assessment methodology. These estimates are summarised in Table 4, below.

**Table 4: Site Wide Carbon Dioxide Emissions and Cumulative Savings**

| Stage | Regulated Carbon Dioxide Emissions (Tonnes $CO_2$ per Annum) | Regulated Carbon Dioxide Savings | |
|---|---|---|---|
| | | Tonnes $CO_2$ per Annum | Percentage |
| Baseline: Part L 2021 Compliant Development | 1,237.6 | - | - |
| After ***Be Lean, Clean and Green*** Measures | 195.1 | 1,042.5 | 84.2% |
| **Cumulative On-Site Savings** | | 1,042.5 | 84.2% |

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# APPENDICES

**Appendix A**
Relevant Planning Policies

**Appendix B**
Summary of specification inputs in assessments

**Appendix C**
SAP TER / DER Worksheets

**Appendix D**
BRUKL Worksheets

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# Appendix A

Relevant Planning Policies

# Horsham District Planning Framework (2015)

**Policy 35**

**Strategic Policy: Climate Change**

Development will be supported where it makes a clear contribution to mitigating and adapting to the impacts of climate change and to meeting the district's carbon reduction targets as set out in the Council's Acting Together on Climate Change Strategy, 2009.

Measures which should be used to mitigate the effects of climate change include;

1. Reduced energy use in construction;
2. Improved energy efficiency in new developments, including influencing the behaviour of occupants to reduce energy use;
3. The use of decentralised, renewable and low carbon energy supply systems;
4. The use of patterns of development which reduce the need to travel, encourage walking and cycling and include good accessibility to public transport and other forms of sustainable transport; and
5. Measures which reduce the amount of biodegradable waste sent to landfill.

Development must be designed so that it can adapt to the impacts of climate change, reducing vulnerability, particularly in terms of flood risk, water supply and changes to the district's landscape. Developments should adapt to climate change using the following measures:

1. Provision of appropriate flood storage capacity in new building development;
2. Use of green infrastructure and dual use SuDS to help absorb heat, reduce surface water runoff, provide flood storage capacity and assist habitat migration;
3. Use of measures which promote the conservation of water and/or greywater recycling; and
4. Use of site layout, design measures and construction techniques that provide resilience to climate change (opportunities for natural ventilation and solar gain).If it is not possible to incorporate the adaption and mitigation measures proposed, an explanation should be provided as to why this is the case.

**Policy 36**

**Strategic Policy: Appropriate Energy Use**

*Energy hierarchy*

All development will be required to contribute to clean, efficient energy in Horsham based on the following hierarchy:

1. Lean – use less energy – e.g. through demand reduction
2. Clean – supply energy efficiently – e.g. through heat networks
3. Green – use renewable energy sources

*District Heating and Cooling*

Commercial and residential developments in Heat Priority Areas or the strategic development locations will be expected to connect to district heating networks where they exist using the following hierarchy, or incorporate the necessary infrastructure for connection to future network.

Development should demonstrate that the heating and cooling systems have been selected in accordance with the following heating and cooling hierarchy;

1. Connection to existing (C)CHP distribution networks
2. Site wide renewable (C)CHP
3. Site wide gas-fired (C)CHP
4. Site wide renewable community heating/cooling
5. Site wide gas-fired community heating/cooling
6. Individual building renewable heating
7. Individual building heating, with the exception of electric heating

All (C)CHP must be of a scale and operated to maximise the potential for carbon reduction. Where site-wide (C)CHP is proposed, consideration must be given to extending the network to adjacent sites.

*Energy Statements*

All applications for residential or commercial development must include an Energy Statement demonstrating and quantifying how the development will comply with the Energy Hierarchy.

Developments in Heat Priority Areas and strategic developments should demonstrate and quantify how the development will comply with the heating and cooling hierarchy. Horsham District Council will work proactively with applicants on major developments to ensure these requirements are met.

*Renewable energy schemes*

The Council will permit schemes for renewable energy (e.g. solar) where they do not have a significant adverse effect on landscape and townscape character, biodiversity, heritage or cultural assets or amenity value. Community initiatives which seek to deliver renewable and low carbon energy will be encouraged.

**Policy 37**

**Sustainable Construction**

Proposals must seek to improve the sustainability of development. To deliver sustainable design, development should incorporate the following measures where appropriate according to the type of development and location:

1. Maximise energy efficiency and integrate the use of decentralised, renewable and low carbon energy;
2. Limit water use to 110 litres/person/day;
3. Use design measures to minimise vulnerability to flooding and heatwaveevents;
4. Be designed to encourage the use of natural lighting and ventilation;
5. Be designed to encourage walking, cycling, cycle storage and accessibility to sustainable forms of transport;
6. Minimise construction and demolition waste and utilise recycled and low-impact materials;
7. Be flexible to allow future modification of use or layout, facilitating future adaptation, refurbishment and retrofitting;
8. Incorporate measures which enhance the biodiversity value of development.

All new development will be required to provide satisfactory arrangements for the storage of refuse and recyclable materials as an integral part of design.

New homes and workplaces should include the provision of high-speed broadband access and enable provision of future technologies where available.

# Local Policy: Horsham District Council, Draft Strategic Policy HA3

1. Building on the Southwater Neighbourhood Plan allocation, Land North West of Southwater, as identified on the Policies Map, is allocated for mixed-use strategic development and associated infrastructure for 1000 homes, of which it is anticipated 735 homes will be delivered in the Plan period. This delivery comprises 450 homes allocated in the Neighbourhood Plan, together with an additional 285 homes.

2. Development will be in accordance with a comprehensive masterplan to be agreed with the Council which clearly shows the key elements of development, a comprehensive site-wide Design Code, and a clear phasing plan and will provide the following:

a) Approximately 1000 homes (C2 and C3 use classes), a minimum 35% of which will be affordable, together with provision for young families, older people, and the provision of a permanent Gypsy and Traveller site of 5 pitches.

b) A neighbourhood centre shall be provided, offering appropriate uses, including leisure, sports facilities, and retail whilst retaining Lintot Square as the primary centre of Southwater.

c) Subject to suitable access being demonstrated, around 4.0 ha of employment floorspace shall be provided (office, including flexible desk space, industrial, storage and /or distribution) within one or both of the following locations: i. the employment area identified to the north of the development site; ii. the neighbourhood centre.

d) Land and contributions to meet the education provision standards advised by the Local Education Authority, (or any future updates) as follows: i. one form of entry primary school expandable to two forms of entry to incorporate support centres for special educational needs and disability (SEND); ii. up to 6 form entry secondary school expandable to 8 forms of entry, to incorporate support centres for special educational needs and disability (SEND); iii. one new full-day care nurseries, to accommodate a minimum 60 places in total.

e) Formal and informal open space, sport and recreation provision to meet the needs of the new community in accordance with standards and the respective recommendations in the Playing Pitch Strategy Open Space, Sport & Recreation Review 2021. Informal open space provision must be designed for all and shall include (but not limited to): i. incorporate a 5km safe circular route for pedestrians and cyclists and a trim trail; ii. Multi-Use Games Areas; iii. equipped childrens play facilities; iv. social seating areas.

f) Comprehensive sustainable travel improvements.

3. Development proposals are required to demonstrate that they are landscape-led, the pattern of development enhances identified landscape and heritage features, and that:

a) The tranquil character and the setting of the Downs Link is preserved;

b) Public rights of way across the site connect their users with the landscape and retain some of their rural aspect;

c) A landscape buffer is provided along the western edge of the allocation;

d) Important key views within the development towards the open countryside are identified, including trees, heritage or other assets of special interest. The layout should also have regard and respond sensitively to key views into the site;

e) Create character areas through the development based on the existing woodland and field character building in opportunities for leisure activities, informal food growing and a mosaic of meadows, water bodies and tree cover.

4. Proposals must provide a comprehensive Ecology and Green Infrastructure Strategy, incorporating a Biodiversity Net Gain Plan, to demonstrate how a minimum 12% net biodiversity gain will be achieved on the site, and in particular demonstrate:

a) The three areas of Ancient Woodland (Courtland Wood, Two Mile Ash Gill and Smith's Copse (also a local wildlife site)) and any other woodland, are protected and their setting enhanced;

b) That natural and semi-natural habitats, including woodland and ancient woodland, hedgerows and ponds, are retained and protected wherever possible;

c) The creation of native species-rich hedges through the development; and

d) The retention and creation of wildlife corridors, and support for delivery of the Nature Recovery Network.

5. The masterplan and Sustainability Statement must demonstrate the delivery of net zero carbon, including demonstrating a fabric first approach to the construction of built development, and maximum use of on-site renewable energy technologies. This shall include a strategy to ensure that from 2025, all homes built on the site are designed as net-zero carbon through their expected lifetime.

6. The design and layout of the development will recognise and respect existing heritage assets, particularly Great House Farm (Grade II*), and preserve those elements of the heritage assets and their settings that are significant in illustrating their historic and architectural interest. The masterplan should include consideration of a sustainable future use for Great House Farm that is compatible with the desire to preserve the special interest of the listed building.

7. A comprehensive transport strategy is submitted as part of the masterplan with development to include the following:

a) A walking and cycling strategy that demonstrates how attractive, direct and legible routes that have priority over motorised traffic, and integrated with the existing and wider network, will be delivered and maintained. It should take account of the West Sussex County Council schemes from their "Walking and Cycling Strategy (2016-2026)", including investigating direct and indirect walking and cycling routes connecting Horsham to Southwater.

b) Improved links shall be provided between the development and Christ's Hospital station to help promote sustainable travel. This will include:

i. enhancements to the Downs Link;

ii. subject to suitable access and strong landscaping being provided, a new link road connecting the development to Two Mile Ash Road, together with a new crossing to connect with Christ's Hospital Road. A new footway will also be provided along Station Road at Christ's Hospital to complete the route and deter on-verge parking associated with the station;

iii. a new car park and cycle storage at Christ's Hospital station;

>iv. exploring the options with Metrobus to provide a direct service between the development and the station.

c) New road improvements shall be provided as part of the development, including:

i. a new link road between the development and Hop Oast roundabout;

ii. full signalisation of the Hop Oast roundabout to allow safe crossing of pedestrians and cyclists north to Horsham, plus further improvements to junctions on the A24 in consultation with, and as required by West Sussex County Council;

iii. four new accesses to the development, in consultation with West Sussex County Council, in order to spread traffic evenly across the development;

iv. new walking and cycling routes within the site;

v. improvements between Cedar Drive roundabout and the new school;

vi. the provision of a sustainable link for pedestrians and cyclists between Southwater village and Horsham (a bridge, underpass, or signal-controlled toucan crossing close to Hop Oast roundabout), in consultation with, and as agreed by, West Sussex County Council.

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# Appendix B

Summary of specification inputs in sample assessments

# Land North-West of Southwater - Specifications used for sample calculations

| Strategy | | | Dwellings (Residential) | Care Home | Community Hub | School | Warehouse |
|---|---|---|---|---|---|---|---|
| Construction | External Wall U-value (W/m²K) | | 0.19 | 0.21 | 0.18 | 0.18 | 0.25 |
| | Party Wall U-value ((W/m²K) | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Corridor Wall U-value (W/m²K) | | 0.18 | - | - | - | - |
| | Lift/Stair Wall U-value (W/m²K) | | 0.20 | - | - | - | - |
| | Entrance Door | | 1.40 | 1.40 | 1.40 | 1.40 | 1.40 |
| | Ground floor (W/m²K) | | 0.10 | 0.10 | 0.10 | 0.10 | 0.12 |
| | Exposed floor (W/m²K) | | 0.10 | - | - | - | - |
| | Main flat roof U-value (W/m²K) | | 0.10 | 0.12 | 0.12 | 0.14 | 0.18 |
| | Pitched roof U-value (W/m²K) | | 0.16 | - | - | - | - |
| | Air tightness m³/h/m²@50 Pa | | Houses - 4.00<br>Apartments - 3.00 | 5.00 | 3.00 | 7.00 | 5.00 |
| Glazing | Type | | Double | Double | Triple | Double | Double |
| | Glazing U-value (W/m²K) | | 1.20 | 1.30 | 0.85 | 1.40 | 1.20 |
| Ventilation | Ventilation | | Houses - Natural Ventilation<br>Apartments - Exhaust Air Heat Pump | Mechanical Ventilation with Heat Recovery | Mechanical Ventilation with Heat Recovery | Mechanical Ventilation with Heat Recovery | Mechanical Ventilation with Heat Recovery |
| Be Green Space Heating | Heat pump | Heating Type | Houses - Individual Air Source Heat Pump<br>Apartments - Exhaust Air Heat Pumps | Air Source Heat Pump | Air Source Heat Pump | Air Source Heat Pump | Air Source Heat Pump |
| | | Annual heat proportion (%) | 100% | 100% | 100% | 100% | 100% |
| PV | Output | | 3,304 kWp (3.3 kWp per dwelling) | 5.7 kWh/m2 | 2.74 kWh/m2 | 0 | 6.15 kWh/m2 |

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# Appendix C

SAP TER / DER Worksheets

# Full SAP Calculation Printout

| | | | |
|---|---|---|---|
| **Plot Reference** | 1B2P Core Mid MF W | **Issued on Date** | 16/01/2026 |
| **Assessment Reference** | 1B2P Core Mid MF W | **Plot Type Ref** | 1B2P Core Mid MF W |
| **Plot Address** | | **SAP Version** | 10.2 |

| | | | | | |
|---|---|---|---|---|---|
| **SAP Rating** | 85 B | **DER** | 2.26 | **TER** | 14.56 |
| **Environmental** | 98 A | **% DER < TER** | | | 84.48 |
| **$CO_2$ Emissions (t/year)** | 0.09 | **DFEE** | 30.88 | **TFEE** | 27.88 |
| **Compliance Check** | See BREL | **% DFEE < TFEE** | | | -10.76 |
| **% DPER < TPER** | 71.20 | **DPER** | 22.78 | **TPER** | 79.09 |

| | | | |
|---|---|---|---|
| **Assessor Details** | Miss Eleanor Risby | **Assessor ID** | M976-0001 |
| **Client** | | | |

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE

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## 1. Overall dwelling characteristics

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| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 50.2000 (1b) | x | 2.5000 (2b) | = | 125.5000 | (1b) - (3b) (4) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 50.2000 | | | | | |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = | 125.5000 | (5) |

---

## 2. Ventilation rate

---

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

| | | Air changes per hour | |
|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 0.0000 / (5) = | 0.0000 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 3.0000 | (17) |
| Infiltration rate | | 0.1500 | (18) |
| Number of sides sheltered | | 3 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 0.7750 | (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.1162 | (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.1482 | 0.1453 | 0.1424 | 0.1279 | 0.1250 | 0.1104 | 0.1104 | 0.1075 | 0.1162 | 0.1250 | 0.1308 | 0.1366 | (22b) |

Balanced mechanical ventilation with heat recovery

| | |
|---|---|
| If mechanical ventilation | 0.5000 (23a) |
| If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) | 0.6399 (23b) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = | 77.4000 (23c) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Effective ac | 0.2928 | 0.2899 | 0.2870 | 0.2725 | 0.2696 | 0.2551 | 0.2551 | 0.2522 | 0.2609 | 0.2696 | 0.2754 | 0.2812 | (25) |

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## 3. Heat losses and heat loss parameter

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| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | | |
| Glazing | | | 6.2500 | 1.1450 | 7.1565 | | | (27) |
| Corridor Door | | | 2.0600 | 1.0000 | 2.0600 | | | (26) |
| External Wall 1 | 17.8200 | 8.3100 | 9.5100 | 0.1900 | 1.8069 | 14.0000 | 133.1400 | (29a) |
| Corridor | 17.8200 | | 17.8200 | 0.1600 | 2.8512 | 14.0000 | 249.4800 | (29a) |
| Core | 20.5200 | | 20.5200 | 0.2500 | 5.1300 | 9.0000 | 184.6800 | (29a) |
| Total net area of external elements Aum(A, m2) | | | 56.1600 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 19.0046 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall | | | 20.5200 | 0.0000 | 0.0000 | 20.0000 | 410.4000 | (32) |
| Party Floor 1 | | | 50.2000 | | | 40.0000 | 2008.0000 | (32d) |
| Party Ceiling 1 | | | 50.2000 | | | 30.0000 | 1506.0000 | (32b) |
| Internal Wall 1 | | | 87.0000 | | | 9.0000 | 783.0000 | (32c) |

| | | |
|---|---|---|
| Heat capacity Cm = Sum(A x k) | (28)...(30) + (32) + (32a)...(32e) = | 5274.7000 (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | | 105.0737 (35) |

List of Thermal Bridges

| | K1 Element | Length | Psi-value | Total |
|---|---|---|---|---|
| E7 | Party floor between dwellings (in blocks of flats) | 5.4000 | 0.0700 | 0.3780 |
| E7 | Party floor between dwellings (in blocks of flats) | 13.2000 | 0.1000 | 1.3200 |
| E23 | Balcony within or between dwellings, balcony support penetrates wall insulation | 7.8000 | 0.1500 | 1.1700 |
| E16 | Corner (normal) | 5.4000 | 0.1400 | 0.7560 |
| E18 | Party wall between dwellings | 2.7000 | 0.0600 | 0.1620 |
| E18 | Party wall between dwellings | 2.7000 | 0.0900 | 0.2430 |
| P3 | Party wall - Intermediate floor between dwellings (in blocks of flats) | 15.2000 | 0.0000 | 0.0000 |
| E2 | Other lintels (including other steel lintels) | 4.3300 | 0.1000 | 0.4330 |
| E3 | Sill | 3.5000 | 0.0500 | 0.1675 |
| E4 | Jamb | 11.7000 | 0.0500 | 0.5850 |
| E7 | Party floor between dwellings (in blocks of flats) | 15.2000 | 0.1000 | 1.5200 |

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 6.7345 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 25.7391 (37)

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 12.1279 | 12.0076 | 11.8872 | 11.2854 | 11.1650 | 10.5632 | 10.5632 | 10.4429 | 10.8039 | 11.1650 | 11.4058 | 11.6465 | (38) |
| Heat transfer coeff | 37.8670 | 37.7467 | 37.6263 | 37.0245 | 36.9041 | 36.3023 | 36.3023 | 36.1820 | 36.5430 | 36.9041 | 37.1448 | 37.3856 | (39) |

Average = Sum(39)m / 12 = 36.9944

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 0.7543 | 0.7519 | 0.7495 | 0.7375 | 0.7351 | 0.7232 | 0.7232 | 0.7208 | 0.7279 | 0.7351 | 0.7399 | 0.7447 | (40) |
| HLP (average) | | | | | | | | | | | | 0.7369 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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4. Water heating energy requirements (kWh/year)

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Assumed occupancy 1.6960 (42)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Hot water usage for mixer showers | 52.6557 | 51.8644 | 50.7113 | 48.5050 | 46.8769 | 45.0612 | 44.0291 | 45.1735 | 46.4279 | 48.3774 | 50.6311 | 52.4539 | (42a) |
| Hot water usage for baths | 22.7669 | 22.4288 | 21.9526 | 21.0747 | 20.4173 | 19.6884 | 19.2947 | 19.7675 | 20.2823 | 21.0623 | 21.9583 | 22.6899 | (42b) |
| Hot water usage for other uses | 31.9986 | 30.8351 | 29.6715 | 28.5079 | 27.3443 | 26.1807 | 26.1807 | 27.3443 | 28.5079 | 29.6715 | 30.8351 | 31.9986 | (42c) |

Average daily hot water use (litres/day) 98.7449 (43)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 107.4212 | 105.1282 | 102.3354 | 98.0876 | 94.6385 | 90.9303 | 89.5045 | 92.2853 | 95.2181 | 99.1112 | 103.4244 | 107.1425 | (44) |
| Energy conte | 170.1289 | 149.7011 | 157.2856 | 134.2770 | 127.4016 | 111.8094 | 108.2479 | 114.2684 | 117.4134 | 134.4929 | 147.3470 | 167.7593 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1640.1327 | |
| Distribution loss (46)m = 0.15 x (45)m | 25.5193 | 22.4552 | 23.5928 | 20.1416 | 19.1102 | 16.7714 | 16.2372 | 17.1403 | 17.6120 | 20.1739 | 22.1021 | 25.1639 | (46) |
| Water storage loss (or HIU loss): | | | | | | | | | | | | | |
| Store volume | | | | | | | | | | | | 180.0000 | (47) |
| a) If manufacturer declared loss factor is known (kWh/day): | | | | | | | | | | | | 0.8400 | (48) |
| Temperature factor from Table 2b | | | | | | | | | | | | 0.5400 | (49) |
| Enter (49) or (54) in (55) | | | | | | | | | | | | 0.4536 | (55) |
| Total storage loss | 14.0616 | 12.7008 | 14.0616 | 13.6080 | 14.0616 | 13.6080 | 14.0616 | 14.0616 | 13.6080 | 14.0616 | 13.6080 | 14.0616 | (56) |
| If cylinder contains dedicated solar storage | 14.0616 | 12.7008 | 14.0616 | 13.6080 | 14.0616 | 13.6080 | 14.0616 | 14.0616 | 13.6080 | 14.0616 | 13.6080 | 14.0616 | (57) |
| Primary 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 | (59) |
| Combi loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |
| Total heat required for water heating calculated for each month | 184.1905 | 162.4019 | 171.3472 | 147.8850 | 141.4632 | 125.4174 | 122.3095 | 128.3300 | 131.0214 | 148.5545 | 160.9550 | 181.8209 | (62) |
| WWHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63a) |
| PV diverter | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |
| Output from w/h | 184.1905 | 162.4019 | 171.3472 | 147.8850 | 141.4632 | 125.4174 | 122.3095 | 128.3300 | 131.0214 | 148.5545 | 160.9550 | 181.8209 | (64) |
| | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 1805.6967 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 1806 | (64) |
| Electric shower(s) | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |
| | | | | | | | | | | Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | | 0.0000 | (64a) |
| Heat gains from water heating, kWh/month | 56.5679 | 49.7756 | 52.2975 | 44.6471 | 42.3610 | 37.1766 | 35.9924 | 37.9943 | 39.0400 | 44.7189 | 48.9929 | 55.7800 | (65) |

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

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| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Metabolic gains (Table 5), Watts | | | | | | | | | | | | | |
| (66)m | 84.7995 | 84.7995 | 84.7995 | 84.7995 | 84.7995 | 84.7995 | 84.7995 | 84.7995 | 84.7995 | 84.7995 | 84.7995 | 84.7995 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 84.4943 | 93.5473 | 84.4943 | 87.3108 | 84.4943 | 87.3108 | 84.4943 | 84.4943 | 87.3108 | 84.4943 | 87.3108 | 84.4943 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 147.7534 | 149.2866 | 145.4229 | 137.1977 | 126.8147 | 117.0562 | 110.5370 | 109.0038 | 112.8674 | 121.0927 | 131.4756 | 141.2341 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 31.4800 | 31.4800 | 31.4800 | 31.4800 | 31.4800 | 31.4800 | 31.4800 | 31.4800 | 31.4800 | 31.4800 | 31.4800 | 31.4800 | (69) |
| Pumps, fans | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | -67.8396 | -67.8396 | -67.8396 | -67.8396 | -67.8396 | -67.8396 | -67.8396 | -67.8396 | -67.8396 | -67.8396 | -67.8396 | -67.8396 | (71) |
| Water heating gains (Table 5) | 76.0321 | 74.0709 | 70.2923 | 62.0099 | 56.9369 | 51.6342 | 48.3769 | 51.0675 | 54.2222 | 60.1060 | 68.0457 | 74.9731 | (72) |
| Total internal gains | 356.7196 | 365.3446 | 348.6494 | 334.9582 | 316.6858 | 304.4411 | 291.8481 | 293.0055 | 302.8403 | 314.1329 | 335.2720 | 349.1413 | (73) |

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6. Solar gains

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| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| West | 6.2500 | 19.6403 | 0.4500 | 0.7000 | 0.7700 | 26.7961 | (80) |

---

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 26.7961 | 52.4188 | 86.3263 | 125.9018 | 154.2973 | 157.9508 | 150.3756 | 129.1704 | 100.4011 | 62.1993 | 33.4116 | 22.0358 | (83) |
| Total gains | 383.5157 | 417.7634 | 434.9757 | 460.8600 | 470.9831 | 462.3919 | 442.2237 | 422.1759 | 403.2413 | 376.3322 | 368.6835 | 371.1771 | (84) |

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7. Mean internal temperature (heating season)

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

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| tau | 38.6932 | 38.8165 | 38.9407 | 39.5737 | 39.7027 | 40.3609 | 40.3609 | 40.4952 | 40.0950 | 39.7027 | 39.4454 | 39.1914 | |
| alpha | 3.5795 | 3.5878 | 3.5960 | 3.6382 | 3.6468 | 3.6907 | 3.6907 | 3.6997 | 3.6730 | 3.6468 | 3.6297 | 3.6128 | |
| util living area | 0.9269 | 0.9008 | 0.8613 | 0.7732 | 0.6478 | 0.4819 | 0.3558 | 0.3865 | 0.5783 | 0.7924 | 0.8934 | 0.9329 | (86) |
| Living | 19.9697 | 20.1242 | 20.3303 | 20.6006 | 20.7845 | 20.8837 | 20.9082 | 20.9054 | 20.8508 | 20.6215 | 20.2740 | 19.9501 | |
| Non living | 19.0740 | 19.2677 | 19.5243 | 19.8591 | 20.0722 | 20.1862 | 20.2080 | 20.2081 | 20.1513 | 19.8912 | 19.4657 | 19.0563 | |
| 24 / 16 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 24 / 9 | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |
| 16 / 9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| MIT | 21.0000 | 21.0000 | 21.0000 | 21.0000 | 21.0000 | 21.0000 | 21.0000 | 21.0000 | 21.0000 | 21.0000 | 21.0000 | 21.0000 | (87) |
| Th 2 | 20.2931 | 20.2952 | 20.2973 | 20.3078 | 20.3099 | 20.3204 | 20.3204 | 20.3225 | 20.3162 | 20.3099 | 20.3057 | 20.3015 | (88) |
| util rest of house | 0.9185 | 0.8897 | 0.8458 | 0.7490 | 0.6124 | 0.4359 | 0.3027 | 0.3322 | 0.5313 | 0.7652 | 0.8799 | 0.9251 | (89) |
| MIT 2 | 20.2931 | 20.2952 | 20.2973 | 20.3078 | 20.3099 | 20.3204 | 20.3204 | 20.3225 | 20.3162 | 20.3099 | 20.3057 | 20.3015 | (90) |
| Living area fraction | | | | | | | | | fLA = Living area / (4) = | | | 0.5727 | (91) |
| MIT | 20.6979 | 20.6988 | 20.6997 | 20.7042 | 20.7051 | 20.7096 | 20.7096 | 20.7105 | 20.7078 | 20.7051 | 20.7033 | 20.7015 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 20.6979 | 20.6988 | 20.6997 | 20.7042 | 20.7051 | 20.7096 | 20.7096 | 20.7105 | 20.7078 | 20.7051 | 20.7033 | 20.7015 | (93) |

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8. Space heating requirement

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| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9234 | 0.8962 | 0.8549 | 0.7631 | 0.6330 | 0.4625 | 0.3333 | 0.3635 | 0.5586 | 0.7812 | 0.8878 | 0.9297 | (94) |
| Useful gains | 354.1514 | 374.4010 | 371.8473 | 351.6938 | 298.1323 | 213.8734 | 147.3858 | 153.4698 | 225.2638 | 293.9956 | 327.3226 | 345.0849 | (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 | 620.9414 | 596.3535 | 534.2836 | 437.0454 | 332.3262 | 221.7935 | 149.1889 | 155.9632 | 241.4699 | 372.9208 | 505.2935 | 616.9192 | (97) |
| Space heating kWh | 198.4918 | 149.1521 | 120.8526 | 61.4531 | 25.4403 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 58.7204 | 128.1391 | 202.2448 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 944.4940 | |
| Solar heating kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | 198.4918 | 149.1521 | 120.8526 | 61.4531 | 25.4403 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 58.7204 | 128.1391 | 202.2448 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 944.4940 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 18.8146 | (99) |

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

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| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | | | | | | | | | | | | 0.0000 | (201) |
| Fraction of space heat from main system(s) | | | | | | | | | | | | 1.0000 | (202) |
| Efficiency of main space heating system 1 (in %) | | | | | | | | | | | | 297.4056 | (206) |
| Efficiency of main space heating system 2 (in %) | | | | | | | | | | | | 0.0000 | (207) |
| Efficiency of secondary/supplementary heating system, % | | | | | | | | | | | | 0.0000 | (208) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement | 198.4918 | 149.1521 | 120.8526 | 61.4531 | 25.4403 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 58.7204 | 128.1391 | 202.2448 | (98) |
| Space heating efficiency (main heating system 1) | 297.4056 | 297.4056 | 297.4056 | 297.4056 | 297.4056 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 297.4056 | 297.4056 | 297.4056 | (210) |
| Space heating fuel (main heating system) | 66.7411 | 50.1511 | 40.6356 | 20.6631 | 8.5541 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 19.7442 | 43.0856 | 68.0030 | (211) |
| Space heating efficiency (main heating system 2) | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (212) |
| Space heating fuel (main heating system 2) | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (213) |
| Space heating fuel (secondary) | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (215) |
| Water heating | | | | | | | | | | | | | |
| Water heating requirement | 184.1905 | 162.4019 | 171.3472 | 147.8850 | 141.4632 | 125.4174 | 122.3095 | 128.3300 | 131.0214 | 148.5545 | 160.9550 | 181.8209 | (64) |
| Efficiency of water heater | | | | | | | | | | | | 194.1800 | (216) |
| (217)m | 194.1800 | 194.1800 | 194.1800 | 194.1800 | 194.1800 | 194.1800 | 194.1800 | 194.1800 | 194.1800 | 194.1800 | 194.1800 | 194.1800 | (217) |
| Fuel for water heating, kWh/month | 94.8556 | 83.6347 | 88.2414 | 76.1587 | 72.8516 | 64.5882 | 62.9877 | 66.0882 | 67.4742 | 76.5035 | 82.8896 | 93.6352 | (219) |
| Space cooling fuel requirement | | | | | | | | | | | | | |
| (221)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (221) |
| Pumps and Fa | 7.9171 | 7.1510 | 7.9171 | 7.6617 | 7.9171 | 7.6617 | 7.9171 | 7.9171 | 7.6617 | 7.9171 | 7.6617 | 7.9171 | (231) |
| Lighting | 18.0301 | 14.4644 | 13.0236 | 9.5416 | 7.3702 | 6.0216 | 6.7234 | 8.7393 | 11.3515 | 14.8938 | 16.8225 | 18.5312 | (232) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (233a)m | -27.9479 | -44.8302 | -72.8999 | -87.3750 | -95.8244 | -88.4395 | -86.8390 | -80.9114 | -68.5351 | -53.1759 | -31.9838 | -23.2810 | (233a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (234a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (234a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (235a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235a) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | | |
| (235c)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235c) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (233b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (233b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (234b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (234b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (235b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235b) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | | |
| (235d)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235d) |
| Annual totals kWh/year | | | | | | | | | | | | | |
| Space heating fuel - main system 1 | | | | | | | | | | | | 317.5778 | (211) |
| Space heating fuel - main system 2 | | | | | | | | | | | | 0.0000 | (213) |
| Space heating fuel - secondary | | | | | | | | | | | | 0.0000 | (215) |
| Efficiency of water heater | | | | | | | | | | | | 194.1800 | |

| | | |
|---|---|---|
| Water heating fuel used | 929.9087 | (219) |
| Space cooling fuel | 0.0000 | (221) |
| Electricity for pumps and fans: | | |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.9500) | | |
| mechanical ventilation fans (SFP = 0.9500) | 93.2178 | (230a) |
| Total electricity for the above, kWh/year | 93.2178 | (231) |
| Electricity for lighting (calculated in Appendix L) | 145.5132 | (232) |
| Energy saving/generation technologies (Appendices M ,N and Q) | | |
| PV generation | -762.0431 | (233) |
| Wind generation | 0.0000 | (234) |
| Hydro-electric generation (Appendix N) | 0.0000 | (235a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 | (235) |
| Appendix Q - special features | | |
| Energy saved or generated | -0.0000 | (236) |
| Energy used | 0.0000 | (237) |
| Total delivered energy for all uses | 724.1744 | (238) |

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

| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 317.5778 | 0.1558 | 49.4798 | (261) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 929.9087 | 0.1413 | 131.4104 | (264) |
| Space and water heating | | | 180.8902 | (265) |
| Pumps, fans and electric keep-hot | 93.2178 | 0.1387 | 12.9305 | (267) |
| Energy for lighting | 145.5132 | 0.1443 | 21.0021 | (268) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -762.0431 | 0.1333 | -101.5570 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -101.5570 | (269) |
| Total CO2, kg/year | | | 113.2657 | (272) |
| EPC Dwelling Carbon Dioxide Emission Rate (DER) | | | 2.2600 | (273) |

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

| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 317.5778 | 1.5768 | 500.7605 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 929.9087 | 1.5226 | 1415.8357 | (278) |
| Space and water heating | | | 1916.5961 | (279) |
| Pumps, fans and electric keep-hot | 93.2178 | 1.5128 | 141.0199 | (281) |
| Energy for lighting | 145.5132 | 1.5338 | 223.1930 | (282) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -762.0431 | 1.4925 | -1137.3382 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -1137.3382 | (283) |
| Total Primary energy kWh/year | | | 1143.4708 | (286) |
| Dwelling Primary energy Rate (DPER) | | | 22.7800 | (287) |

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF TARGET EMISSIONS

1. Overall dwelling characteristics

| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 50.2000 | (1b) x | 2.5000 | (2b) = | 125.5000 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 50.2000 | | | | | | (4) |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | | 125.5000 | (5) |

2. Ventilation rate

| | | m3 per hour | |
|---|---|---|---|
| Number of open chimneys | 0 * 80 = | 0.0000 | (6a) |
| Number of open flues | 0 * 20 = | 0.0000 | (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 | (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 | (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 | (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 | (6f) |
| Number of intermittent extract fans | 2 * 10 = | 20.0000 | (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 | (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 | (7c) |
| | Air changes per hour | | |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 20.0000 / (5) = | 0.1594 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 5.0000 | (17) |
| Infiltration rate | | 0.4094 | (18) |
| Number of sides sheltered | | 3 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 0.7750 | (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.3173 | (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | | | | | | | | | | | | | |
| | 0.4045 | 0.3966 | 0.3886 | 0.3490 | 0.3411 | 0.3014 | 0.3014 | 0.2935 | 0.3173 | 0.3411 | 0.3569 | 0.3728 | (22b) |
| Effective ac | 0.5818 | 0.5786 | 0.5755 | 0.5609 | 0.5582 | 0.5454 | 0.5454 | 0.5431 | 0.5503 | 0.5582 | 0.5637 | 0.5695 | (25) |

## 3. Heat losses and heat loss parameter

| Element | Gross | Openings | NetArea | U-value | A x U | K-value | A x K | |
|---|---|---|---|---|---|---|---|---|
| Main dwelling | m2 | m2 | m2 | W/m2K | W/K | kJ/m2K | kJ/K | |
| TER Opaque door | | | 2.0600 | 1.0000 | 2.0600 | | | (26) |
| TER Opening Type | | | 6.2500 | 1.1450 | 7.1565 | | | (27) |
| External Wall 1 | 17.8200 | 8.3100 | 9.5100 | 0.1800 | 1.7118 | | | (29a) |
| Corridor | 17.8200 | | 17.8200 | 0.1800 | 3.2076 | | | (29a) |
| Core | 20.5200 | | 20.5200 | 0.1800 | 3.6936 | | | (29a) |
| Total net area of external elements Aum(A, m2) | | | 56.1600 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 17.8295 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall | | | 20.5200 | 0.0000 | 0.0000 | | | (32) |

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 105.0737 (35)

List of Thermal Bridges

| K1 Element | Length | Psi-value | Total |
|---|---|---|---|
| E7 Party floor between dwellings (in blocks of flats) | 5.4000 | 0.0700 | 0.3780 |
| E7 Party floor between dwellings (in blocks of flats) | 13.2000 | 0.0700 | 0.9240 |
| E23 Balcony within or between dwellings, balcony support penetrates wall insulation | 7.8000 | 0.0200 | 0.1560 |
| E16 Corner (normal) | 5.4000 | 0.0900 | 0.4860 |
| E18 Party wall between dwellings | 2.7000 | 0.0600 | 0.1620 |
| E18 Party wall between dwellings | 2.7000 | 0.0600 | 0.1620 |
| P3 Party wall - Intermediate floor between dwellings (in blocks of flats) | 15.2000 | 0.0000 | 0.0000 |
| E2 Other lintels (including other steel lintels) | 4.3300 | 0.0500 | 0.2165 |
| E3 Sill | 3.5500 | 0.0500 | 0.1675 |
| E4 Jamb | 11.7000 | 0.0500 | 0.5850 |
| E7 Party floor between dwellings (in blocks of flats) | 15.2000 | 0.0700 | 1.0640 |

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 4.3010 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 22.1305 (37)

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 24.0957 | 23.9641 | 23.8352 | 23.2294 | 23.1161 | 22.5885 | 22.5885 | 22.4908 | 22.7917 | 23.1161 | 23.3454 | 23.5851 | (38) |
| Heat transfer coeff | | | | | | | | | | | | | |
| | 46.2262 | 46.0946 | 45.9656 | 45.3599 | 45.2466 | 44.7190 | 44.7190 | 44.6213 | 44.9222 | 45.2466 | 45.4759 | 45.7155 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 45.3594 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 0.9208 | 0.9182 | 0.9157 | 0.9036 | 0.9013 | 0.8908 | 0.8908 | 0.8889 | 0.8949 | 0.9013 | 0.9059 | 0.9107 | (40) |
| HLP (average) | | | | | | | | | | | | 0.9036 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

## 4. Water heating energy requirements (kWh/year)

Assumed occupancy 1.6960 (42)

Hot water usage for mixer showers

| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 52.6557 | 51.8644 | 50.7113 | 48.5050 | 46.8769 | 45.0612 | 44.0291 | 45.1735 | 46.4279 | 48.3774 | 50.6311 | 52.4539 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 22.7669 | 22.4288 | 21.9526 | 21.0747 | 20.4173 | 19.6884 | 19.2947 | 19.7675 | 20.2823 | 21.0623 | 21.9583 | 22.6899 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 31.9986 | 30.8351 | 29.6715 | 28.5079 | 27.3443 | 26.1807 | 26.1807 | 27.3443 | 28.5079 | 29.6715 | 30.8351 | 31.9986 | (42c) |

Average daily hot water use (litres/day) 98.7449 (43)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | | | | | | | | | | | | | |
| | 107.4212 | 105.1282 | 102.3354 | 98.0876 | 94.6385 | 90.9303 | 89.5045 | 92.2853 | 95.2181 | 99.1112 | 103.4244 | 107.1425 | (44) |
| Energy conte | 170.1289 | 149.7011 | 157.2856 | 134.2770 | 127.4016 | 111.8094 | 108.2479 | 114.2684 | 117.4134 | 134.4929 | 147.3470 | 167.7593 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1640.1327 | |
| Distribution loss (46)m = 0.15 x (45)m | | | | | | | | | | | | | |
| | 25.5193 | 22.4552 | 23.5928 | 20.1416 | 19.1102 | 16.7714 | 16.2372 | 17.1403 | 17.6120 | 20.1739 | 22.1021 | 25.1639 | (46) |
| Water storage loss (or HIU loss): | | | | | | | | | | | | | |
| Store volume | | | | | | | | | | | | 150.0000 | (47) |
| a) If manufacturer declared loss factor is known (kWh/day): | | | | | | | | | | | | 1.3938 | (48) |
| Temperature factor from Table 2b | | | | | | | | | | | | 0.5400 | (49) |
| Enter (49) or (54) in (55) | | | | | | | | | | | | 0.7527 | (55) |
| Total storage loss | | | | | | | | | | | | | |
| | 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (56) |
| If cylinder contains dedicated solar storage | | | | | | | | | | | | | |
| | 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (57) |
| Primary loss | 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |
| Total heat required for water heating calculated for each month | | | | | | | | | | | | | |
| | 216.7238 | 191.7869 | 203.8805 | 179.3689 | 173.9965 | 156.9012 | 154.8428 | 160.8633 | 162.5053 | 181.0878 | 192.4389 | 214.3542 | (62) |
| WWHRS | -24.0720 | -21.2895 | -22.2931 | -18.4596 | -17.2036 | -14.7213 | -13.7989 | -14.6737 | -15.2312 | -17.9559 | -20.3419 | -23.6262 | (63a) |
| PV diverter | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |
| Output from w/h | | | | | | | | | | | | | |
| | 192.6519 | 170.4974 | 181.5874 | 160.9093 | 156.7928 | 142.1799 | 141.0440 | 146.1896 | 147.2741 | 163.1319 | 172.0970 | 190.7280 | (64) |
| | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | | 1965.0834 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 1965 | (64) |
| Electric shower(s) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |
| | | | | | | Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | | | | | | 0.0000 | (64a) |
| Heat gains from water heating, kWh/month | | | | | | | | | | | | | |
| | 93.8438 | 83.4442 | 89.5734 | 80.7206 | 79.6370 | 73.2501 | 73.2684 | 75.2702 | 75.1134 | 81.9948 | 85.0664 | 93.0559 | (65) |

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

Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 84.7995 | 84.7995 | 84.7995 | 84.7995 | 84.7995 | 84.7995 | 84.7995 | 84.7995 | 84.7995 | 84.7995 | 84.7995 | 84.7995 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | | | | | | | | | | | | | |
| | 82.0470 | 90.8377 | 82.0470 | 84.7819 | 82.0470 | 84.7819 | 82.0470 | 82.0470 | 84.7819 | 82.0470 | 84.7819 | 82.0470 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | | | | | | | | | | | | | |
| | 147.7534 | 149.2866 | 145.4229 | 137.1977 | 126.8147 | 117.0562 | 110.5370 | 109.0038 | 112.8674 | 121.0927 | 131.4756 | 141.2341 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | | | | | | | | | | | | | |
| | 31.4800 | 31.4800 | 31.4800 | 31.4800 | 31.4800 | 31.4800 | 31.4800 | 31.4800 | 31.4800 | 31.4800 | 31.4800 | 31.4800 | (69) |
| Pumps, fans | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 3.0000 | 3.0000 | 3.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | | | | | | | | | | | | | |
| | -67.8396 | -67.8396 | -67.8396 | -67.8396 | -67.8396 | -67.8396 | -67.8396 | -67.8396 | -67.8396 | -67.8396 | -67.8396 | -67.8396 | (71) |
| Water heating gains (Table 5) | | | | | | | | | | | | | |
| | 126.1341 | 124.1729 | 120.3943 | 112.1119 | 107.0389 | 101.7362 | 98.4790 | 101.1696 | 104.3242 | 110.2081 | 118.1477 | 125.0751 | (72) |
| Total internal gains | | | | | | | | | | | | | |
| | 407.3744 | 415.7371 | 399.3041 | 385.5313 | 367.3405 | 352.0142 | 339.5028 | 340.6602 | 350.4134 | 364.7876 | 385.8451 | 399.7961 | (73) |

## 6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| West | 6.2500 | 19.6403 | 0.6300 | 0.7000 | 0.7700 | 37.5145 | (80) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 37.5145 | 73.3863 | 120.8568 | 176.2625 | 216.0163 | 221.1311 | 210.5258 | 180.8386 | 140.5615 | 87.0791 | 46.7762 | 30.8501 | (83) |
| Total gains | 444.8889 | 489.1234 | 520.1609 | 561.7938 | 583.3568 | 573.1453 | 550.0286 | 521.4988 | 490.9749 | 451.8667 | 432.6213 | 430.6462 | (84) |

## 7. Mean internal temperature (heating season)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature during heating periods in the living area from Table 9, Th1 (C) | | | | | | | | | | | | 21.0000 | (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a) | | | | | | | | | | | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| tau | 31.6962 | 31.7867 | 31.8759 | 32.3015 | 32.3824 | 32.7645 | 32.7645 | 32.8362 | 32.6162 | 32.3824 | 32.2192 | 32.0502 | |
| alpha | 3.1131 | 3.1191 | 3.1251 | 3.1534 | 3.1588 | 3.1843 | 3.1843 | 3.1891 | 3.1744 | 3.1588 | 3.1479 | 3.1367 | |
| util living area | | | | | | | | | | | | | |
| | 0.9150 | 0.8868 | 0.8420 | 0.7503 | 0.6249 | 0.4704 | 0.3489 | 0.3811 | 0.5680 | 0.7747 | 0.8793 | 0.9213 | (86) |
| MIT | 19.4415 | 19.6817 | 20.0221 | 20.4527 | 20.7581 | 20.9283 | 20.9790 | 20.9719 | 20.8659 | 20.4817 | 19.9191 | 19.4083 | (87) |
| Th 2 | 20.1498 | 20.1520 | 20.1542 | 20.1645 | 20.1664 | 20.1753 | 20.1753 | 20.1770 | 20.1719 | 20.1664 | 20.1625 | 20.1584 | (88) |
| util rest of house | | | | | | | | | | | | | |
| | 0.9046 | 0.8735 | 0.8234 | 0.7221 | 0.5844 | 0.4171 | 0.2866 | 0.3172 | 0.5137 | 0.7430 | 0.8631 | 0.9116 | (89) |
| MIT 2 | 18.3401 | 18.6391 | 19.0598 | 19.5838 | 19.9336 | 20.1185 | 20.1630 | 20.1596 | 20.0583 | 19.6303 | 18.9467 | 18.3048 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.5727 | (91) |
| MIT | 18.9709 | 19.2362 | 19.6109 | 20.0814 | 20.4058 | 20.5823 | 20.6303 | 20.6248 | 20.5208 | 20.1179 | 19.5036 | 18.9368 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 18.9709 | 19.2362 | 19.6109 | 20.0814 | 20.4058 | 20.5823 | 20.6303 | 20.6248 | 20.5208 | 20.1179 | 19.5036 | 18.9368 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.8876 | 0.8569 | 0.8101 | 0.7191 | 0.5964 | 0.4438 | 0.3213 | 0.3524 | 0.5372 | 0.7410 | 0.8485 | 0.8948 | (94) |
| Useful gains | 394.8628 | 419.1352 | 421.4062 | 403.9901 | 347.9212 | 254.3723 | 176.7287 | 183.7593 | 263.7722 | 334.8246 | 367.0829 | 385.3613 | (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 | | | | | | | | | | | | | |
| | 678.1786 | 660.8220 | 602.6518 | 507.1890 | 393.9070 | 267.5205 | 180.2326 | 188.5172 | 288.4380 | 430.6520 | 564.0645 | 673.7018 | (97) |
| Space heating kWh | | | | | | | | | | | | | |
| | 210.7870 | 162.4135 | 134.8467 | 74.3032 | 34.2134 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 71.2955 | 141.8268 | 214.5254 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 1044.2115 | |
| Solar heating kWh | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | | | | | | | | | | | | | |
| | 210.7870 | 162.4135 | 134.8467 | 74.3032 | 34.2134 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 71.2955 | 141.8268 | 214.5254 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 1044.2115 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 20.8010 | (99) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | | | | | | | | | | | | 0.0000 | (201) |
| Fraction of space heat from main system(s) | | | | | | | | | | | | 1.0000 | (202) |
| Efficiency of main space heating system 1 (in %) | | | | | | | | | | | | 92.3000 | (206) |
| Efficiency of main space heating system 2 (in %) | | | | | | | | | | | | 0.0000 | (207) |
| Efficiency of secondary/supplementary heating system, % | | | | | | | | | | | | 0.0000 | (208) |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| Space heating requirement | | | | | | | | | | | | | |
| | 210.7870 | 162.4135 | 134.8467 | 74.3032 | 34.2134 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 71.2955 | 141.8268 | 214.5254 | (98) |
| Space heating efficiency (main heating system 1) | | | | | | | | | | | | | |
| | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 92.3000 | 92.3000 | 92.3000 | (210) |
| Space heating fuel (main heating system) | | | | | | | | | | | | | |
| | 228.3716 | 175.9627 | 146.0961 | 80.5019 | 37.0676 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 77.2433 | 153.6585 | 232.4218 | (211) |
| Space heating efficiency (main heating system 2) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (212) |
| Space heating fuel (main heating system 2) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (213) |
| Space heating fuel (secondary) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (215) |
| Water heating | | | | | | | | | | | | | |
| Water heating requirement | | | | | | | | | | | | | |
| | 192.6519 | 170.4974 | 181.5874 | 160.9093 | 156.7928 | 142.1799 | 141.0440 | 146.1896 | 147.2741 | 163.1319 | 172.0970 | 190.7280 | (64) |
| Efficiency of water heater | | | | | | | | | | | | 79.8000 | (216) |
| (217)m | 84.2620 | 83.9510 | 83.4022 | 82.4394 | 81.2755 | 79.8000 | 79.8000 | 79.8000 | 79.8000 | 82.3380 | 83.6293 | 84.3241 | (217) |
| Fuel for water heating, kWh/month | | | | | | | | | | | | | |
| | 228.6344 | 203.0916 | 217.7251 | 195.1849 | 192.9153 | 178.1703 | 176.7468 | 183.1950 | 184.5540 | 198.1248 | 205.7855 | 226.1844 | (219) |
| Space cooling fuel requirement | | | | | | | | | | | | | |
| (221)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (221) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Pumps and Fa | 7.3041 | 6.5973 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 | (231) |
| Lighting | 17.0477 | 13.6763 | 12.3140 | 9.0218 | 6.9687 | 5.6935 | 6.3571 | 8.2632 | 10.7330 | 14.0823 | 15.9059 | 17.5216 | (232) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (233a)m | -7.4431 | -11.4422 | -17.9162 | -22.0059 | -25.4253 | -24.3737 | -24.0906 | -21.8926 | -18.3353 | -13.8734 | -8.5162 | -6.3301 | (233a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (234a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (234a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (235a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235a) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | | |
| (235c)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235c) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (233b)m | -1.7447 | -3.8126 | -7.8514 | -12.2056 | -16.5504 | -16.7735 | -16.5644 | -13.8234 | -9.8808 | -5.5708 | -2.3669 | -1.3686 | (233b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (234b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (234b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (235b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235b) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | | |
| (235d)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235d) |

| | | |
|---|---|---|
| Annual totals kWh/year | | |
| Space heating fuel - main system 1 | 1131.3234 | (211) |
| Space heating fuel - main system 2 | 0.0000 | (213) |
| Space heating fuel - secondary | 0.0000 | (215) |
| Efficiency of water heater | 79.8000 | |
| Water heating fuel used | 2390.3121 | (219) |
| Space cooling fuel | 0.0000 | (221) |
| | | |
| Electricity for pumps and fans: | | |
| Total electricity for the above, kWh/year | 86.0000 | (231) |
| Electricity for lighting (calculated in Appendix L) | 137.5851 | (232) |
| | | |
| Energy saving/generation technologies (Appendices M ,N and Q) | | |
| PV generation | -310.1576 | (233) |
| Wind generation | 0.0000 | (234) |
| Hydro-electric generation (Appendix N) | 0.0000 | (235a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 | (235) |
| Appendix Q - special features | | |
| Energy saved or generated | -0.0000 | (236) |
| Energy used | 0.0000 | (237) |
| Total delivered energy for all uses | 3435.0630 | (238) |

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

| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 1131.3234 | 0.2100 | 237.5779 | (261) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 2390.3121 | 0.2100 | 501.9655 | (264) |
| Space and water heating | | | 739.5435 | (265) |
| Pumps, fans and electric keep-hot | 86.0000 | 0.1387 | 11.9293 | (267) |
| Energy for lighting | 137.5851 | 0.1443 | 19.8578 | (268) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -201.6446 | 0.1328 | -26.7805 | |
| PV Unit electricity exported | -108.5130 | 0.1249 | -13.5556 | |
| Total | | | -40.3360 | (269) |
| Total CO2, kg/year | | | 730.9945 | (272) |
| EPC Target Carbon Dioxide Emission Rate (TER) | | | 14.5600 | (273) |

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

| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 1131.3234 | 1.1300 | 1278.3954 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 2390.3121 | 1.1300 | 2701.0527 | (278) |
| Space and water heating | | | 3979.4481 | (279) |
| Pumps, fans and electric keep-hot | 86.0000 | 1.5128 | 130.1008 | (281) |
| Energy for lighting | 137.5851 | 1.5338 | 211.0326 | (282) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -201.6446 | 1.4907 | -300.6000 | |
| PV Unit electricity exported | -108.5130 | 0.4585 | -49.7532 | |
| Total | | | -350.3532 | (283) |
| Total Primary energy kWh/year | | | 3970.2283 | (286) |
| Target Primary Energy Rate (TPER) | | | 79.0900 | (287) |

# Full SAP Calculation Printout

| | | | |
|---|---|---|---|
| **Plot Reference** | 1B2P Mid GF W | **Issued on Date** | 16/01/2026 |
| **Assessment Reference** | 1B2P Mid GF W | **Plot Type Ref** | 1B2P Mid GF W |
| **Plot Address** | | **SAP Version** | 10.2 |

| | | | | | |
|---|---|---|---|---|---|
| **SAP Rating** | 85 B | **DER** | 2.38 | **TER** | 16.40 |
| **Environmental** | 98 A | **% DER < TER** | | | 85.49 |
| **$CO_2$ Emissions (t/year)** | 0.09 | **DFEE** | 36.22 | **TFEE** | 37.62 |
| **Compliance Check** | See BREL | **% DFEE < TFEE** | | | 3.72 |
| **% DPER < TPER** | 72.98 | **DPER** | 24.04 | **TPER** | 88.97 |

| | | | |
|---|---|---|---|
| **Assessor Details** | Miss Eleanor Risby | **Assessor ID** | M976-0001 |
| **Client** | | | |

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE

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## 1. Overall dwelling characteristics

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| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 50.2000 | (1b) | x 2.5000 | (2b) = | 125.5000 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 50.2000 | | | | | (4) |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = | 125.5000 | (5) |

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## 2. Ventilation rate

---

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

| | | Air changes per hour | |
|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 0.0000 / (5) = | 0.0000 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 3.0000 | (17) |
| Infiltration rate | | 0.1500 | (18) |
| Number of sides sheltered | | 3 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 0.7750 | (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.1162 | (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.1482 | 0.1453 | 0.1424 | 0.1279 | 0.1250 | 0.1104 | 0.1104 | 0.1075 | 0.1162 | 0.1250 | 0.1308 | 0.1366 | (22b) |

Balanced mechanical ventilation with heat recovery

| | | |
|---|---|---|
| If mechanical ventilation | 0.5000 | (23a) |
| If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) | 0.6458 | (23b) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = | 77.4000 | (23c) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Effective ac | 0.2942 | 0.2913 | 0.2884 | 0.2738 | 0.2709 | 0.2564 | 0.2564 | 0.2535 | 0.2622 | 0.2709 | 0.2767 | 0.2825 | (25) |

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## 3. Heat losses and heat loss parameter

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| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | | |
| Glazing | | | 6.2500 | 1.1450 | 7.1565 | | | (27) |
| Corridor Door | | | 2.0600 | 1.0000 | 2.0600 | | | (26) |
| Heatloss Floor 1 | | | 50.2000 | 0.1000 | 5.0200 | 110.0000 | 5522.0000 | (28a) |
| External Wall 1 | 17.8200 | 8.3100 | 9.5100 | 0.1900 | 1.8069 | 14.0000 | 133.1400 | (29a) |
| Corridor | 17.8200 | | 17.8200 | 0.1600 | 2.8512 | 14.0000 | 249.4800 | (29a) |
| Main Roof | 50.2000 | | 50.2000 | 0.1000 | 5.0200 | 100.0000 | 5020.0000 | (30) |
| Total net area of external elements Aum(A, m2) | | | 136.0400 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 23.9146 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall | | | 41.0400 | 0.0000 | 0.0000 | 20.0000 | 820.8000 | (32) |
| Internal Wall 1 | | | 87.0000 | | | 9.0000 | 783.0000 | (32c) |

| | | |
|---|---|---|
| Heat capacity Cm = Sum(A x k) | (28)...(30) + (32) + (32a)...(32e) = 12528.4200 | (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | 249.5701 | (35) |
| List of Thermal Bridges | | |

| | Length | Psi-value | Total | |
|---|---|---|---|---|
| K1 Element | | | | |
| E7 Party floor between dwellings (in blocks of flats) | 2.7000 | 0.0700 | 0.1890 | |
| E7 Party floor between dwellings (in blocks of flats) | 6.6000 | 0.1000 | 0.6600 | |
| E23 Balcony within or between dwellings, balcony support penetrates wall insulation | 3.9000 | 0.1500 | 0.5850 | |
| E18 Party wall between dwellings | 5.4000 | 0.0600 | 0.3240 | |
| E18 Party wall between dwellings | 5.4000 | 0.0900 | 0.4860 | |
| P3 Party wall - Intermediate floor between dwellings (in blocks of flats) | 15.2000 | 0.0000 | 0.0000 | |
| E2 Other lintels (including other steel lintels) | 4.3300 | 0.1000 | 0.4330 | |
| E3 Sill | 3.5000 | 0.0500 | 0.1675 | |
| E4 Jamb | 11.7000 | 0.0500 | 0.5850 | |
| P1 Party wall - Ground floor | 15.2000 | 0.0500 | 0.7600 | |
| E5 Ground floor (normal) | 6.6000 | 0.2000 | 1.3200 | |
| E5 Ground floor (normal) | 6.6000 | 0.2000 | 1.3200 | |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) | | | 6.8295 | (36) |
| Point Thermal bridges | | (36a) = | 0.0000 | |
| Total fabric heat loss | | (33) + (36) + (36a) = | 30.7441 | (37) |

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 12.1831 | 12.0627 | 11.9424 | 11.3406 | 11.2202 | 10.6184 | 10.6184 | 10.4980 | 10.8591 | 11.2202 | 11.4609 | 11.7016 | (38) |
| Heat transfer coeff | 42.9272 | 42.8068 | 42.6865 | 42.0846 | 41.9643 | 41.3625 | 41.3625 | 41.2421 | 41.6032 | 41.9643 | 42.2050 | 42.4457 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 42.0546 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 0.8551 | 0.8527 | 0.8503 | 0.8383 | 0.8359 | 0.8240 | 0.8240 | 0.8216 | 0.8287 | 0.8359 | 0.8407 | 0.8455 | (40) |
| HLP (average) | | | | | | | | | | | | 0.8377 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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4. Water heating energy requirements (kWh/year)

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| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Assumed occupancy | | | | | | | | | | | 1.6960 | (42) |
| Hot water usage for mixer showers | 52.6557 | 51.8644 | 50.7113 | 48.5050 | 46.8769 | 45.0612 | 44.0291 | 45.1735 | 46.4279 | 48.3774 | 50.6311 | 52.4539 | (42a) |
| Hot water usage for baths | 22.7669 | 22.4288 | 21.9526 | 21.0747 | 20.4173 | 19.6884 | 19.2947 | 19.7675 | 20.2823 | 21.0623 | 21.9583 | 22.6899 | (42b) |
| Hot water usage for other uses | 31.9986 | 30.8351 | 29.6715 | 28.5079 | 27.3443 | 26.1807 | 26.1807 | 27.3443 | 28.5079 | 29.6715 | 30.8351 | 31.9986 | (42c) |
| Average daily hot water use (litres/day) | | | | | | | | | | | | 98.7449 | (43) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 107.4212 | 105.1282 | 102.3354 | 98.0876 | 94.6385 | 90.9303 | 89.5045 | 92.2853 | 95.2181 | 99.1112 | 103.4244 | 107.1425 | (44) |
| Energy conte | 170.1289 | 149.7011 | 157.2856 | 134.2770 | 127.4016 | 111.8094 | 108.2479 | 114.2684 | 117.4134 | 134.4929 | 147.3470 | 167.7593 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1640.1327 | |
| Distribution loss (46)m = 0.15 x (45)m | 25.5193 | 22.4552 | 23.5928 | 20.1416 | 19.1102 | 16.7714 | 16.2372 | 17.1403 | 17.6120 | 20.1739 | 22.1021 | 25.1639 | (46) |
| Water storage loss (or HIU loss): | | | | | | | | | | | | | |
| Store volume | | | | | | | | | | | | 180.0000 | (47) |
| a) If manufacturer declared loss factor is known (kWh/day): | | | | | | | | | | | | 0.8400 | (48) |
| Temperature factor from Table 2b | | | | | | | | | | | | 0.5400 | (49) |
| Enter (49) or (54) in (55) | | | | | | | | | | | | 0.4536 | (55) |
| Total storage loss | 14.0616 | 12.7008 | 14.0616 | 13.6080 | 14.0616 | 13.6080 | 14.0616 | 14.0616 | 13.6080 | 14.0616 | 13.6080 | 14.0616 | (56) |
| If cylinder contains dedicated solar storage | 14.0616 | 12.7008 | 14.0616 | 13.6080 | 14.0616 | 13.6080 | 14.0616 | 14.0616 | 13.6080 | 14.0616 | 13.6080 | 14.0616 | (57) |
| Primary 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 | (59) |
| Combi loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |
| Total heat required for water heating calculated for each month | 184.1905 | 162.4019 | 171.3472 | 147.8850 | 141.4632 | 125.4174 | 122.3095 | 128.3300 | 131.0214 | 148.5545 | 160.9550 | 181.8209 | (62) |
| WWHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63a) |
| PV diverter | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |
| Output from w/h | 184.1905 | 162.4019 | 171.3472 | 147.8850 | 141.4632 | 125.4174 | 122.3095 | 128.3300 | 131.0214 | 148.5545 | 160.9550 | 181.8209 | (64) |
| | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 1805.6967 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 1806 | (64) |
| Electric shower(s) | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |
| | | | | | | | | | | Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | | 0.0000 | (64a) |
| Heat gains from water heating, kWh/month | 56.5679 | 49.7756 | 52.2975 | 44.6471 | 42.3610 | 37.1766 | 35.9924 | 37.9943 | 39.0400 | 44.7189 | 48.9929 | 55.7800 | (65) |

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

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| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Metabolic gains (Table 5), Watts | | | | | | | | | | | | | |
| (66)m | 84.7995 | 84.7995 | 84.7995 | 84.7995 | 84.7995 | 84.7995 | 84.7995 | 84.7995 | 84.7995 | 84.7995 | 84.7995 | 84.7995 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 84.4943 | 93.5473 | 84.4943 | 87.3108 | 84.4943 | 87.3108 | 84.4943 | 84.4943 | 87.3108 | 84.4943 | 87.3108 | 84.4943 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 147.7534 | 149.2866 | 145.4229 | 137.1977 | 126.8147 | 117.0562 | 110.5370 | 109.0038 | 112.8674 | 121.0927 | 131.4756 | 141.2341 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 31.4800 | 31.4800 | 31.4800 | 31.4800 | 31.4800 | 31.4800 | 31.4800 | 31.4800 | 31.4800 | 31.4800 | 31.4800 | 31.4800 | (69) |
| Pumps, fans | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | -67.8396 | -67.8396 | -67.8396 | -67.8396 | -67.8396 | -67.8396 | -67.8396 | -67.8396 | -67.8396 | -67.8396 | -67.8396 | -67.8396 | (71) |
| Water heating gains (Table 5) | 76.0321 | 74.0709 | 70.2923 | 62.0099 | 56.9369 | 51.6342 | 48.3769 | 51.0675 | 54.2222 | 60.1060 | 68.0457 | 74.9731 | (72) |
| Total internal gains | 356.7196 | 365.3446 | 348.6494 | 334.9582 | 316.6858 | 304.4411 | 291.8481 | 293.0055 | 302.8403 | 314.1329 | 335.2720 | 349.1413 | (73) |

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6. Solar gains

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| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| West | 6.2500 | 19.6403 | 0.4500 | 0.7000 | 0.7700 | 26.7961 | (80) |

---

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 26.7961 | 52.4188 | 86.3263 | 125.9018 | 154.2973 | 157.9508 | 150.3756 | 129.1704 | 100.4011 | 62.1993 | 33.4116 | 22.0358 | (83) |
| Total gains | 383.5157 | 417.7634 | 434.9757 | 460.8600 | 470.9831 | 462.3919 | 442.2237 | 422.1759 | 403.2413 | 376.3322 | 368.6835 | 371.1771 | (84) |

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7. Mean internal temperature (heating season)

---

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

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| tau | 81.0702 | 81.2982 | 81.5274 | 82.6933 | 82.9304 | 84.1371 | 84.1371 | 84.3826 | 83.6502 | 82.9304 | 82.4574 | 81.9898 | |
| alpha | 6.4047 | 6.4199 | 6.4352 | 6.5129 | 6.5287 | 6.6091 | 6.6091 | 6.6255 | 6.5767 | 6.5287 | 6.4972 | 6.4660 | |
| util living area | 0.9915 | 0.9838 | 0.9669 | 0.9060 | 0.7737 | 0.5663 | 0.4109 | 0.4481 | 0.6881 | 0.9221 | 0.9813 | 0.9929 | (86) |
| Living | 20.3809 | 20.4799 | 20.6152 | 20.7964 | 20.9084 | 20.9481 | 20.9525 | 20.9522 | 20.9364 | 20.8003 | 20.5700 | 20.3669 | |
| Non living | 19.4835 | 19.6100 | 19.7804 | 20.0053 | 20.1256 | 20.1695 | 20.1721 | 20.1742 | 20.1575 | 20.0156 | 19.7333 | 19.4727 | |
| 24 / 16 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 24 / 9 | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |
| 16 / 9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| MIT | 21.0000 | 21.0000 | 21.0000 | 21.0000 | 21.0000 | 21.0000 | 21.0000 | 21.0000 | 21.0000 | 21.0000 | 21.0000 | 21.0000 | (87) |
| Th 2 | 20.2058 | 20.2079 | 20.2099 | 20.2202 | 20.2223 | 20.2326 | 20.2326 | 20.2347 | 20.2285 | 20.2223 | 20.2182 | 20.2140 | (88) |
| util rest of house | 0.9889 | 0.9791 | 0.9573 | 0.8808 | 0.7247 | 0.5011 | 0.3396 | 0.3743 | 0.6205 | 0.8957 | 0.9750 | 0.9908 | (89) |
| MIT 2 | 20.2058 | 20.2079 | 20.2099 | 20.2202 | 20.2223 | 20.2326 | 20.2326 | 20.2347 | 20.2285 | 20.2223 | 20.2182 | 20.2140 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.5727 | (91) |
| MIT | 20.6607 | 20.6615 | 20.6624 | 20.6668 | 20.6677 | 20.6721 | 20.6721 | 20.6730 | 20.6703 | 20.6677 | 20.6659 | 20.6642 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 20.6607 | 20.6615 | 20.6624 | 20.6668 | 20.6677 | 20.6721 | 20.6721 | 20.6730 | 20.6703 | 20.6677 | 20.6659 | 20.6642 | (93) |

---

8. Space heating requirement

---

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9905 | 0.9819 | 0.9631 | 0.8959 | 0.7535 | 0.5387 | 0.3805 | 0.4167 | 0.6600 | 0.9117 | 0.9788 | 0.9921 | (94) |
| Useful gains | 379.8607 | 410.2173 | 418.9178 | 412.8924 | 354.8842 | 249.1059 | 168.2554 | 175.9123 | 266.1408 | 343.1077 | 360.8760 | 368.2415 | (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 | 702.3166 | 674.7009 | 604.5430 | 495.2020 | 376.3228 | 251.1573 | 168.4324 | 176.2271 | 273.3471 | 422.4835 | 572.5501 | 698.8337 | (97) |
| Space heating kWh | 239.9072 | 177.7330 | 138.1052 | 59.2629 | 15.9503 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 59.0556 | 152.4054 | 245.9605 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 1088.3801 | |
| Solar heating kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | 239.9072 | 177.7330 | 138.1052 | 59.2629 | 15.9503 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 59.0556 | 152.4054 | 245.9605 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 1088.3801 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 21.6809 | (99) |

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

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| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | | | | | | | | | | | | 0.0000 | (201) |
| Fraction of space heat from main system(s) | | | | | | | | | | | | 1.0000 | (202) |
| Efficiency of main space heating system 1 (in %) | | | | | | | | | | | | 300.7908 | (206) |
| Efficiency of main space heating system 2 (in %) | | | | | | | | | | | | 0.0000 | (207) |
| Efficiency of secondary/supplementary heating system, % | | | | | | | | | | | | 0.0000 | (208) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement | 239.9072 | 177.7330 | 138.1052 | 59.2629 | 15.9503 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 59.0556 | 152.4054 | 245.9605 | (98) |
| Space heating efficiency (main heating system 1) | 300.7908 | 300.7908 | 300.7908 | 300.7908 | 300.7908 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 300.7908 | 300.7908 | 300.7908 | (210) |
| Space heating fuel (main heating system) | 79.7588 | 59.0886 | 45.9140 | 19.7024 | 5.3028 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 19.6334 | 50.6682 | 81.7713 | (211) |
| Space heating efficiency (main heating system 2) | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (212) |
| Space heating fuel (main heating system 2) | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (213) |
| Space heating fuel (secondary) | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (215) |
| Water heating | | | | | | | | | | | | | |
| Water heating requirement | 184.1905 | 162.4019 | 171.3472 | 147.8850 | 141.4632 | 125.4174 | 122.3095 | 128.3300 | 131.0214 | 148.5545 | 160.9550 | 181.8209 | (64) |
| Efficiency of water heater | | | | | | | | | | | | 194.1800 | (216) |
| (217)m | 194.1800 | 194.1800 | 194.1800 | 194.1800 | 194.1800 | 194.1800 | 194.1800 | 194.1800 | 194.1800 | 194.1800 | 194.1800 | 194.1800 | (217) |
| Fuel for water heating, kWh/month | 94.8556 | 83.6347 | 88.2414 | 76.1587 | 72.8516 | 64.5882 | 62.9877 | 66.0882 | 67.4742 | 76.5035 | 82.8896 | 93.6352 | (219) |
| Space cooling fuel requirement | | | | | | | | | | | | | |
| (221)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (221) |
| Pumps and Fa | 7.4766 | 6.7530 | 7.4766 | 7.2354 | 7.4766 | 7.2354 | 7.4766 | 7.4766 | 7.2354 | 7.4766 | 7.2354 | 7.4766 | (231) |
| Lighting | 18.0301 | 14.4644 | 13.0236 | 9.5416 | 7.3702 | 6.0216 | 6.7234 | 8.7393 | 11.3515 | 14.8938 | 16.8225 | 18.5312 | (232) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (233a)m | -28.1034 | -45.1204 | -73.2674 | -87.1719 | -95.0392 | -88.3356 | -86.7326 | -80.8234 | -68.4760 | -53.1418 | -32.1323 | -23.4072 | (233a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (234a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (234a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (235a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235a) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | | |
| (235c)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235c) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (233b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (233b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (234b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (234b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (235b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235b) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | | |
| (235d)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235d) |
| Annual totals kWh/year | | | | | | | | | | | | | |
| Space heating fuel - main system 1 | | | | | | | | | | | | 361.8395 | (211) |
| Space heating fuel - main system 2 | | | | | | | | | | | | 0.0000 | (213) |
| Space heating fuel - secondary | | | | | | | | | | | | 0.0000 | (215) |
| Efficiency of water heater | | | | | | | | | | | | 194.1800 | |

| | | |
|---|---|---|
| Water heating fuel used | 929.9087 | (219) |
| Space cooling fuel | 0.0000 | (221) |
| Electricity for pumps and fans: | | |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.9500) | | |
| mechanical ventilation fans (SFP = 0.9500) | 88.0308 | (230a) |
| Total electricity for the above, kWh/year | 88.0308 | (231) |
| Electricity for lighting (calculated in Appendix L) | 145.5132 | (232) |
| Energy saving/generation technologies (Appendices M ,N and Q) | | |
| PV generation | -761.7512 | (233) |
| Wind generation | 0.0000 | (234) |
| Hydro-electric generation (Appendix N) | 0.0000 | (235a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 | (235) |
| Appendix Q - special features | | |
| Energy saved or generated | -0.0000 | (236) |
| Energy used | 0.0000 | (237) |
| Total delivered energy for all uses | 763.5410 | (238) |

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

| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 361.8395 | 0.1566 | 56.6469 | (261) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 929.9087 | 0.1413 | 131.4104 | (264) |
| Space and water heating | | | 188.0572 | (265) |
| Pumps, fans and electric keep-hot | 88.0308 | 0.1387 | 12.2110 | (267) |
| Energy for lighting | 145.5132 | 0.1443 | 21.0021 | (268) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -761.7512 | 0.1333 | -101.5493 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -101.5493 | (269) |
| Total CO2, kg/year | | | 119.7209 | (272) |
| EPC Dwelling Carbon Dioxide Emission Rate (DER) | | | 2.3800 | (273) |

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

| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 361.8395 | 1.5796 | 571.5557 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 929.9087 | 1.5226 | 1415.8357 | (278) |
| Space and water heating | | | 1987.3914 | (279) |
| Pumps, fans and electric keep-hot | 88.0308 | 1.5128 | 133.1730 | (281) |
| Energy for lighting | 145.5132 | 1.5338 | 223.1930 | (282) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -761.7512 | 1.4926 | -1137.0203 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -1137.0203 | (283) |
| Total Primary energy kWh/year | | | 1206.7371 | (286) |
| Dwelling Primary energy Rate (DPER) | | | 24.0400 | (287) |

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF TARGET EMISSIONS

1. Overall dwelling characteristics

| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 50.2000 | (1b) x | 2.5000 | (2b) = | 125.5000 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 50.2000 | | | | | | (4) |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | | 125.5000 | (5) |

2. Ventilation rate

| | | m3 per hour | |
|---|---|---|---|
| Number of open chimneys | 0 * 80 = | 0.0000 | (6a) |
| Number of open flues | 0 * 20 = | 0.0000 | (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 | (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 | (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 | (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 | (6f) |
| Number of intermittent extract fans | 2 * 10 = | 20.0000 | (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 | (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 | (7c) |
| | Air changes per hour | | |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 20.0000 / (5) = | 0.1594 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 5.0000 | (17) |
| Infiltration rate | | 0.4094 | (18) |
| Number of sides sheltered | | 3 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 0.7750 | (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.3173 | (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | | | | | | | | | | | | | |
| | 0.4045 | 0.3966 | 0.3886 | 0.3490 | 0.3411 | 0.3014 | 0.3014 | 0.2935 | 0.3173 | 0.3411 | 0.3569 | 0.3728 | (22b) |
| Effective ac | 0.5818 | 0.5786 | 0.5755 | 0.5609 | 0.5582 | 0.5454 | 0.5454 | 0.5431 | 0.5503 | 0.5582 | 0.5637 | 0.5695 | (25) |

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3. Heat losses and heat loss parameter

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| Element | Gross | Openings | NetArea | U-value | A x U | K-value | A x K | |
|---|---|---|---|---|---|---|---|---|
| | m2 | m2 | m2 | W/m2K | W/K | kJ/m2K | kJ/K | |
| Main dwelling | | | | | | | | |
| TER Opaque door | | | 2.0600 | 1.0000 | 2.0600 | | | (26) |
| TER Opening Type | | | 6.2500 | 1.1450 | 7.1565 | | | (27) |
| Heatloss Floor 1 | | | 50.2000 | 0.1300 | 6.5260 | | | (28a) |
| External Wall 1 | 17.8200 | 8.3100 | 9.5100 | 0.1800 | 1.7118 | | | (29a) |
| Corridor | 17.8200 | | 17.8200 | 0.1800 | 3.2076 | | | (29a) |
| Main Roof | 50.2000 | | 50.2000 | 0.1100 | 5.5220 | | | (30) |
| Total net area of external elements Aum(A, m2) | | | 136.0400 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | | (26)...(30) + (32) = | 26.1839 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall | | | 41.0400 | 0.0000 | 0.0000 | | | (32) |

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 249.5701 (35)

List of Thermal Bridges

| K1 Element | Length | Psi-value | Total |
|---|---|---|---|
| E7 Party floor between dwellings (in blocks of flats) | 2.7000 | 0.0700 | 0.1890 |
| E7 Party floor between dwellings (in blocks of flats) | 6.6000 | 0.0700 | 0.4620 |
| E23 Balcony within or between dwellings, balcony support penetrates wall insulation | 3.9000 | 0.0200 | 0.0780 |
| E18 Party wall between dwellings | 5.4000 | 0.0600 | 0.3240 |
| E18 Party wall between dwellings | 5.4000 | 0.0600 | 0.3240 |
| P3 Party wall - Intermediate floor between dwellings (in blocks of flats) | 15.2000 | 0.0000 | 0.0000 |
| E2 Other lintels (including other steel lintels) | 4.3300 | 0.0500 | 0.2165 |
| E3 Sill | 3.3500 | 0.0500 | 0.1675 |
| E4 Jamb | 11.7000 | 0.0500 | 0.5850 |
| P1 Party wall - Ground floor | 15.2000 | 0.0800 | 1.2160 |
| E5 Ground floor (normal) | 6.6000 | 0.1600 | 1.0560 |
| E5 Ground floor (normal) | 6.6000 | 0.1600 | 1.0560 |

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 5.6740 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 31.8579 (37)

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 24.0957 | 23.9641 | 23.8352 | 23.2294 | 23.1161 | 22.5885 | 22.5885 | 22.4908 | 22.7917 | 23.1161 | 23.3454 | 23.5851 | (38) |
| Heat transfer coeff | | | | | | | | | | | | | |
| | 55.9536 | 55.8220 | 55.6930 | 55.0873 | 54.9740 | 54.4464 | 54.4464 | 54.3487 | 54.6496 | 54.9740 | 55.2033 | 55.4429 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 55.0868 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.1146 | 1.1120 | 1.1094 | 1.0974 | 1.0951 | 1.0846 | 1.0846 | 1.0826 | 1.0886 | 1.0951 | 1.0997 | 1.1044 | (40) |
| HLP (average) | | | | | | | | | | | | 1.0973 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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4. Water heating energy requirements (kWh/year)

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Assumed occupancy 1.6960 (42)

Hot water usage for mixer showers

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 52.6557 | 51.8644 | 50.7113 | 48.5050 | 46.8769 | 45.0612 | 44.0291 | 45.1735 | 46.4279 | 48.3774 | 50.6311 | 52.4539 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 22.7669 | 22.4288 | 21.9526 | 21.0747 | 20.4173 | 19.6884 | 19.2947 | 19.7675 | 20.2823 | 21.0623 | 21.9583 | 22.6899 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 31.9986 | 30.8351 | 29.6715 | 28.5079 | 27.3443 | 26.1807 | 26.1807 | 27.3443 | 28.5079 | 29.6715 | 30.8351 | 31.9986 | (42c) |

Average daily hot water use (litres/day) 98.7449 (43)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | | | | | | | | | | | | | |
| | 107.4212 | 105.1282 | 102.3354 | 98.0876 | 94.6385 | 90.9303 | 89.5045 | 92.2853 | 95.2181 | 99.1112 | 103.4244 | 107.1425 | (44) |
| Energy conte | 170.1289 | 149.7011 | 157.2856 | 134.2770 | 127.4016 | 111.8094 | 108.2479 | 114.2684 | 117.4134 | 134.4929 | 147.3470 | 167.7593 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1640.1327 | |
| Distribution loss (46)m = 0.15 x (45)m | | | | | | | | | | | | | |
| | 25.5193 | 22.4552 | 23.5928 | 20.1416 | 19.1102 | 16.7714 | 16.2372 | 17.1403 | 17.6120 | 20.1739 | 22.1021 | 25.1639 | (46) |
| Water storage loss (or HIU loss): | | | | | | | | | | | | | |
| Store volume | | | | | | | | | | | | 150.0000 | (47) |
| a) If manufacturer declared loss factor is known (kWh/day): | | | | | | | | | | | | 1.3938 | (48) |
| Temperature factor from Table 2b | | | | | | | | | | | | 0.5400 | (49) |
| Enter (49) or (54) in (55) | | | | | | | | | | | | 0.7527 | (55) |
| Total storage loss | | | | | | | | | | | | | |
| | 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (56) |
| If cylinder contains dedicated solar storage | | | | | | | | | | | | | |
| | 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (57) |
| Primary loss | 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |
| Total heat required for water heating calculated for each month | | | | | | | | | | | | | |
| | 216.7238 | 191.7869 | 203.8805 | 179.3689 | 173.9965 | 156.9012 | 154.8428 | 160.8633 | 162.5053 | 181.0878 | 192.4389 | 214.3542 | (62) |
| WWHRS | -24.0720 | -21.2895 | -22.2931 | -18.4596 | -17.2036 | -14.7213 | -13.7989 | -14.6737 | -15.2312 | -17.9559 | -20.3419 | -23.6262 | (63a) |
| PV diverter | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |
| Output from w/h | | | | | | | | | | | | | |
| | 192.6519 | 170.4974 | 181.5874 | 160.9093 | 156.7928 | 142.1799 | 141.0440 | 146.1896 | 147.2741 | 163.1319 | 172.0970 | 190.7280 | (64) |
| | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 1965.0834 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 1965 | (64) |
| Electric shower(s) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |
| | | | | | | | | | | Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | | 0.0000 | (64a) |
| Heat gains from water heating, kWh/month | | | | | | | | | | | | | |
| | 93.8438 | 83.4442 | 89.5734 | 80.7206 | 79.6370 | 73.2501 | 73.2684 | 75.2702 | 75.1134 | 81.9948 | 85.0664 | 93.0559 | (65) |

---

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

Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 84.7995 | 84.7995 | 84.7995 | 84.7995 | 84.7995 | 84.7995 | 84.7995 | 84.7995 | 84.7995 | 84.7995 | 84.7995 | 84.7995 | (66) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 82.0470 | 90.8377 | 82.0470 | 84.7819 | 82.0470 | 84.7819 | 82.0470 | 82.0470 | 84.7819 | 82.0470 | 84.7819 | 82.0470 | (67) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 147.7534 | 149.2866 | 145.4229 | 137.1977 | 126.8147 | 117.0562 | 110.5370 | 109.0038 | 112.8674 | 121.0927 | 131.4756 | 141.2341 | (68) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 31.4800 | 31.4800 | 31.4800 | 31.4800 | 31.4800 | 31.4800 | 31.4800 | 31.4800 | 31.4800 | 31.4800 | 31.4800 | 31.4800 | (69) |
| Pumps, fans | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 3.0000 | 3.0000 | 3.0000 | (70) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | -67.8396 | -67.8396 | -67.8396 | -67.8396 | -67.8396 | -67.8396 | -67.8396 | -67.8396 | -67.8396 | -67.8396 | -67.8396 | -67.8396 | (71) |

Water heating gains (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 126.1341 | 124.1729 | 120.3943 | 112.1119 | 107.0389 | 101.7362 | 98.4790 | 101.1696 | 104.3242 | 110.2081 | 118.1477 | 125.0751 | (72) |

Total internal gains

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 407.3744 | 415.7371 | 399.3041 | 385.5313 | 367.3405 | 352.0142 | 339.5028 | 340.6602 | 350.4134 | 364.7876 | 385.8451 | 399.7961 | (73) |

## 6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| West | 6.2500 | 19.6403 | 0.6300 | 0.7000 | 0.7700 | 37.5145 | (80) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 37.5145 | 73.3863 | 120.8568 | 176.2625 | 216.0163 | 221.1311 | 210.5258 | 180.8386 | 140.5615 | 87.0791 | 46.7762 | 30.8501 | (83) |
| Total gains | 444.8889 | 489.1234 | 520.1609 | 561.7938 | 583.3568 | 573.1453 | 550.0286 | 521.4988 | 490.9749 | 451.8667 | 432.6213 | 430.6462 | (84) |

## 7. Mean internal temperature (heating season)

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

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| tau | 62.1965 | 62.3431 | 62.4875 | 63.1746 | 63.3048 | 63.9182 | 63.9182 | 64.0331 | 63.6805 | 63.3048 | 63.0419 | 62.7693 | |
| alpha | 5.1464 | 5.1562 | 5.1658 | 5.2116 | 5.2203 | 5.2612 | 5.2612 | 5.2689 | 5.2454 | 5.2203 | 5.2028 | 5.1846 | |
| util living area | 0.9884 | 0.9797 | 0.9607 | 0.9015 | 0.7792 | 0.5898 | 0.4324 | 0.4742 | 0.7128 | 0.9201 | 0.9772 | 0.9901 | (86) |
| MIT | 19.9353 | 20.0967 | 20.3369 | 20.6543 | 20.8776 | 20.9774 | 20.9963 | 20.9941 | 20.9413 | 20.6631 | 20.2564 | 19.9109 | (87) |
| Th 2 | 19.9889 | 19.9911 | 19.9931 | 20.0030 | 20.0048 | 20.0134 | 20.0134 | 20.0150 | 20.0101 | 20.0048 | 20.0011 | 19.9972 | (88) |
| util rest of house | 0.9848 | 0.9737 | 0.9487 | 0.8724 | 0.7221 | 0.5066 | 0.3371 | 0.3754 | 0.6308 | 0.8900 | 0.9693 | 0.9870 | (89) |
| MIT 2 | 18.7746 | 18.9793 | 19.2799 | 19.6664 | 19.9070 | 20.0012 | 20.0123 | 20.0130 | 19.9733 | 19.6866 | 19.1901 | 18.7500 | (90) |
| Living area fraction | | | | | | | | | fLA = Living area / (4) = | | | 0.5727 | (91) |
| MIT | 19.4393 | 19.6192 | 19.8852 | 20.2322 | 20.4629 | 20.5603 | 20.5758 | 20.5749 | 20.5277 | 20.2459 | 19.8008 | 19.4149 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 19.4393 | 19.6192 | 19.8852 | 20.2322 | 20.4629 | 20.5603 | 20.5758 | 20.5749 | 20.5277 | 20.2459 | 19.8008 | 19.4149 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9824 | 0.9709 | 0.9472 | 0.8798 | 0.7497 | 0.5535 | 0.3918 | 0.4320 | 0.6754 | 0.8983 | 0.9673 | 0.9848 | (94) |
| Useful gains | 437.0586 | 474.8932 | 492.6754 | 494.2596 | 437.3369 | 317.2502 | 215.4959 | 225.2936 | 331.5799 | 405.8932 | 418.4764 | 424.0873 | (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 | 847.1002 | 821.6569 | 745.4650 | 624.2589 | 481.7294 | 324.5176 | 216.4702 | 226.9002 | 351.2725 | 530.2713 | 701.1244 | 843.5571 | (97) |
| Space heating kWh | 305.0709 | 233.0252 | 188.0755 | 93.5995 | 33.0281 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 92.5373 | 203.5066 | 312.0855 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 1460.9286 | |
| Solar heating kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | 305.0709 | 233.0252 | 188.0755 | 93.5995 | 33.0281 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 92.5373 | 203.5066 | 312.0855 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 1460.9286 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 29.1022 | (99) |

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

| | |
|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | 0.0000 (201) |
| Fraction of space heat from main system(s) | 1.0000 (202) |
| Efficiency of main space heating system 1 (in %) | 92.3000 (206) |
| Efficiency of main space heating system 2 (in %) | 0.0000 (207) |
| Efficiency of secondary/supplementary heating system, % | 0.0000 (208) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement | 305.0709 | 233.0252 | 188.0755 | 93.5995 | 33.0281 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 92.5373 | 203.5066 | 312.0855 | (98) |
| Space heating efficiency (main heating system 1) | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 92.3000 | 92.3000 | 92.3000 | (210) |
| Space heating fuel (main heating system) | 330.5211 | 252.4651 | 203.7654 | 101.4079 | 35.7834 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 100.2571 | 220.4838 | 338.1208 | (211) |
| Space heating efficiency (main heating system 2) | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (212) |
| Space heating fuel (main heating system 2) | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (213) |
| Space heating fuel (secondary) | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (215) |
| Water heating | | | | | | | | | | | | | |
| Water heating requirement | 192.6519 | 170.4974 | 181.5874 | 160.9093 | 156.7928 | 142.1799 | 141.0440 | 146.1896 | 147.2741 | 163.1319 | 172.0970 | 190.7280 | (64) |
| Efficiency of water heater | | | | | | | | | | | | 79.8000 | (216) |
| (217)m | 85.0857 | 84.7609 | 84.1386 | 82.8896 | 81.2325 | 79.8000 | 79.8000 | 79.8000 | 79.8000 | 82.8388 | 84.4367 | 85.1569 | (217) |
| Fuel for water heating, kWh/month | 226.4211 | 201.1510 | 215.8194 | 194.1249 | 193.0174 | 178.1703 | 176.7468 | 183.1950 | 184.5540 | 196.9270 | 203.8177 | 223.9723 | (219) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space cooling fuel requirement | | | | | | | | | | | | | |
| (221)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (221) |
| Pumps and Fa | 7.3041 | 6.5973 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 | (231) |
| Lighting | 17.0477 | 13.6763 | 12.3140 | 9.0218 | 6.9687 | 5.6935 | 6.3571 | 8.2632 | 10.7330 | 14.0823 | 15.9059 | 17.5216 | (232) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (233a)m | -7.4431 | -11.4422 | -17.9162 | -22.0059 | -25.4253 | -24.3737 | -24.0906 | -21.8926 | -18.3353 | -13.8734 | -8.5162 | -6.3301 | (233a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (234a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (234a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (235a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235a) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | | |
| (235c)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235c) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (233b)m | -1.7447 | -3.8126 | -7.8514 | -12.2056 | -16.5504 | -16.7735 | -16.5644 | -13.8234 | -9.8808 | -5.5708 | -2.3669 | -1.3686 | (233b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (234b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (234b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (235b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235b) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | | |
| (235d)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235d) |

| | | |
|---|---|---|
| Annual totals kWh/year | | |
| Space heating fuel - main system 1 | 1582.8046 | (211) |
| Space heating fuel - main system 2 | 0.0000 | (213) |
| Space heating fuel - secondary | 0.0000 | (215) |
| Efficiency of water heater | 79.8000 | |
| Water heating fuel used | 2377.9169 | (219) |
| Space cooling fuel | 0.0000 | (221) |
| | | |
| Electricity for pumps and fans: | | |
| Total electricity for the above, kWh/year | 86.0000 | (231) |
| Electricity for lighting (calculated in Appendix L) | 137.5851 | (232) |
| | | |
| Energy saving/generation technologies (Appendices M ,N and Q) | | |
| PV generation | -310.1576 | (233) |
| Wind generation | 0.0000 | (234) |
| Hydro-electric generation (Appendix N) | 0.0000 | (235a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 | (235) |
| Appendix Q - special features | | |
| Energy saved or generated | -0.0000 | (236) |
| Energy used | 0.0000 | (237) |
| Total delivered energy for all uses | 3874.1490 | (238) |

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

| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 1582.8046 | 0.2100 | 332.3890 | (261) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 2377.9169 | 0.2100 | 499.3626 | (264) |
| Space and water heating | | | 831.7515 | (265) |
| Pumps, fans and electric keep-hot | 86.0000 | 0.1387 | 11.9293 | (267) |
| Energy for lighting | 137.5851 | 0.1443 | 19.8578 | (268) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -201.6446 | 0.1328 | -26.7805 | |
| PV Unit electricity exported | -108.5130 | 0.1249 | -13.5556 | |
| Total | | | -40.3360 | (269) |
| Total CO2, kg/year | | | 823.2025 | (272) |
| EPC Target Carbon Dioxide Emission Rate (TER) | | | 16.4000 | (273) |

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

| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 1582.8046 | 1.1300 | 1788.5692 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 2377.9169 | 1.1300 | 2687.0461 | (278) |
| Space and water heating | | | 4475.6153 | (279) |
| Pumps, fans and electric keep-hot | 86.0000 | 1.5128 | 130.1008 | (281) |
| Energy for lighting | 137.5851 | 1.5338 | 211.0326 | (282) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -201.6446 | 1.4907 | -300.6000 | |
| PV Unit electricity exported | -108.5130 | 0.4585 | -49.7532 | |
| Total | | | -350.3532 | (283) |
| Total Primary energy kWh/year | | | 4466.3955 | (286) |
| Target Primary Energy Rate (TPER) | | | 88.9700 | (287) |

# Full SAP Calculation Printout

| | | | |
|---|---|---|---|
| Plot Reference | 1B2P Mid MF W | Issued on Date | 16/01/2026 |
| Assessment Reference | 1B2P Mid MF W | Plot Type Ref | 1B2P Mid MF W |
| Plot Address | | SAP Version | 10.2 |

| | | | | | |
|---|---|---|---|---|---|
| SAP Rating | 87 B | DER | 1.86 | TER | 13.50 |
| Environmental | 99 A | % DER < TER | | | 86.22 |
| $CO_2$ Emissions (t/year) | 0.07 | DFEE | 23.68 | TFEE | 22.92 |
| Compliance Check | See BREL | % DFEE < TFEE | | | -3.32 |
| % DPER < TPER | 74.48 | DPER | 18.73 | TPER | 73.40 |

| | | | |
|---|---|---|---|
| Assessor Details | Miss Eleanor Risby | Assessor ID | M976-0001 |
| Client | | | |

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE

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## 1. Overall dwelling characteristics

| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 50.2000 | (1b) | x 2.5000 | (2b) = | 125.5000 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 50.2000 | | | | | (4) |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = | 125.5000 | (5) |

## 2. Ventilation rate

| | m3 per hour | | |
|---|---|---|---|
| Number of open chimneys | 0 * 80 = | 0.0000 | (6a) |
| Number of open flues | 0 * 20 = | 0.0000 | (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 | (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 | (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 | (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 | (6f) |
| Number of intermittent extract fans | 0 * 10 = | 0.0000 | (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 | (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 | (7c) |
| | Air changes per hour | | |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 0.0000 / (5) = | 0.0000 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 3.0000 | (17) |
| Infiltration rate | | 0.1500 | (18) |
| Number of sides sheltered | | 3 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 0.7750 | (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.1162 | (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.1482 | 0.1453 | 0.1424 | 0.1279 | 0.1250 | 0.1104 | 0.1104 | 0.1075 | 0.1162 | 0.1250 | 0.1308 | 0.1366 | (22b) |

Balanced mechanical ventilation with heat recovery

| | |
|---|---|
| If mechanical ventilation | 0.5000 (23a) |
| If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) | 0.6314 (23b) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = | 77.4000 (23c) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Effective ac | 0.2909 | 0.2880 | 0.2851 | 0.2706 | 0.2677 | 0.2531 | 0.2531 | 0.2502 | 0.2589 | 0.2677 | 0.2735 | 0.2793 | (25) |

## 3. Heat losses and heat loss parameter

| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | | |
| Glazing | | | 6.2500 | 1.1450 | 7.1565 | | | (27) |
| Corridor Door | | | 2.0600 | 1.0000 | 2.0600 | | | (26) |
| External Wall 1 | 17.8200 | 8.3100 | 9.5100 | 0.1900 | 1.8069 | 14.0000 | 133.1400 | (29a) |
| Corridor | 17.8200 | | 17.8200 | 0.1600 | 2.8512 | 14.0000 | 249.4800 | (29a) |
| Total net area of external elements Aum(A, m2) | | | 35.6400 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 13.8746 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall | | | 41.0400 | 0.0000 | 0.0000 | 20.0000 | 820.8000 | (32) |
| Party Floor 1 | | | 50.2000 | | | 40.0000 | 2008.0000 | (32d) |
| Party Ceiling 1 | | | 50.2000 | | | 30.0000 | 1506.0000 | (32b) |
| Internal Wall 1 | | | 87.0000 | | | 9.0000 | 783.0000 | (32c) |

| | |
|---|---|
| Heat capacity Cm = Sum(A x k) | (28)...(30) + (32) + (32a)...(32e) = 5500.4200 (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | 109.5701 (35) |
| List of Thermal Bridges | |

| K1 Element | Length | Psi-value | Total |
|---|---|---|---|
| E7 Party floor between dwellings (in blocks of flats) | 5.4000 | 0.0700 | 0.3780 |
| E7 Party floor between dwellings (in blocks of flats) | 13.2000 | 0.1000 | 1.3200 |
| E23 Balcony within or between dwellings, balcony support penetrates wall insulation | 7.8000 | 0.1500 | 1.1700 |
| E18 Party wall between dwellings | 5.4000 | 0.0600 | 0.3240 |
| E18 Party wall between dwellings | 5.4000 | 0.0900 | 0.4860 |
| P3 Party wall - Intermediate floor between dwellings (in blocks of flats) | 30.4000 | 0.0000 | 0.0000 |
| E2 Other lintels (including other steel lintels) | 4.3300 | 0.1000 | 0.4330 |
| E3 Sill | 3.5000 | 0.0500 | 0.1675 |
| E4 Jamb | 11.7000 | 0.0500 | 0.5850 |

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 4.8635 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 18.7381 (37)

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 12.0484 | 11.9280 | 11.8076 | 11.2058 | 11.0855 | 10.4836 | 10.4836 | 10.3633 | 10.7244 | 11.0855 | 11.3262 | 11.5669 | (38) |
| Heat transfer coeff | 30.7864 | 30.6661 | 30.5457 | 29.9439 | 29.8235 | 29.2217 | 29.2217 | 29.1014 | 29.4625 | 29.8235 | 30.0643 | 30.3050 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 29.9138 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 0.6133 | 0.6109 | 0.6085 | 0.5965 | 0.5941 | 0.5821 | 0.5821 | 0.5797 | 0.5869 | 0.5941 | 0.5989 | 0.6037 | (40) |
| HLP (average) | | | | | | | | | | | | 0.5959 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

## 4. Water heating energy requirements (kWh/year)

Assumed occupancy 1.6960 (42)

Hot water usage for mixer showers

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 52.6557 | 51.8644 | 50.7113 | 48.5050 | 46.8769 | 45.0612 | 44.0291 | 45.1735 | 46.4279 | 48.3774 | 50.6311 | 52.4539 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 22.7669 | 22.4288 | 21.9526 | 21.0747 | 20.4173 | 19.6884 | 19.2947 | 19.7675 | 20.2823 | 21.0623 | 21.9583 | 22.6899 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 31.9986 | 30.8351 | 29.6715 | 28.5079 | 27.3443 | 26.1807 | 26.1807 | 27.3443 | 28.5079 | 29.6715 | 30.8351 | 31.9986 | (42c) |

Average daily hot water use (litres/day) 98.7449 (43)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 107.4212 | 105.1282 | 102.3354 | 98.0876 | 94.6385 | 90.9303 | 89.5045 | 92.2853 | 95.2181 | 99.1112 | 103.4244 | 107.1425 | (44) |
| Energy conte | 170.1289 | 149.7011 | 157.2856 | 134.2770 | 127.4016 | 111.8094 | 108.2479 | 114.2684 | 117.4134 | 134.4929 | 147.3470 | 167.7593 | (45) |
| Energy content (annual) | | | | | | | | | | | Total = Sum(45)m = | 1640.1327 | |
| Distribution loss (46)m = 0.15 x (45)m | 25.5193 | 22.4552 | 23.5928 | 20.1416 | 19.1102 | 16.7714 | 16.2372 | 17.1403 | 17.6120 | 20.1739 | 22.1021 | 25.1639 | (46) |
| Water storage loss (or HIU loss): | | | | | | | | | | | | | |
| Store volume | | | | | | | | | | | | 180.0000 | (47) |
| a) If manufacturer declared loss factor is known (kWh/day): | | | | | | | | | | | | 0.8400 | (48) |
| Temperature factor from Table 2b | | | | | | | | | | | | 0.5400 | (49) |
| Enter (49) or (54) in (55) | | | | | | | | | | | | 0.4536 | (55) |
| Total storage loss | 14.0616 | 12.7008 | 14.0616 | 13.6080 | 14.0616 | 13.6080 | 14.0616 | 14.0616 | 13.6080 | 14.0616 | 13.6080 | 14.0616 | (56) |
| If cylinder contains dedicated solar storage | 14.0616 | 12.7008 | 14.0616 | 13.6080 | 14.0616 | 13.6080 | 14.0616 | 14.0616 | 13.6080 | 14.0616 | 13.6080 | 14.0616 | (57) |
| Primary 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 | (59) |
| Combi loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |
| Total heat required for water heating calculated for each month | 184.1905 | 162.4019 | 171.3472 | 147.8850 | 141.4632 | 125.4174 | 122.3095 | 128.3300 | 131.0214 | 148.5545 | 160.9550 | 181.8209 | (62) |
| WWHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63a) |
| PV diverter | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |
| Output from w/h | 184.1905 | 162.4019 | 171.3472 | 147.8850 | 141.4632 | 125.4174 | 122.3095 | 128.3300 | 131.0214 | 148.5545 | 160.9550 | 181.8209 | (64) |
| | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 1805.6967 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 1806 | (64) |
| Electric shower(s) | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |
| | | | | | | | | | | Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | | 0.0000 | (64a) |
| Heat gains from water heating, kWh/month | 56.5679 | 49.7756 | 52.2975 | 44.6471 | 42.3610 | 37.1766 | 35.9924 | 37.9943 | 39.0400 | 44.7189 | 48.9929 | 55.7800 | (65) |

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

Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 84.7995 | 84.7995 | 84.7995 | 84.7995 | 84.7995 | 84.7995 | 84.7995 | 84.7995 | 84.7995 | 84.7995 | 84.7995 | 84.7995 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 84.4943 | 93.5473 | 84.4943 | 87.3108 | 84.4943 | 87.3108 | 84.4943 | 84.4943 | 87.3108 | 84.4943 | 87.3108 | 84.4943 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 147.7534 | 149.2866 | 145.4229 | 137.1977 | 126.8147 | 117.0562 | 110.5370 | 109.0038 | 112.8674 | 121.0927 | 131.4756 | 141.2341 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 31.4800 | 31.4800 | 31.4800 | 31.4800 | 31.4800 | 31.4800 | 31.4800 | 31.4800 | 31.4800 | 31.4800 | 31.4800 | 31.4800 | (69) |
| Pumps, fans | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | -67.8396 | -67.8396 | -67.8396 | -67.8396 | -67.8396 | -67.8396 | -67.8396 | -67.8396 | -67.8396 | -67.8396 | -67.8396 | -67.8396 | (71) |
| Water heating gains (Table 5) | 76.0321 | 74.0709 | 70.2923 | 62.0099 | 56.9369 | 51.6342 | 48.3769 | 51.0675 | 54.2222 | 60.1060 | 68.0457 | 74.9731 | (72) |
| Total internal gains | 356.7196 | 365.3446 | 348.6494 | 334.9582 | 316.6858 | 304.4411 | 291.8481 | 293.0055 | 302.8403 | 314.1329 | 335.2720 | 349.1413 | (73) |

## 6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| West | 6.2500 | 19.6403 | 0.4500 | 0.7000 | 0.7700 | 26.7961 | (80) |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 26.7961 | 52.4188 | 86.3263 | 125.9018 | 154.2973 | 157.9508 | 150.3756 | 129.1704 | 100.4011 | 62.1993 | 33.4116 | 22.0358 | (83) |
| Total gains | 383.5157 | 417.7634 | 434.9757 | 460.8600 | 470.9831 | 462.3919 | 442.2237 | 422.1759 | 403.2413 | 376.3322 | 368.6835 | 371.1771 | (84) |

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7. Mean internal temperature (heating season)

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

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| tau | 49.6288 | 49.8236 | 50.0199 | 51.0252 | 51.2312 | 52.2862 | 52.2862 | 52.5025 | 51.8590 | 51.2312 | 50.8209 | 50.4173 | |
| alpha | 4.3086 | 4.3216 | 4.3347 | 4.4017 | 4.4154 | 4.4857 | 4.4857 | 4.5002 | 4.4573 | 4.4154 | 4.3881 | 4.3612 | |
| util living area | 0.9089 | 0.8731 | 0.8198 | 0.7060 | 0.5641 | 0.4003 | 0.2899 | 0.3159 | 0.4920 | 0.7291 | 0.8616 | 0.9163 | (86) |
| Living | 20.3496 | 20.4772 | 20.6264 | 20.7997 | 20.8889 | 20.9242 | 20.9298 | 20.9294 | 20.9134 | 20.8040 | 20.5771 | 20.3361 | |
| Non living | 19.6478 | 19.8064 | 19.9899 | 20.2040 | 20.3053 | 20.3520 | 20.3568 | 20.3589 | 20.3378 | 20.2141 | 19.9408 | 19.6385 | |
| 24 / 16 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 24 / 9 | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |
| 16 / 9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| MIT | 21.0000 | 21.0000 | 21.0000 | 21.0000 | 21.0000 | 21.0000 | 21.0000 | 21.0000 | 21.0000 | 21.0000 | 21.0000 | 21.0000 | (87) |
| Th 2 | 20.4181 | 20.4202 | 20.4224 | 20.4332 | 20.4353 | 20.4461 | 20.4461 | 20.4483 | 20.4418 | 20.4353 | 20.4310 | 20.4267 | (88) |
| util rest of house | 0.8996 | 0.8609 | 0.8033 | 0.6826 | 0.5343 | 0.3668 | 0.2537 | 0.2784 | 0.4552 | 0.7022 | 0.8467 | 0.9077 | (89) |
| MIT 2 | 20.4181 | 20.4202 | 20.4224 | 20.4332 | 20.4353 | 20.4461 | 20.4461 | 20.4483 | 20.4418 | 20.4353 | 20.4310 | 20.4267 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.5727 | (91) |
| MIT | 20.7513 | 20.7523 | 20.7532 | 20.7578 | 20.7587 | 20.7633 | 20.7633 | 20.7643 | 20.7615 | 20.7587 | 20.7569 | 20.7550 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 20.7513 | 20.7523 | 20.7532 | 20.7578 | 20.7587 | 20.7633 | 20.7633 | 20.7643 | 20.7615 | 20.7587 | 20.7569 | 20.7550 | (93) |

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8. Space heating requirement

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| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9051 | 0.8680 | 0.8129 | 0.6962 | 0.5515 | 0.3860 | 0.2745 | 0.2999 | 0.4764 | 0.7179 | 0.8554 | 0.9127 | (94) |
| Useful gains | 347.1020 | 362.6347 | 353.5996 | 320.8375 | 259.7496 | 178.4934 | 121.3898 | 126.6066 | 192.1150 | 270.1565 | 315.3753 | 338.7900 | (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 | 506.4784 | 486.1268 | 435.3738 | 355.0687 | 270.1630 | 180.1034 | 121.6599 | 127.0060 | 196.2638 | 302.9689 | 410.5838 | 501.7000 | (97) |
| Space heating kWh | 118.5760 | 82.9867 | 60.8400 | 24.6464 | 7.7476 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 24.4124 | 68.5501 | 121.2050 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 508.9642 | |
| Solar heating kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | 118.5760 | 82.9867 | 60.8400 | 24.6464 | 7.7476 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 24.4124 | 68.5501 | 121.2050 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 508.9642 | |
| Space heating per m2 | | | | | | | | | | (98c) / (4) = | | 10.1387 | (99) |

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

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

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

Efficiency of main space heating system 1 (in %) 290.9143 (206)

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

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement | 118.5760 | 82.9867 | 60.8400 | 24.6464 | 7.7476 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 24.4124 | 68.5501 | 121.2050 | (98) |
| Space heating efficiency (main heating system 1) | 290.9143 | 290.9143 | 290.9143 | 290.9143 | 290.9143 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 290.9143 | 290.9143 | 290.9143 | (210) |
| Space heating fuel (main heating system) | 40.7598 | 28.5262 | 20.9134 | 8.4721 | 2.6632 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 8.3916 | 23.5637 | 41.6635 | (211) |
| Space heating efficiency (main heating system 2) | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (212) |
| Space heating fuel (main heating system 2) | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (213) |
| Space heating fuel (secondary) | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (215) |
| Water heating | | | | | | | | | | | | | |
| Water heating requirement | 184.1905 | 162.4019 | 171.3472 | 147.8850 | 141.4632 | 125.4174 | 122.3095 | 128.3300 | 131.0214 | 148.5545 | 160.9550 | 181.8209 | (64) |
| Efficiency of water heater | | | | | | | | | | | | 194.1800 | (216) |
| (217)m | 194.1800 | 194.1800 | 194.1800 | 194.1800 | 194.1800 | 194.1800 | 194.1800 | 194.1800 | 194.1800 | 194.1800 | 194.1800 | 194.1800 | (217) |
| Fuel for water heating, kWh/month | 94.8556 | 83.6347 | 88.2414 | 76.1587 | 72.8516 | 64.5882 | 62.9877 | 66.0882 | 67.4742 | 76.5035 | 82.8896 | 93.6352 | (219) |
| Space cooling fuel requirement | | | | | | | | | | | | | |
| (221)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (221) |
| Pumps and Fa | 8.5528 | 7.7251 | 8.5528 | 8.2769 | 8.5528 | 8.2769 | 8.5528 | 8.5528 | 8.2769 | 8.5528 | 8.2769 | 8.5528 | (231) |
| Lighting | 18.0301 | 14.4644 | 13.0236 | 9.5416 | 7.3702 | 6.0216 | 6.7234 | 8.7393 | 11.3515 | 14.8938 | 16.8225 | 18.5312 | (232) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (233a)m | -27.6118 | -44.0709 | -71.3857 | -85.6464 | -94.7034 | -88.5889 | -86.9922 | -81.0382 | -68.6202 | -52.4962 | -31.5684 | -23.0187 | (233a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (234a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (234a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (235a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235a) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | | |
| (235c)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235c) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (233b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (233b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (234b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (234b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (235b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235b) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | | |
| (235d)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235d) |

Annual totals kWh/year

Space heating fuel - main system 1 174.9533 (211)

Space heating fuel - main system 2 0.0000 (213)

Space heating fuel - secondary 0.0000 (215)

Efficiency of water heater 194.1800

Water heating fuel used 929.9087 (219)

Space cooling fuel 0.0000 (221)

| | | |
|---|---|---|
| Electricity for pumps and fans: | | |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.9500) | | |
| mechanical ventilation fans (SFP = 0.9500) | 100.7019 | (230a) |
| Total electricity for the above, kWh/year | 100.7019 | (231) |
| Electricity for lighting (calculated in Appendix L) | 145.5132 | (232) |
| Energy saving/generation technologies (Appendices M ,N and Q) | | |
| PV generation | -755.7409 | (233) |
| Wind generation | 0.0000 | (234) |
| Hydro-electric generation (Appendix N) | 0.0000 | (235a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 | (235) |
| Appendix Q - special features | | |
| Energy saved or generated | -0.0000 | (236) |
| Energy used | 0.0000 | (237) |
| Total delivered energy for all uses | 595.3362 | (238) |

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

| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 174.9533 | 0.1570 | 27.4613 | (261) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 929.9087 | 0.1413 | 131.4104 | (264) |
| Space and water heating | | | 158.8717 | (265) |
| Pumps, fans and electric keep-hot | 100.7019 | 0.1387 | 13.9686 | (267) |
| Energy for lighting | 145.5132 | 0.1443 | 21.0021 | (268) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -755.7409 | 0.1331 | -100.6155 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -100.6155 | (269) |
| Total CO2, kg/year | | | 93.2269 | (272) |
| EPC Dwelling Carbon Dioxide Emission Rate (DER) | | | 1.8600 | (273) |

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

| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 174.9533 | 1.5811 | 276.6153 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 929.9087 | 1.5226 | 1415.8357 | (278) |
| Space and water heating | | | 1692.4510 | (279) |
| Pumps, fans and electric keep-hot | 100.7019 | 1.5128 | 152.3418 | (281) |
| Energy for lighting | 145.5132 | 1.5338 | 223.1930 | (282) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -755.7409 | 1.4920 | -1127.5478 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -1127.5478 | (283) |
| Total Primary energy kWh/year | | | 940.4381 | (286) |
| Dwelling Primary energy Rate (DPER) | | | 18.7300 | (287) |

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF TARGET EMISSIONS

1. Overall dwelling characteristics

| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 50.2000 | (1b) x | 2.5000 | (2b) = | 125.5000 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 50.2000 | | | | | (4) |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | | 125.5000 | (5) |

2. Ventilation rate

| | | m3 per hour | |
|---|---|---|---|
| Number of open chimneys | 0 * 80 = | 0.0000 | (6a) |
| Number of open flues | 0 * 20 = | 0.0000 | (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 | (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 | (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 | (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 | (6f) |
| Number of intermittent extract fans | 2 * 10 = | 20.0000 | (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 | (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 | (7c) |
| | Air changes per hour | | |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 20.0000 / (5) = | 0.1594 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 5.0000 | (17) |
| Infiltration rate | | 0.4094 | (18) |
| Number of sides sheltered | | 3 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 0.7750 | (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.3173 | (21) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.4045 | 0.3966 | 0.3886 | 0.3490 | 0.3411 | 0.3014 | 0.3014 | 0.2935 | 0.3173 | 0.3411 | 0.3569 | 0.3728 | (22b) |
| Effective ac | 0.5818 | 0.5786 | 0.5755 | 0.5609 | 0.5582 | 0.5454 | 0.5454 | 0.5431 | 0.5503 | 0.5582 | 0.5637 | 0.5695 | (25) |

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3. Heat losses and heat loss parameter

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| Element | Gross | Openings | NetArea | U-value | A x U | K-value | A x K | |
|---|---|---|---|---|---|---|---|---|
| | m2 | m2 | m2 | W/m2K | W/K | kJ/m2K | kJ/K | |
| Main dwelling | | | | | | | | |
| TER Opaque door | | | 2.0600 | 1.0000 | 2.0600 | | | (26) |
| TER Opening Type | | | 6.2500 | 1.1450 | 7.1565 | | | (27) |
| External Wall 1 | 17.8200 | 8.3100 | 9.5100 | 0.1800 | 1.7118 | | | (29a) |
| Corridor | 17.8200 | | 17.8200 | 0.1800 | 3.2076 | | | (29a) |
| Total net area of external elements Aum(A, m2) | | | 35.6400 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 14.1359 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall | | | 41.0400 | 0.0000 | 0.0000 | | | (32) |

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 109.5701 (35)

List of Thermal Bridges

| K1 Element | Length | Psi-value | Total |
|---|---|---|---|
| E7 Party floor between dwellings (in blocks of flats) | 5.4000 | 0.0700 | 0.3780 |
| E7 Party floor between dwellings (in blocks of flats) | 13.2000 | 0.0700 | 0.9240 |
| E23 Balcony within or between dwellings, balcony support penetrates wall insulation | 7.8000 | 0.0200 | 0.1560 |
| E18 Party wall between dwellings | 5.4000 | 0.0600 | 0.3240 |
| E18 Party wall between dwellings | 5.4000 | 0.0600 | 0.3240 |
| P3 Party wall - Intermediate floor between dwellings (in blocks of flats) | 30.4000 | 0.0000 | 0.0000 |
| E2 Other lintels (including other steel lintels) | 4.3300 | 0.0500 | 0.2165 |
| E3 Sill | 3.3500 | 0.0500 | 0.1675 |
| E4 Jamb | 11.7000 | 0.0500 | 0.5850 |

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 3.0750 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 17.2109 (37)

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 24.0957 | 23.9641 | 23.8352 | 23.2294 | 23.1161 | 22.5885 | 22.5885 | 22.4908 | 22.7917 | 23.1161 | 23.3454 | 23.5851 | (38) |
| Heat transfer coeff | 41.3066 | 41.1750 | 41.0460 | 40.4403 | 40.3270 | 39.7994 | 39.7994 | 39.7017 | 40.0026 | 40.3270 | 40.5563 | 40.7959 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 40.4398 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 0.8228 | 0.8202 | 0.8177 | 0.8056 | 0.8033 | 0.7928 | 0.7928 | 0.7909 | 0.7969 | 0.8033 | 0.8079 | 0.8127 | (40) |
| HLP (average) | | | | | | | | | | | | 0.8056 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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4. Water heating energy requirements (kWh/year)

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Assumed occupancy 1.6960 (42)

Hot water usage for mixer showers

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 52.6557 | 51.8644 | 50.7113 | 48.5050 | 46.8769 | 45.0612 | 44.0291 | 45.1735 | 46.4279 | 48.3774 | 50.6311 | 52.4539 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 22.7669 | 22.4288 | 21.9526 | 21.0747 | 20.4173 | 19.6884 | 19.2947 | 19.7675 | 20.2823 | 21.0623 | 21.9583 | 22.6899 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 31.9986 | 30.8351 | 29.6715 | 28.5079 | 27.3443 | 26.1807 | 26.1807 | 27.3443 | 28.5079 | 29.6715 | 30.8351 | 31.9986 | (42c) |

Average daily hot water use (litres/day) 98.7449 (43)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 107.4212 | 105.1282 | 102.3354 | 98.0876 | 94.6385 | 90.9303 | 89.5045 | 92.2853 | 95.2181 | 99.1112 | 103.4244 | 107.1425 | (44) |
| Energy conte | 170.1289 | 149.7011 | 157.2856 | 134.2770 | 127.4016 | 111.8094 | 108.2479 | 114.2684 | 117.4134 | 134.4929 | 147.3470 | 167.7593 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1640.1327 | |
| Distribution loss (46)m = 0.15 x (45)m | 25.5193 | 22.4552 | 23.5928 | 20.1416 | 19.1102 | 16.7714 | 16.2372 | 17.1403 | 17.6120 | 20.1739 | 22.1021 | 25.1639 | (46) |
| Water storage loss (or HIU loss): | | | | | | | | | | | | | |
| Store volume | | | | | | | | | | | | 150.0000 | (47) |
| a) If manufacturer declared loss factor is known (kWh/day): | | | | | | | | | | | | 1.3938 | (48) |
| Temperature factor from Table 2b | | | | | | | | | | | | 0.5400 | (49) |
| Enter (49) or (54) in (55) | | | | | | | | | | | | 0.7527 | (55) |
| Total storage loss | 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (56) |
| If cylinder contains dedicated solar storage | 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (57) |
| Primary loss | 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |
| Total heat required for water heating calculated for each month | 216.7238 | 191.7869 | 203.8805 | 179.3689 | 173.9965 | 156.9012 | 154.8428 | 160.8633 | 162.5053 | 181.0878 | 192.4389 | 214.3542 | (62) |
| WWHRS | -24.0720 | -21.2895 | -22.2931 | -18.4596 | -17.2036 | -14.7213 | -13.7989 | -14.6737 | -15.2312 | -17.9559 | -20.3419 | -23.6262 | (63a) |
| PV diverter | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |
| Output from w/h | 192.6519 | 170.4974 | 181.5874 | 160.9093 | 156.7928 | 142.1799 | 141.0440 | 146.1896 | 147.2741 | 163.1319 | 172.0970 | 190.7280 | (64) |
| | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | | 1965.0834 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 1965 | (64) |
| Electric shower(s) | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |
| | | | | | | | | | Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | | | 0.0000 | (64a) |
| Heat gains from water heating, kWh/month | 93.8438 | 83.4442 | 89.5734 | 80.7206 | 79.6370 | 73.2501 | 73.2684 | 75.2702 | 75.1134 | 81.9948 | 85.0664 | 93.0559 | (65) |

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

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| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Metabolic gains (Table 5), Watts | | | | | | | | | | | | | |
| (66)m | 84.7995 | 84.7995 | 84.7995 | 84.7995 | 84.7995 | 84.7995 | 84.7995 | 84.7995 | 84.7995 | 84.7995 | 84.7995 | 84.7995 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 82.0470 | 90.8377 | 82.0470 | 84.7819 | 82.0470 | 84.7819 | 82.0470 | 82.0470 | 84.7819 | 82.0470 | 84.7819 | 82.0470 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 147.7534 | 149.2866 | 145.4229 | 137.1977 | 126.8147 | 117.0562 | 110.5370 | 109.0038 | 112.8674 | 121.0927 | 131.4756 | 141.2341 | (68) |

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 31.4800 | 31.4800 | 31.4800 | 31.4800 | 31.4800 | 31.4800 | 31.4800 | 31.4800 | 31.4800 | 31.4800 | 31.4800 | (69) |
| Pumps, fans | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 3.0000 | 3.0000 | 3.0000 (70) |
| Losses e.g. evaporation (negative values) (Table 5) | | | | | | | | | | | | |
| | -67.8396 | -67.8396 | -67.8396 | -67.8396 | -67.8396 | -67.8396 | -67.8396 | -67.8396 | -67.8396 | -67.8396 | -67.8396 | -67.8396 (71) |
| Water heating gains (Table 5) | | | | | | | | | | | | |
| | 126.1341 | 124.1729 | 120.3943 | 112.1119 | 107.0389 | 101.7362 | 98.4790 | 101.1696 | 104.3242 | 110.2081 | 118.1477 | 125.0751 (72) |
| Total internal gains | | | | | | | | | | | | |
| | 407.3744 | 415.7371 | 399.3041 | 385.5313 | 367.3405 | 352.0142 | 339.5028 | 340.6602 | 350.4134 | 364.7876 | 385.8451 | 399.7961 (73) |

## 6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| West | 6.2500 | 19.6403 | 0.6300 | 0.7000 | 0.7700 | 37.5145 | (80) |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 37.5145 | 73.3863 | 120.8568 | 176.2625 | 216.0163 | 221.1311 | 210.5258 | 180.8386 | 140.5615 | 87.0791 | 46.7762 | 30.8501 (83) |
| Total gains | 444.8889 | 489.1234 | 520.1609 | 561.7938 | 583.3568 | 573.1453 | 550.0286 | 521.4988 | 490.9749 | 451.8667 | 432.6213 | 430.6462 (84) |

## 7. Mean internal temperature (heating season)

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

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| tau | 36.9891 | 37.1073 | 37.2239 | 37.7815 | 37.8876 | 38.3899 | 38.3899 | 38.4843 | 38.1949 | 37.8876 | 37.6735 | 37.4521 | |
| alpha | 3.4659 | 3.4738 | 3.4816 | 3.5188 | 3.5258 | 3.5593 | 3.5593 | 3.5656 | 3.5463 | 3.5258 | 3.5116 | 3.4968 | |
| util living area | | | | | | | | | | | | | |
| | 0.9096 | 0.8773 | 0.8260 | 0.7221 | 0.5870 | 0.4303 | 0.3147 | 0.3448 | 0.5277 | 0.7491 | 0.8683 | 0.9165 | (86) |
| MIT | 19.7732 | 19.9932 | 20.2866 | 20.6379 | 20.8586 | 20.9648 | 20.9911 | 20.9876 | 20.9266 | 20.6495 | 20.1864 | 19.7447 | (87) |
| Th 2 | 20.2336 | 20.2358 | 20.2381 | 20.2485 | 20.2505 | 20.2596 | 20.2596 | 20.2613 | 20.2561 | 20.2505 | 20.2465 | 20.2424 | (88) |
| util rest of house | | | | | | | | | | | | | |
| | 0.8991 | 0.8637 | 0.8071 | 0.6943 | 0.5494 | 0.3843 | 0.2631 | 0.2913 | 0.4790 | 0.7176 | 0.8517 | 0.9066 | (89) |
| MIT 2 | 18.8083 | 19.0810 | 19.4413 | 19.8659 | 20.1151 | 20.2317 | 20.2543 | 20.2535 | 20.1942 | 19.8896 | 19.3322 | 18.7794 | (90) |
| Living area fraction | | | | | | | | | fLA = Living area / (4) = | | | 0.5727 | (91) |
| MIT | 19.3609 | 19.6034 | 19.9254 | 20.3081 | 20.5409 | 20.6515 | 20.6763 | 20.6740 | 20.6136 | 20.3248 | 19.8214 | 19.3322 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 19.3609 | 19.6034 | 19.9254 | 20.3081 | 20.5409 | 20.6515 | 20.6763 | 20.6740 | 20.6136 | 20.3248 | 19.8214 | 19.3322 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.8852 | 0.8511 | 0.7987 | 0.6966 | 0.5642 | 0.4089 | 0.2922 | 0.3213 | 0.5028 | 0.7209 | 0.8413 | 0.8930 | (94) |
| Useful gains | 393.8180 | 416.2934 | 415.4650 | 391.3696 | 329.1515 | 234.3428 | 160.7448 | 167.5817 | 246.8629 | 325.7598 | 363.9638 | 384.5512 | (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 | | | | | | | | | | | | | |
| | 622.1151 | 605.4143 | 551.0598 | 461.3452 | 356.5278 | 240.8481 | 162.2332 | 169.6838 | 260.5614 | 392.1713 | 515.9316 | 617.3326 | (97) |
| Space heating kWh | | | | | | | | | | | | | |
| | 169.8531 | 127.0893 | 100.8825 | 50.3824 | 20.3680 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 49.4102 | 109.4169 | 173.1894 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 800.5916 | |
| Solar heating kWh | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | | | | | | | | | | | | | |
| | 169.8531 | 127.0893 | 100.8825 | 50.3824 | 20.3680 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 49.4102 | 109.4169 | 173.1894 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 800.5916 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 15.9480 | (99) |

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

| | |
|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | 0.0000 (201) |
| Fraction of space heat from main system(s) | 1.0000 (202) |
| Efficiency of main space heating system 1 (in %) | 92.3000 (206) |
| Efficiency of main space heating system 2 (in %) | 0.0000 (207) |
| Efficiency of secondary/supplementary heating system, % | 0.0000 (208) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement | | | | | | | | | | | | | |
| | 169.8531 | 127.0893 | 100.8825 | 50.3824 | 20.3680 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 49.4102 | 109.4169 | 173.1894 | (98) |
| Space heating efficiency (main heating system 1) | | | | | | | | | | | | | |
| | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 92.3000 | 92.3000 | 92.3000 | (210) |
| Space heating fuel (main heating system) | | | | | | | | | | | | | |
| | 184.0228 | 137.6915 | 109.2985 | 54.5855 | 22.0671 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 53.5321 | 118.5448 | 187.6375 | (211) |
| Space heating efficiency (main heating system 2) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (212) |
| Space heating fuel (main heating system 2) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (213) |
| Space heating fuel (secondary) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (215) |
| Water heating | | | | | | | | | | | | | |
| Water heating requirement | | | | | | | | | | | | | |
| | 192.6519 | 170.4974 | 181.5874 | 160.9093 | 156.7928 | 142.1799 | 141.0440 | 146.1896 | 147.2741 | 163.1319 | 172.0970 | 190.7280 | (64) |
| Efficiency of water heater | | | | | | | | | | | | 79.8000 | (216) |
| (217)m | 83.7785 | 83.4103 | 82.7970 | 81.7763 | 80.7408 | 79.8000 | 79.8000 | 79.8000 | 79.8000 | 81.7256 | 83.0724 | 83.8441 | (217) |
| Fuel for water heating, kWh/month | | | | | | | | | | | | | |
| | 229.9538 | 204.4081 | 219.3164 | 196.7676 | 194.1928 | 178.1703 | 176.7468 | 183.1950 | 184.5540 | 199.6094 | 207.1650 | 227.4793 | (219) |
| Space cooling fuel requirement | | | | | | | | | | | | | |
| (221)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (221) |
| Pumps and Fa | 7.3041 | 6.5973 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 | (231) |
| Lighting | 17.0477 | 13.6763 | 12.3140 | 9.0218 | 6.9687 | 5.6935 | 6.3571 | 8.2632 | 10.7330 | 14.0823 | 15.9059 | 17.5216 | (232) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (233a)m | -7.4431 | -11.4422 | -17.9162 | -22.0059 | -25.4253 | -24.3737 | -24.0906 | -21.8926 | -18.3353 | -13.8734 | -8.5162 | -6.3301 | (233a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (234a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (234a) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (235a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235a) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | | |
| (235c)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235c) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (233b)m | -1.7447 | -3.8126 | -7.8514 | -12.2056 | -16.5504 | -16.7735 | -16.5644 | -13.8234 | -9.8808 | -5.5708 | -2.3669 | -1.3686 | (233b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (234b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (234b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (235b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235b) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | | |
| (235d)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235d) |

| | | |
|---|---|---|
| Annual totals kWh/year | | |
| Space heating fuel - main system 1 | 867.3799 | (211) |
| Space heating fuel - main system 2 | 0.0000 | (213) |
| Space heating fuel - secondary | 0.0000 | (215) |
| Efficiency of water heater | 79.8000 | |
| Water heating fuel used | 2401.5586 | (219) |
| Space cooling fuel | 0.0000 | (221) |
| | | |
| Electricity for pumps and fans: | | |
| Total electricity for the above, kWh/year | 86.0000 | (231) |
| Electricity for lighting (calculated in Appendix L) | 137.5851 | (232) |
| | | |
| Energy saving/generation technologies (Appendices M ,N and Q) | | |
| PV generation | -310.1576 | (233) |
| Wind generation | 0.0000 | (234) |
| Hydro-electric generation (Appendix N) | 0.0000 | (235a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 | (235) |
| Appendix Q - special features | | |
| Energy saved or generated | -0.0000 | (236) |
| Energy used | 0.0000 | (237) |
| Total delivered energy for all uses | 3182.3660 | (238) |

---

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

---

| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 867.3799 | 0.2100 | 182.1498 | (261) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 2401.5586 | 0.2100 | 504.3273 | (264) |
| Space and water heating | | | 686.4771 | (265) |
| Pumps, fans and electric keep-hot | 86.0000 | 0.1387 | 11.9293 | (267) |
| Energy for lighting | 137.5851 | 0.1443 | 19.8578 | (268) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -201.6446 | 0.1328 | -26.7805 | |
| PV Unit electricity exported | -108.5130 | 0.1249 | -13.5556 | |
| Total | | | -40.3360 | (269) |
| Total CO2, kg/year | | | 677.9281 | (272) |
| EPC Target Carbon Dioxide Emission Rate (TER) | | | 13.5000 | (273) |

---

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

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| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 867.3799 | 1.1300 | 980.1393 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 2401.5586 | 1.1300 | 2713.7612 | (278) |
| Space and water heating | | | 3693.9005 | (279) |
| Pumps, fans and electric keep-hot | 86.0000 | 1.5128 | 130.1008 | (281) |
| Energy for lighting | 137.5851 | 1.5338 | 211.0326 | (282) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -201.6446 | 1.4907 | -300.6000 | |
| PV Unit electricity exported | -108.5130 | 0.4585 | -49.7532 | |
| Total | | | -350.3532 | (283) |
| Total Primary energy kWh/year | | | 3684.6807 | (286) |
| Target Primary Energy Rate (TPER) | | | 73.4000 | (287) |

# Full SAP Calculation Printout

| | | | |
|---|---|---|---|
| Plot Reference | 1B2P Mid TF W | Issued on Date | 16/01/2026 |
| Assessment Reference | 1B2P Mid TF W | Plot Type Ref | 1B2P Mid MF W |
| Plot Address | | SAP Version | 10.2 |

| | | | | | |
|---|---|---|---|---|---|
| SAP Rating | 86 B | DER | 2.16 | TER | 15.58 |
| Environmental | 99 A | % DER < TER | | | 86.14 |
| $CO_2$ Emissions (t/year) | 0.08 | DFEE | 30.90 | TFEE | 33.39 |
| Compliance Check | See BREL | % DFEE < TFEE | | | 7.47 |
| % DPER < TPER | 74.26 | DPER | 21.78 | TPER | 84.59 |

| | | | |
|---|---|---|---|
| Assessor Details | Miss Eleanor Risby | Assessor ID | M976-0001 |
| Client | | | |

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE

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## 1. Overall dwelling characteristics

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| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 50.2000 | (1b) | x 2.5000 | (2b) = | 125.5000 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 50.2000 | | | | | (4) |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = | 125.5000 | (5) |

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## 2. Ventilation rate

---

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

| | | Air changes per hour | |
|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 0.0000 / (5) = | 0.0000 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 3.0000 | (17) |
| Infiltration rate | | 0.1500 | (18) |
| Number of sides sheltered | | 3 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 0.7750 | (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.1162 | (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.1482 | 0.1453 | 0.1424 | 0.1279 | 0.1250 | 0.1104 | 0.1104 | 0.1075 | 0.1162 | 0.1250 | 0.1308 | 0.1366 | (22b) |

Balanced mechanical ventilation with heat recovery

| | | |
|---|---|---|
| If mechanical ventilation | 0.5000 | (23a) |
| If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) | 0.6404 | (23b) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = | 77.4000 | (23c) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Effective ac | 0.2930 | 0.2900 | 0.2871 | 0.2726 | 0.2697 | 0.2552 | 0.2552 | 0.2523 | 0.2610 | 0.2697 | 0.2755 | 0.2813 | (25) |

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## 3. Heat losses and heat loss parameter

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| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | | |
| Glazing | | | 6.2500 | 1.1450 | 7.1565 | | | (27) |
| Corridor Door | | | 2.0600 | 1.0000 | 2.0600 | | | (26) |
| External Wall 1 | 17.8200 | 8.3100 | 9.5100 | 0.1900 | 1.8069 | 14.0000 | 133.1400 | (29a) |
| Corridor | 17.8200 | | 17.8200 | 0.1600 | 2.8512 | 14.0000 | 249.4800 | (29a) |
| Main Roof | 50.2000 | | 50.2000 | 0.1000 | 5.0200 | 100.0000 | 5020.0000 | (30) |
| Total net area of external elements Aum(A, m2) | | | 85.8400 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 18.8946 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall | | | 41.0400 | 0.0000 | 0.0000 | 20.0000 | 820.8000 | (32) |
| Party Floor 1 | | | 50.2000 | | | 40.0000 | 2008.0000 | (32d) |
| Internal Wall 1 | | | 87.0000 | | | 9.0000 | 783.0000 | (32c) |

| | | |
|---|---|---|
| Heat capacity Cm = Sum(A x k) | (28)...(30) + (32) + (32a)...(32e) = 9014.4200 | (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | 179.5701 | (35) |
| List of Thermal Bridges | | |

| K1 Element | Length | Psi-value | Total |
|---|---|---|---|
| E7 Party floor between dwellings (in blocks of flats) | 2.7000 | 0.0700 | 0.1890 |
| E7 Party floor between dwellings (in blocks of flats) | 6.6000 | 0.1000 | 0.6600 |
| E23 Balcony within or between dwellings, balcony support penetrates wall insulation | 3.9000 | 0.1500 | 0.5850 |
| E18 Party wall between dwellings | 5.4000 | 0.0600 | 0.3240 |
| E18 Party wall between dwellings | 5.4000 | 0.0900 | 0.4860 |
| P3 Party wall - Intermediate floor between dwellings (in blocks of flats) | 15.2000 | 0.0000 | 0.0000 |
| E2 Other lintels (including other steel lintels) | 4.3300 | 0.1000 | 0.4330 |
| E3 Sill | 3.3500 | 0.0500 | 0.1675 |
| E4 Jamb | 11.7000 | 0.0500 | 0.5850 |
| E15 Flat roof with parapet | 6.6000 | 0.3000 | 1.9800 |
| E14 Flat roof | 6.6000 | 0.1600 | 1.0560 |
| P4 Party wall - Roof (insulation at ceiling level) | 15.2000 | 0.0500 | 0.7600 |

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 7.2255 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 26.1201 (37)

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 12.1327 | 12.0123 | 11.8919 | 11.2901 | 11.1698 | 10.5680 | 10.5680 | 10.4476 | 10.8087 | 11.1698 | 11.4105 | 11.6512 | (38) |
| Heat transfer coeff | 38.2528 | 38.1324 | 38.0120 | 37.4102 | 37.2899 | 36.6880 | 36.6880 | 36.5677 | 36.9288 | 37.2899 | 37.5306 | 37.7713 | (39) |

Average = Sum(39)m / 12 = 37.3801

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 0.7620 | 0.7596 | 0.7572 | 0.7452 | 0.7428 | 0.7308 | 0.7308 | 0.7284 | 0.7356 | 0.7428 | 0.7476 | 0.7524 | (40) |
| HLP (average) | | | | | | | | | | | | 0.7446 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

## 4. Water heating energy requirements (kWh/year)

Assumed occupancy 1.6960 (42)

Hot water usage for mixer showers

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 52.6557 | 51.8644 | 50.7113 | 48.5050 | 46.8769 | 45.0612 | 44.0291 | 45.1735 | 46.4279 | 48.3774 | 50.6311 | 52.4539 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 22.7669 | 22.4288 | 21.9526 | 21.0747 | 20.4173 | 19.6884 | 19.2947 | 19.7675 | 20.2823 | 21.0623 | 21.9583 | 22.6899 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 31.9986 | 30.8351 | 29.6715 | 28.5079 | 27.3443 | 26.1807 | 26.1807 | 27.3443 | 28.5079 | 29.6715 | 30.8351 | 31.9986 | (42c) |

Average daily hot water use (litres/day) 98.7449 (43)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 107.4212 | 105.1282 | 102.3354 | 98.0876 | 94.6385 | 90.9303 | 89.5045 | 92.2853 | 95.2181 | 99.1112 | 103.4244 | 107.1425 | (44) |
| Energy conte | 170.1289 | 149.7011 | 157.2856 | 134.2770 | 127.4016 | 111.8094 | 108.2479 | 114.2684 | 117.4134 | 134.4929 | 147.3470 | 167.7593 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1640.1327 | |
| Distribution loss (46)m = 0.15 x (45)m | 25.5193 | 22.4552 | 23.5928 | 20.1416 | 19.1102 | 16.7714 | 16.2372 | 17.1403 | 17.6120 | 20.1739 | 22.1021 | 25.1639 | (46) |

Water storage loss (or HIU loss):

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Store volume | | | | | | | | | | | | 180.0000 | (47) |
| a) If manufacturer declared loss factor is known (kWh/day): | | | | | | | | | | | | 0.8400 | (48) |
| Temperature factor from Table 2b | | | | | | | | | | | | 0.5400 | (49) |
| Enter (49) or (54) in (55) | | | | | | | | | | | | 0.4536 | (55) |
| Total storage loss | 14.0616 | 12.7008 | 14.0616 | 13.6080 | 14.0616 | 13.6080 | 14.0616 | 14.0616 | 13.6080 | 14.0616 | 13.6080 | 14.0616 | (56) |
| If cylinder contains dedicated solar storage | 14.0616 | 12.7008 | 14.0616 | 13.6080 | 14.0616 | 13.6080 | 14.0616 | 14.0616 | 13.6080 | 14.0616 | 13.6080 | 14.0616 | (57) |
| Primary 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 | (59) |
| Combi loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |
| Total heat required for water heating calculated for each month | 184.1905 | 162.4019 | 171.3472 | 147.8850 | 141.4632 | 125.4174 | 122.3095 | 128.3300 | 131.0214 | 148.5545 | 160.9550 | 181.8209 | (62) |
| WWHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63a) |
| PV diverter | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |
| Output from w/h | 184.1905 | 162.4019 | 171.3472 | 147.8850 | 141.4632 | 125.4174 | 122.3095 | 128.3300 | 131.0214 | 148.5545 | 160.9550 | 181.8209 | (64) |
| | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 1805.6967 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 1806 | (64) |

Electric shower(s)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |

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

Heat gains from water heating, kWh/month

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 56.5679 | 49.7756 | 52.2975 | 44.6471 | 42.3610 | 37.1766 | 35.9924 | 37.9943 | 39.0400 | 44.7189 | 48.9929 | 55.7800 | (65) |

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

Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 84.7995 | 84.7995 | 84.7995 | 84.7995 | 84.7995 | 84.7995 | 84.7995 | 84.7995 | 84.7995 | 84.7995 | 84.7995 | 84.7995 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 84.4943 | 93.5473 | 84.4943 | 87.3108 | 84.4943 | 87.3108 | 84.4943 | 84.4943 | 87.3108 | 84.4943 | 87.3108 | 84.4943 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 147.7534 | 149.2866 | 145.4229 | 137.1977 | 126.8147 | 117.0562 | 110.5370 | 109.0038 | 112.8674 | 121.0927 | 131.4756 | 141.2341 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 31.4800 | 31.4800 | 31.4800 | 31.4800 | 31.4800 | 31.4800 | 31.4800 | 31.4800 | 31.4800 | 31.4800 | 31.4800 | 31.4800 | (69) |
| Pumps, fans | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | -67.8396 | -67.8396 | -67.8396 | -67.8396 | -67.8396 | -67.8396 | -67.8396 | -67.8396 | -67.8396 | -67.8396 | -67.8396 | -67.8396 | (71) |
| Water heating gains (Table 5) | 76.0321 | 74.0709 | 70.2923 | 62.0099 | 56.9369 | 51.6342 | 48.3769 | 51.0675 | 54.2222 | 60.1060 | 68.0457 | 74.9731 | (72) |
| Total internal gains | 356.7196 | 365.3446 | 348.6494 | 334.9582 | 316.6858 | 304.4411 | 291.8481 | 293.0055 | 302.8403 | 314.1329 | 335.2720 | 349.1413 | (73) |

## 6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| West | 6.2500 | 19.6403 | 0.4500 | 0.7000 | 0.7700 | 26.7961 | (80) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 26.7961 | 52.4188 | 86.3263 | 125.9018 | 154.2973 | 157.9508 | 150.3756 | 129.1704 | 100.4011 | 62.1993 | 33.4116 | 22.0358 | (83) |
| Total gains | 383.5157 | 417.7634 | 434.9757 | 460.8600 | 470.9831 | 462.3919 | 442.2237 | 422.1759 | 403.2413 | 376.3322 | 368.6835 | 371.1771 | (84) |

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7. Mean internal temperature (heating season)

---

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

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| tau | 65.4595 | 65.6661 | 65.8740 | 66.9337 | 67.1498 | 68.2513 | 68.2513 | 68.4759 | 67.8064 | 67.1498 | 66.7191 | 66.2939 | |
| alpha | 5.3640 | 5.3777 | 5.3916 | 5.4622 | 5.4767 | 5.5501 | 5.5501 | 5.5651 | 5.5204 | 5.4767 | 5.4479 | 5.4196 | |
| util living area | 0.9731 | 0.9559 | 0.9246 | 0.8376 | 0.6942 | 0.5019 | 0.3642 | 0.3970 | 0.6125 | 0.8580 | 0.9505 | 0.9766 | (86) |
| Living | 20.3401 | 20.4557 | 20.6043 | 20.7915 | 20.8982 | 20.9379 | 20.9432 | 20.9429 | 20.9259 | 20.7955 | 20.5535 | 20.3246 | |
| Non living | 19.5132 | 19.6590 | 19.8438 | 20.0738 | 20.1907 | 20.2378 | 20.2416 | 20.2436 | 20.2242 | 20.0843 | 19.7914 | 19.5008 | |
| 24 / 16 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 24 / 9 | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |
| 16 / 9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| MIT | 21.0000 | 21.0000 | 21.0000 | 21.0000 | 21.0000 | 21.0000 | 21.0000 | 21.0000 | 21.0000 | 21.0000 | 21.0000 | 21.0000 | (87) |
| Th 2 | 20.2864 | 20.2885 | 20.2906 | 20.3011 | 20.3032 | 20.3137 | 20.3137 | 20.3158 | 20.3095 | 20.3032 | 20.2990 | 20.2948 | (88) |
| util rest of house | 0.9678 | 0.9477 | 0.9106 | 0.8107 | 0.6522 | 0.4503 | 0.3078 | 0.3386 | 0.5575 | 0.8285 | 0.9399 | 0.9720 | (89) |
| MIT 2 | 20.2864 | 20.2885 | 20.2906 | 20.3011 | 20.3032 | 20.3137 | 20.3137 | 20.3158 | 20.3095 | 20.3032 | 20.2990 | 20.2948 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.5727 | (91) |
| MIT | 20.6951 | 20.6960 | 20.6969 | 20.7013 | 20.7022 | 20.7067 | 20.7067 | 20.7076 | 20.7049 | 20.7022 | 20.7005 | 20.6987 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 20.6951 | 20.6960 | 20.6969 | 20.7013 | 20.7022 | 20.7067 | 20.7067 | 20.7076 | 20.7049 | 20.7022 | 20.7005 | 20.6987 | (93) |

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8. Space heating requirement

---

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9710 | 0.9526 | 0.9189 | 0.8265 | 0.6767 | 0.4800 | 0.3401 | 0.3721 | 0.5894 | 0.8460 | 0.9462 | 0.9747 | (94) |
| Useful gains | 372.3762 | 397.9495 | 399.7067 | 380.9218 | 318.7037 | 221.9557 | 150.4158 | 157.1106 | 237.6696 | 318.3863 | 348.8500 | 361.7866 | (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 | 627.1568 | 602.3381 | 539.6517 | 441.4910 | 335.6924 | 224.0443 | 150.6682 | 157.5203 | 243.9123 | 376.7112 | 510.4328 | 623.1758 | (97) |
| Space heating kWh | 189.5568 | 137.3492 | 104.1191 | 43.6098 | 12.6396 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 43.3938 | 116.3396 | 194.4736 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 841.4813 | |
| Solar heating kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | 189.5568 | 137.3492 | 104.1191 | 43.6098 | 12.6396 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 43.3938 | 116.3396 | 194.4736 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 841.4813 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 16.7626 | (99) |

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

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

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

Efficiency of main space heating system 1 (in %) 297.6933 (206)

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

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement | 189.5568 | 137.3492 | 104.1191 | 43.6098 | 12.6396 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 43.3938 | 116.3396 | 194.4736 | (98) |
| Space heating efficiency (main heating system 1) | 297.6933 | 297.6933 | 297.6933 | 297.6933 | 297.6933 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 297.6933 | 297.6933 | 297.6933 | (210) |
| Space heating fuel (main heating system) | 63.6752 | 46.1378 | 34.9753 | 14.6492 | 4.2458 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 14.5767 | 39.0803 | 65.3268 | (211) |
| Space heating efficiency (main heating system 2) | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (212) |
| Space heating fuel (main heating system 2) | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (213) |
| Space heating fuel (secondary) | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (215) |
| Water heating | | | | | | | | | | | | | |
| Water heating requirement | 184.1905 | 162.4019 | 171.3472 | 147.8850 | 141.4632 | 125.4174 | 122.3095 | 128.3300 | 131.0214 | 148.5545 | 160.9550 | 181.8209 | (64) |
| Efficiency of water heater | | | | | | | | | | | | 194.1800 | (216) |
| (217)m | 194.1800 | 194.1800 | 194.1800 | 194.1800 | 194.1800 | 194.1800 | 194.1800 | 194.1800 | 194.1800 | 194.1800 | 194.1800 | 194.1800 | (217) |
| Fuel for water heating, kWh/month | 94.8556 | 83.6347 | 88.2414 | 76.1587 | 72.8516 | 64.5882 | 62.9877 | 66.0882 | 67.4742 | 76.5035 | 82.8896 | 93.6352 | (219) |
| Space cooling fuel requirement | | | | | | | | | | | | | |
| (221)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (221) |
| Pumps and Fa | 7.8794 | 7.1168 | 7.8794 | 7.6252 | 7.8794 | 7.6252 | 7.8794 | 7.8794 | 7.6252 | 7.8794 | 7.6252 | 7.8794 | (231) |
| Lighting | 18.0301 | 14.4644 | 13.0236 | 9.5416 | 7.3702 | 6.0216 | 6.7234 | 8.7393 | 11.3515 | 14.8938 | 16.8225 | 18.5312 | (232) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (233a)m | -27.9085 | -44.6892 | -72.4589 | -86.4811 | -94.8989 | -88.4306 | -86.8299 | -80.9039 | -68.5301 | -52.8499 | -31.8978 | -23.2545 | (233a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (234a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (234a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (235a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235a) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | | |
| (235c)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235c) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (233b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (233b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (234b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (234b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (235b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235b) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | | |
| (235d)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235d) |
| Annual totals kWh/year | | | | | | | | | | | | | |
| Space heating fuel - main system 1 | | | | | | | | | | | | 282.6672 | (211) |
| Space heating fuel - main system 2 | | | | | | | | | | | | 0.0000 | (213) |
| Space heating fuel - secondary | | | | | | | | | | | | 0.0000 | (215) |
| Efficiency of water heater | | | | | | | | | | | | 194.1800 | |

| | | |
|---|---|---|
| Water heating fuel used | 929.9087 | (219) |
| Space cooling fuel | 0.0000 | (221) |
| Electricity for pumps and fans: | | |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.9500) | | |
| mechanical ventilation fans (SFP = 0.9500) | 92.7732 | (230a) |
| Total electricity for the above, kWh/year | 92.7732 | (231) |
| Electricity for lighting (calculated in Appendix L) | 145.5132 | (232) |
| Energy saving/generation technologies (Appendices M ,N and Q) | | |
| PV generation | -759.1332 | (233) |
| Wind generation | 0.0000 | (234) |
| Hydro-electric generation (Appendix N) | 0.0000 | (235a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 | (235) |
| Appendix Q - special features | | |
| Energy saved or generated | -0.0000 | (236) |
| Energy used | 0.0000 | (237) |
| Total delivered energy for all uses | 691.7291 | (238) |

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

| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 282.6672 | 0.1567 | 44.2994 | (261) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 929.9087 | 0.1413 | 131.4104 | (264) |
| Space and water heating | | | 175.7098 | (265) |
| Pumps, fans and electric keep-hot | 92.7732 | 0.1387 | 12.8688 | (267) |
| Energy for lighting | 145.5132 | 0.1443 | 21.0021 | (268) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -759.1332 | 0.1332 | -101.1453 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -101.1453 | (269) |
| Total CO2, kg/year | | | 108.4353 | (272) |
| EPC Dwelling Carbon Dioxide Emission Rate (DER) | | | 2.1600 | (273) |

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

| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 282.6672 | 1.5802 | 446.6680 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 929.9087 | 1.5226 | 1415.8357 | (278) |
| Space and water heating | | | 1862.5037 | (279) |
| Pumps, fans and electric keep-hot | 92.7732 | 1.5128 | 140.3473 | (281) |
| Energy for lighting | 145.5132 | 1.5338 | 223.1930 | (282) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -759.1332 | 1.4924 | -1132.9047 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -1132.9047 | (283) |
| Total Primary energy kWh/year | | | 1093.1393 | (286) |
| Dwelling Primary energy Rate (DPER) | | | 21.7800 | (287) |

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF TARGET EMISSIONS

1. Overall dwelling characteristics

| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 50.2000 | (1b) x | 2.5000 | (2b) = | 125.5000 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 50.2000 | | | | | | (4) |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | | 125.5000 | (5) |

2. Ventilation rate

| | | m3 per hour | |
|---|---|---|---|
| Number of open chimneys | 0 * 80 = | 0.0000 | (6a) |
| Number of open flues | 0 * 20 = | 0.0000 | (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 | (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 | (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 | (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 | (6f) |
| Number of intermittent extract fans | 2 * 10 = | 20.0000 | (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 | (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 | (7c) |
| | Air changes per hour | | |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 20.0000 / (5) = | 0.1594 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 5.0000 | (17) |
| Infiltration rate | | 0.4094 | (18) |
| Number of sides sheltered | | 3 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 0.7750 | (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.3173 | (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | | | | | | | | | | | | | |
| | 0.4045 | 0.3966 | 0.3886 | 0.3490 | 0.3411 | 0.3014 | 0.3014 | 0.2935 | 0.3173 | 0.3411 | 0.3569 | 0.3728 | (22b) |
| Effective ac | 0.5818 | 0.5786 | 0.5755 | 0.5609 | 0.5582 | 0.5454 | 0.5454 | 0.5431 | 0.5503 | 0.5582 | 0.5637 | 0.5695 | (25) |

## 3. Heat losses and heat loss parameter

| Element | Gross | Openings | NetArea | U-value | A x U | K-value | A x K | |
|---|---|---|---|---|---|---|---|---|
| Main dwelling | m2 | m2 | m2 | W/m2K | W/K | kJ/m2K | kJ/K | |
| TER Opaque door | | | 2.0600 | 1.0000 | 2.0600 | | | (26) |
| TER Opening Type | | | 6.2500 | 1.1450 | 7.1565 | | | (27) |
| External Wall 1 | 17.8200 | 8.3100 | 9.5100 | 0.1800 | 1.7118 | | | (29a) |
| Corridor | 17.8200 | | 17.8200 | 0.1800 | 3.2076 | | | (29a) |
| Main Roof | 50.2000 | | 50.2000 | 0.1100 | 5.5220 | | | (30) |
| Total net area of external elements Aum(A, m2) | | | 85.8400 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 19.6579 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall | | | 41.0400 | 0.0000 | 0.0000 | | | (32) |

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 179.5701 (35)

List of Thermal Bridges

| K1 Element | Length | Psi-value | Total |
|---|---|---|---|
| E7 Party floor between dwellings (in blocks of flats) | 2.7000 | 0.0700 | 0.1890 |
| E7 Party floor between dwellings (in blocks of flats) | 6.6000 | 0.0700 | 0.4620 |
| E23 Balcony within or between dwellings, balcony support penetrates wall insulation | 3.9000 | 0.0200 | 0.0780 |
| E18 Party wall between dwellings | 5.4000 | 0.0600 | 0.3240 |
| E18 Party wall between dwellings | 5.4000 | 0.0600 | 0.3240 |
| P3 Party wall - Intermediate floor between dwellings (in blocks of flats) | 15.2000 | 0.0000 | 0.0000 |
| E2 Other lintels (including other steel lintels) | 4.3300 | 0.0500 | 0.2165 |
| E3 Sill | 3.3500 | 0.0500 | 0.1675 |
| E4 Jamb | 11.7000 | 0.0500 | 0.5850 |
| E15 Flat roof with parapet | 6.6000 | 0.5600 | 3.6960 |
| E14 Flat roof | 6.6000 | 0.0800 | 0.5280 |
| P4 Party wall - Roof (insulation at ceiling level) | 15.2000 | 0.1200 | 1.8240 |

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 8.3940 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 28.0519 (37)

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 24.0957 | 23.9641 | 23.8352 | 23.2294 | 23.1161 | 22.5885 | 22.5885 | 22.4908 | 22.7917 | 23.1161 | 23.3454 | 23.5851 | (38) |
| Heat transfer coeff | | | | | | | | | | | | | |
| | 52.1476 | 52.0160 | 51.8870 | 51.2813 | 51.1680 | 50.6404 | 50.6404 | 50.5427 | 50.8436 | 51.1680 | 51.3973 | 51.6369 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 51.2808 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.0388 | 1.0362 | 1.0336 | 1.0215 | 1.0193 | 1.0088 | 1.0088 | 1.0068 | 1.0128 | 1.0193 | 1.0238 | 1.0286 | (40) |
| HLP (average) | | | | | | | | | | | | 1.0215 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

## 4. Water heating energy requirements (kWh/year)

Assumed occupancy 1.6960 (42)

Hot water usage for mixer showers

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 52.6557 | 51.8644 | 50.7113 | 48.5050 | 46.8769 | 45.0612 | 44.0291 | 45.1735 | 46.4279 | 48.3774 | 50.6311 | 52.4539 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 22.7669 | 22.4288 | 21.9526 | 21.0747 | 20.4173 | 19.6884 | 19.2947 | 19.7675 | 20.2823 | 21.0623 | 21.9583 | 22.6899 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 31.9986 | 30.8351 | 29.6715 | 28.5079 | 27.3443 | 26.1807 | 26.1807 | 27.3443 | 28.5079 | 29.6715 | 30.8351 | 31.9986 | (42c) |

Average daily hot water use (litres/day) 98.7449 (43)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | | | | | | | | | | | | | |
| | 107.4212 | 105.1282 | 102.3354 | 98.0876 | 94.6385 | 90.9303 | 89.5045 | 92.2853 | 95.2181 | 99.1112 | 103.4244 | 107.1425 | (44) |
| Energy conte | 170.1289 | 149.7011 | 157.2856 | 134.2770 | 127.4016 | 111.8094 | 108.2479 | 114.2684 | 117.4134 | 134.4929 | 147.3470 | 167.7593 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1640.1327 | |
| Distribution loss (46)m = 0.15 x (45)m | | | | | | | | | | | | | |
| | 25.5193 | 22.4552 | 23.5928 | 20.1416 | 19.1102 | 16.7714 | 16.2372 | 17.1403 | 17.6120 | 20.1739 | 22.1021 | 25.1639 | (46) |
| Water storage loss (or HIU loss): | | | | | | | | | | | | | |
| Store volume | | | | | | | | | | | | 150.0000 | (47) |
| a) If manufacturer declared loss factor is known (kWh/day): | | | | | | | | | | | | 1.3938 | (48) |
| Temperature factor from Table 2b | | | | | | | | | | | | 0.5400 | (49) |
| Enter (49) or (54) in (55) | | | | | | | | | | | | 0.7527 | (55) |
| Total storage loss | | | | | | | | | | | | | |
| | 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (56) |
| If cylinder contains dedicated solar storage | | | | | | | | | | | | | |
| | 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (57) |
| Primary loss | 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |
| Total heat required for water heating calculated for each month | | | | | | | | | | | | | |
| | 216.7238 | 191.7869 | 203.8805 | 179.3689 | 173.9965 | 156.9012 | 154.8428 | 160.8633 | 162.5053 | 181.0878 | 192.4389 | 214.3542 | (62) |
| WWHRS | -24.0720 | -21.2895 | -22.2931 | -18.4596 | -17.2036 | -14.7213 | -13.7989 | -14.6737 | -15.2312 | -17.9559 | -20.3419 | -23.6262 | (63a) |
| PV diverter | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |
| Output from w/h | | | | | | | | | | | | | |
| | 192.6519 | 170.4974 | 181.5874 | 160.9093 | 156.7928 | 142.1799 | 141.0440 | 146.1896 | 147.2741 | 163.1319 | 172.0970 | 190.7280 | (64) |
| | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 1965.0834 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 1965 | (64) |
| Electric shower(s) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |
| | | | | | | | | | | Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | | 0.0000 | (64a) |
| Heat gains from water heating, kWh/month | | | | | | | | | | | | | |
| | 93.8438 | 83.4442 | 89.5734 | 80.7206 | 79.6370 | 73.2501 | 73.2684 | 75.2702 | 75.1134 | 81.9948 | 85.0664 | 93.0559 | (65) |

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

Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 84.7995 | 84.7995 | 84.7995 | 84.7995 | 84.7995 | 84.7995 | 84.7995 | 84.7995 | 84.7995 | 84.7995 | 84.7995 | 84.7995 | (66) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 82.0470 | 90.8377 | 82.0470 | 84.7819 | 82.0470 | 84.7819 | 82.0470 | 82.0470 | 84.7819 | 82.0470 | 84.7819 | 82.0470 | (67) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 147.7534 | 149.2866 | 145.4229 | 137.1977 | 126.8147 | 117.0562 | 110.5370 | 109.0038 | 112.8674 | 121.0927 | 131.4756 | 141.2341 | (68) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 31.4800 | 31.4800 | 31.4800 | 31.4800 | 31.4800 | 31.4800 | 31.4800 | 31.4800 | 31.4800 | 31.4800 | 31.4800 | 31.4800 | (69) |
| Pumps, fans | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 3.0000 | 3.0000 | 3.0000 | (70) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | -67.8396 | -67.8396 | -67.8396 | -67.8396 | -67.8396 | -67.8396 | -67.8396 | -67.8396 | -67.8396 | -67.8396 | -67.8396 | -67.8396 | (71) |

Water heating gains (Table 5)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 126.1341 | 124.1729 | 120.3943 | 112.1119 | 107.0389 | 101.7362 | 98.4790 | 101.1696 | 104.3242 | 110.2081 | 118.1477 | 125.0751 | (72) |

Total internal gains

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 407.3744 | 415.7371 | 399.3041 | 385.5313 | 367.3405 | 352.0142 | 339.5028 | 340.6602 | 350.4134 | 364.7876 | 385.8451 | 399.7961 | (73) |

---

## 6. Solar gains

---

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| West | 6.2500 | 19.6403 | 0.6300 | 0.7000 | 0.7700 | 37.5145 | (80) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 37.5145 | 73.3863 | 120.8568 | 176.2625 | 216.0163 | 221.1311 | 210.5258 | 180.8386 | 140.5615 | 87.0791 | 46.7762 | 30.8501 | (83) |
| Total gains | 444.8889 | 489.1234 | 520.1609 | 561.7938 | 583.3568 | 573.1453 | 550.0286 | 521.4988 | 490.9749 | 451.8667 | 432.6213 | 430.6462 | (84) |

---

## 7. Mean internal temperature (heating season)

---

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

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| tau | 48.0177 | 48.1391 | 48.2588 | 48.8288 | 48.9370 | 49.4468 | 49.4468 | 49.5424 | 49.2492 | 48.9370 | 48.7187 | 48.4925 | |
| alpha | 4.2012 | 4.2093 | 4.2173 | 4.2553 | 4.2625 | 4.2965 | 4.2965 | 4.3028 | 4.2833 | 4.2625 | 4.2479 | 4.2328 | |
| util living area | 0.9700 | 0.9540 | 0.9238 | 0.8477 | 0.7198 | 0.5432 | 0.4001 | 0.4381 | 0.6563 | 0.8698 | 0.9495 | 0.9733 | (86) |
| MIT | 19.7608 | 19.9533 | 20.2323 | 20.5913 | 20.8414 | 20.9637 | 20.9922 | 20.9885 | 20.9189 | 20.6057 | 20.1404 | 19.7323 | (87) |
| Th 2 | 20.0511 | 20.0533 | 20.0554 | 20.0654 | 20.0673 | 20.0760 | 20.0760 | 20.0776 | 20.0727 | 20.0673 | 20.0635 | 20.0595 | (88) |
| util rest of house | 0.9636 | 0.9445 | 0.9080 | 0.8173 | 0.6689 | 0.4726 | 0.3184 | 0.3537 | 0.5858 | 0.8370 | 0.9375 | 0.9677 | (89) |
| MIT 2 | 18.6298 | 18.8716 | 19.2180 | 19.6532 | 19.9294 | 20.0525 | 20.0728 | 20.0725 | 20.0141 | 19.6811 | 19.1165 | 18.6001 | (90) |
| Living area fraction | | | | | | | | | fLA = Living area / (4) = | | | 0.5727 | (91) |
| MIT | 19.2775 | 19.4911 | 19.7989 | 20.1905 | 20.4517 | 20.5743 | 20.5993 | 20.5971 | 20.5323 | 20.2107 | 19.7029 | 19.2485 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 19.2775 | 19.4911 | 19.7989 | 20.1905 | 20.4517 | 20.5743 | 20.5993 | 20.5971 | 20.5323 | 20.2107 | 19.7029 | 19.2485 | (93) |

---

## 8. Space heating requirement

---

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9573 | 0.9377 | 0.9031 | 0.8217 | 0.6907 | 0.5113 | 0.3650 | 0.4017 | 0.6219 | 0.8426 | 0.9320 | 0.9616 | (94) |
| Useful gains | 425.8715 | 458.6734 | 469.7317 | 461.6357 | 402.9413 | 293.0435 | 200.7691 | 209.4864 | 305.3457 | 380.7345 | 403.2200 | 414.1076 | (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 | 781.0417 | 758.9703 | 690.0406 | 578.9900 | 447.8070 | 302.5422 | 202.5270 | 212.1327 | 327.0416 | 491.7581 | 647.7552 | 777.0590 | (97) |
| Space heating kWh | 264.2467 | 201.7995 | 163.9099 | 84.4951 | 33.3801 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 82.6015 | 176.0654 | 270.0359 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 1276.5340 | |
| Solar heating kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | 264.2467 | 201.7995 | 163.9099 | 84.4951 | 33.3801 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 82.6015 | 176.0654 | 270.0359 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 1276.5340 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 25.4290 | (99) |

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

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

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

Efficiency of main space heating system 1 (in %) 92.3000 (206)

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

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement | 264.2467 | 201.7995 | 163.9099 | 84.4951 | 33.3801 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 82.6015 | 176.0654 | 270.0359 | (98) |
| Space heating efficiency (main heating system 1) | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 92.3000 | 92.3000 | 92.3000 | (210) |
| Space heating fuel (main heating system) | 286.2911 | 218.6344 | 177.5838 | 91.5440 | 36.1648 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 89.4925 | 190.7534 | 292.5632 | (211) |
| Space heating efficiency (main heating system 2) | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (212) |
| Space heating fuel (main heating system 2) | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (213) |
| Space heating fuel (secondary) | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (215) |
| Water heating | | | | | | | | | | | | | |
| Water heating requirement | 192.6519 | 170.4974 | 181.5874 | 160.9093 | 156.7928 | 142.1799 | 141.0440 | 146.1896 | 147.2741 | 163.1319 | 172.0970 | 190.7280 | (64) |
| Efficiency of water heater | | | | | | | | | | | | 79.8000 | (216) |
| (217)m | 84.7688 | 84.4388 | 83.8308 | 82.6854 | 81.2453 | 79.8000 | 79.8000 | 79.8000 | 79.8000 | 82.6146 | 84.1110 | 84.8393 | (217) |
| Fuel for water heating, kWh/month | 227.2673 | 201.9184 | 216.6118 | 194.6042 | 192.9869 | 178.1703 | 176.7468 | 183.1950 | 184.5540 | 197.4615 | 204.6071 | 224.8109 | (219) |
| Space cooling fuel requirement | | | | | | | | | | | | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (221)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (221) |
| Pumps and Fa | 7.3041 | 6.5973 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 | (231) |
| Lighting | 17.0477 | 13.6763 | 12.3140 | 9.0218 | 6.9687 | 5.6935 | 6.3571 | 8.2632 | 10.7330 | 14.0823 | 15.9059 | 17.5216 | (232) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (233a)m | -7.4431 | -11.4422 | -17.9162 | -22.0059 | -25.4253 | -24.3737 | -24.0906 | -21.8926 | -18.3353 | -13.8734 | -8.5162 | -6.3301 | (233a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (234a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (234a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (235a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235a) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | | |
| (235c)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235c) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (233b)m | -1.7447 | -3.8126 | -7.8514 | -12.2056 | -16.5504 | -16.7735 | -16.5644 | -13.8234 | -9.8808 | -5.5708 | -2.3669 | -1.3686 | (233b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (234b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (234b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (235b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235b) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | | |
| (235d)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235d) |

| | | |
|---|---|---|
| Annual totals kWh/year | | |
| Space heating fuel - main system 1 | 1383.0271 | (211) |
| Space heating fuel - main system 2 | 0.0000 | (213) |
| Space heating fuel - secondary | 0.0000 | (215) |
| Efficiency of water heater | 79.8000 | |
| Water heating fuel used | 2382.9343 | (219) |
| Space cooling fuel | 0.0000 | (221) |
| | | |
| Electricity for pumps and fans: | | |
| Total electricity for the above, kWh/year | 86.0000 | (231) |
| Electricity for lighting (calculated in Appendix L) | 137.5851 | (232) |
| | | |
| Energy saving/generation technologies (Appendices M ,N and Q) | | |
| PV generation | -310.1576 | (233) |
| Wind generation | 0.0000 | (234) |
| Hydro-electric generation (Appendix N) | 0.0000 | (235a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 | (235) |
| Appendix Q - special features | | |
| Energy saved or generated | -0.0000 | (236) |
| Energy used | 0.0000 | (237) |
| Total delivered energy for all uses | 3679.3889 | (238) |

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

| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 1383.0271 | 0.2100 | 290.4357 | (261) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 2382.9343 | 0.2100 | 500.4162 | (264) |
| Space and water heating | | | 790.8519 | (265) |
| Pumps, fans and electric keep-hot | 86.0000 | 0.1387 | 11.9293 | (267) |
| Energy for lighting | 137.5851 | 0.1443 | 19.8578 | (268) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -201.6446 | 0.1328 | -26.7805 | |
| PV Unit electricity exported | -108.5130 | 0.1249 | -13.5556 | |
| Total | | | -40.3360 | (269) |
| Total CO2, kg/year | | | 782.3029 | (272) |
| EPC Target Carbon Dioxide Emission Rate (TER) | | | 15.5800 | (273) |

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

| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 1383.0271 | 1.1300 | 1562.8207 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 2382.9343 | 1.1300 | 2692.7157 | (278) |
| Space and water heating | | | 4255.5364 | (279) |
| Pumps, fans and electric keep-hot | 86.0000 | 1.5128 | 130.1008 | (281) |
| Energy for lighting | 137.5851 | 1.5338 | 211.0326 | (282) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -201.6446 | 1.4907 | -300.6000 | |
| PV Unit electricity exported | -108.5130 | 0.4585 | -49.7532 | |
| Total | | | -350.3532 | (283) |
| Total Primary energy kWh/year | | | 4246.3165 | (286) |
| Target Primary Energy Rate (TPER) | | | 84.5900 | (287) |

# Full SAP Calculation Printout

| | | | |
|---|---|---|---|
| Plot Reference | 2B4P End GF N | Issued on Date | 16/01/2026 |
| Assessment Reference | 2B4P End GF N | Plot Type Ref | 2B4P End GF N |
| Plot Address | | SAP Version | 10.2 |

| | | | | | |
|---|---|---|---|---|---|
| SAP Rating | 85 B | DER | 1.89 | TER | 14.16 |
| Environmental | 98 A | % DER < TER | | | 86.65 |
| $CO_2$ Emissions (t/year) | 0.11 | DFEE | 38.87 | TFEE | 38.49 |
| Compliance Check | See BREL | % DFEE < TFEE | | | -0.98 |
| % DPER < TPER | 75.41 | DPER | 18.75 | TPER | 76.24 |

| | | | |
|---|---|---|---|
| Assessor Details | Miss Eleanor Risby | Assessor ID | M976-0001 |
| Client | | | |

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE

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1. Overall dwelling characteristics

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| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 80.5500 | (1b) | x 2.5000 | (2b) = | 201.3750 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 80.5500 | | | | | (4) |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | 201.3750 | (5) |

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2. Ventilation rate

---

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

| | Air changes per hour | | |
|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 0.0000 / (5) = | 0.0000 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 3.0000 | (17) |
| Infiltration rate | | 0.1500 | (18) |
| Number of sides sheltered | | 2 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 0.8500 | (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.1275 | (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.1626 | 0.1594 | 0.1562 | 0.1403 | 0.1371 | 0.1211 | 0.1211 | 0.1179 | 0.1275 | 0.1371 | 0.1434 | 0.1498 | (22b) |

Balanced mechanical ventilation with heat recovery

| | | |
|---|---|---|
| If mechanical ventilation | | 0.5000 (23a) |
| If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) | | 0.5000 (23b) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = | | 77.4000 (23c) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Effective ac | 0.2756 | 0.2724 | 0.2692 | 0.2532 | 0.2501 | 0.2341 | 0.2341 | 0.2309 | 0.2405 | 0.2501 | 0.2564 | 0.2628 | (25) |

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3. Heat losses and heat loss parameter

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| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | | |
| Glazing | | | 14.9300 | 1.1450 | 17.0954 | | | (27) |
| Corridor Door | | | 2.0600 | 1.0000 | 2.0600 | | | (26) |
| Heatloss Floor 1 | | | 80.5500 | 0.1000 | 8.0550 | 110.0000 | 8860.5000 | (28a) |
| External Wall 1 | 54.2700 | 16.9900 | 37.2800 | 0.1900 | 7.0832 | 14.0000 | 521.9200 | (29a) |
| Corridor | 17.2800 | | 17.2800 | 0.1600 | 2.7648 | 14.0000 | 241.9200 | (29a) |
| Total net area of external elements Aum(A, m2) | | | 152.1000 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | | (26)...(30) + (32) = | 37.0584 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall | | | 32.0000 | 0.0000 | 0.0000 | 20.0000 | 640.0000 | (32) |
| Party Ceiling 1 | | | 80.5500 | | | 30.0000 | 2416.5000 | (32b) |
| Internal Wall 1 | | | 150.7500 | | | 9.0000 | 1356.7500 | (32c) |

| | | |
|---|---|---|
| Heat capacity Cm = Sum(A x k) | (28)...(30) + (32) + (32a)...(32e) = | 14037.5900 (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | | 174.2718 (35) |
| List of Thermal Bridges | | |

| | Length | Psi-value | Total |
|---|---|---|---|
| K1 Element | | | |
| E2 Other lintels (including other steel lintels) | 9.5800 | 0.1000 | 0.9580 |
| E3 Sill | 8.6000 | 0.0500 | 0.4300 |
| E4 Jamb | 24.9000 | 0.0500 | 1.2450 |
| E7 Party floor between dwellings (in blocks of flats) | 16.2000 | 0.0700 | 1.1340 |
| E7 Party floor between dwellings (in blocks of flats) | 6.4000 | 0.1000 | 0.6400 |
| E23 Balcony within or between dwellings, balcony support penetrates wall insulation | 3.9000 | 0.1500 | 0.5850 |
| E16 Corner (normal) | 8.1000 | 0.1000 | 0.8100 |
| E17 Corner (inverted - internal area greater than external area) | 5.4000 | 0.0000 | 0.0000 |
| E17 Corner (inverted - internal area greater than external area) | 2.7000 | 0.0000 | 0.0000 |
| E18 Party wall between dwellings | 5.4000 | 0.0600 | 0.3240 |
| E18 Party wall between dwellings | 2.7000 | 0.0900 | 0.2430 |
| E25 Staggered party wall between dwellings | 2.7000 | 0.0900 | 0.2430 |
| P3 Party wall - Intermediate floor between dwellings (in blocks of flats) | 11.8500 | 0.0000 | 0.0000 |
| P1 Party wall - Ground floor | 11.8500 | 0.0500 | 0.5925 |
| E5 Ground floor (normal) | 20.1000 | 0.2000 | 4.0200 |
| E5 Ground floor (normal) | 6.4000 | 0.2700 | 1.7280 |

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 12.9525 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 50.0109 (37)

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 18.3122 | 18.1003 | 17.8885 | 16.8294 | 16.6176 | 15.5585 | 15.5585 | 15.3467 | 15.9821 | 16.6176 | 17.0412 | 17.4649 | (38) |
| Heat transfer coeff | 68.3231 | 68.1113 | 67.8994 | 66.8403 | 66.6285 | 65.5694 | 65.5694 | 65.3576 | 65.9930 | 66.6285 | 67.0522 | 67.4758 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 66.7874 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 0.8482 | 0.8456 | 0.8429 | 0.8298 | 0.8272 | 0.8140 | 0.8140 | 0.8114 | 0.8193 | 0.8272 | 0.8324 | 0.8377 | (40) |
| HLP (average) | | | | | | | | | | | | 0.8291 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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## 4. Water heating energy requirements (kWh/year)

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Assumed occupancy 2.4732 (42)
Hot water usage for mixer showers

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 65.6874 | 64.7002 | 63.2617 | 60.5095 | 58.4784 | 56.2133 | 54.9259 | 56.3534 | 57.9183 | 60.3503 | 63.1617 | 65.4357 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 28.3709 | 27.9496 | 27.3563 | 26.2622 | 25.4430 | 24.5347 | 24.0440 | 24.6332 | 25.2748 | 26.2467 | 27.3633 | 28.2750 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 39.9582 | 38.5052 | 37.0521 | 35.5991 | 34.1461 | 32.6931 | 32.6931 | 34.1461 | 35.5991 | 37.0521 | 38.5052 | 39.9582 | (42c) |

Average daily hot water use (litres/day) 123.1915 (43)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 134.0165 | 131.1550 | 127.6701 | 122.3708 | 118.0675 | 113.4411 | 111.6629 | 115.1327 | 118.7922 | 123.6492 | 129.0302 | 133.6689 | (44) |
| Energy conte | 212.2494 | 186.7629 | 196.2242 | 167.5195 | 158.9415 | 139.4890 | 135.0466 | 142.5584 | 146.4827 | 167.7908 | 183.8271 | 209.2932 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 2046.1855 | |
| Distribution loss (46)m = 0.15 x (45)m | 31.8374 | 28.0144 | 29.4336 | 25.1279 | 23.8412 | 20.9234 | 20.2570 | 21.3838 | 21.9724 | 25.1686 | 27.5741 | 31.3940 | (46) |
| Water storage loss (or HIU loss): | | | | | | | | | | | | | |
| Store volume | | | | | | | | | | | | 180.0000 | (47) |
| a) If manufacturer declared loss factor is known (kWh/day): | | | | | | | | | | | | 0.8400 | (48) |
| Temperature factor from Table 2b | | | | | | | | | | | | 0.5400 | (49) |
| Enter (49) or (54) in (55) | | | | | | | | | | | | 0.4536 | (55) |
| Total storage loss | 14.0616 | 12.7008 | 14.0616 | 13.6080 | 14.0616 | 13.6080 | 14.0616 | 14.0616 | 13.6080 | 14.0616 | 13.6080 | 14.0616 | (56) |
| If cylinder contains dedicated solar storage | 14.0616 | 12.7008 | 14.0616 | 13.6080 | 14.0616 | 13.6080 | 14.0616 | 14.0616 | 13.6080 | 14.0616 | 13.6080 | 14.0616 | (57) |
| Primary 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 | (59) |
| Combi loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |
| Total heat required for water heating calculated for each month | 226.3110 | 199.4637 | 210.2858 | 181.1275 | 173.0031 | 153.0970 | 149.1082 | 156.6200 | 160.0907 | 181.8524 | 197.4351 | 223.3548 | (62) |
| WWHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63a) |
| PV diverter | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |
| Output from w/h | 226.3110 | 199.4637 | 210.2858 | 181.1275 | 173.0031 | 153.0970 | 149.1082 | 156.6200 | 160.0907 | 181.8524 | 197.4351 | 223.3548 | (64) |
| | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 2211.7495 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 2212 | (64) |
| Electric shower(s) | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |
| | | | | | | | | | | Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | | 0.0000 | (64a) |
| Heat gains from water heating, kWh/month | 70.5729 | 62.0987 | 65.2446 | 55.7002 | 52.8481 | 46.3801 | 44.9030 | 47.4007 | 48.7055 | 55.7904 | 61.1225 | 69.5900 | (65) |

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

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Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 123.6607 | 123.6607 | 123.6607 | 123.6607 | 123.6607 | 123.6607 | 123.6607 | 123.6607 | 123.6607 | 123.6607 | 123.6607 | 123.6607 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 115.7685 | 128.1722 | 115.7685 | 119.6274 | 115.7685 | 119.6274 | 115.7685 | 115.7685 | 119.6274 | 115.7685 | 119.6274 | 115.7685 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 220.5862 | 222.8752 | 217.1070 | 204.8272 | 189.3262 | 174.7574 | 165.0245 | 162.7355 | 168.5037 | 180.7835 | 196.2846 | 210.8533 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 35.3661 | 35.3661 | 35.3661 | 35.3661 | 35.3661 | 35.3661 | 35.3661 | 35.3661 | 35.3661 | 35.3661 | 35.3661 | 35.3661 | (69) |
| Pumps, fans | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | -98.9286 | -98.9286 | -98.9286 | -98.9286 | -98.9286 | -98.9286 | -98.9286 | -98.9286 | -98.9286 | -98.9286 | -98.9286 | -98.9286 | (71) |
| Water heating gains (Table 5) | 94.8561 | 92.4087 | 87.6943 | 77.3615 | 71.0323 | 64.4168 | 60.3535 | 63.7106 | 67.6465 | 74.9871 | 84.8924 | 93.5349 | (72) |
| Total internal gains | 491.3090 | 503.5544 | 480.6680 | 461.9143 | 436.2252 | 418.8998 | 401.2447 | 402.3128 | 415.8759 | 431.6373 | 460.9026 | 480.2550 | (73) |

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## 6. Solar gains

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

| | | W/m2 | or Table 6b | or Table 6c | Table 6d | | |
|---|---|---|---|---|---|---|---|
| North | | 5.0400 | 10.6334 | 0.4500 | 0.7000 | 0.7700 | 11.6989 (74) |
| Northeast | | 1.8200 | 11.2829 | 0.4500 | 0.7000 | 0.7700 | 4.4827 (75) |
| West | | 6.2500 | 19.6403 | 0.4500 | 0.7000 | 0.7700 | 26.7961 (80) |
| Northwest | | 1.8200 | 11.2829 | 0.4500 | 0.7000 | 0.7700 | 4.4827 (81) |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 47.4604 | 93.0253 | 157.1961 | 240.9214 | 309.0830 | 323.3324 | 304.9237 | 252.0625 | 186.1418 | 111.1147 | 59.1244 | 39.1102 (83) |
| Total gains | 538.7693 | 596.5797 | 637.8640 | 702.8357 | 745.3082 | 742.2322 | 706.1684 | 654.3753 | 602.0177 | 542.7521 | 520.0270 | 519.3651 (84) |

7. Mean internal temperature (heating season)

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

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| tau | 57.0719 | 57.2494 | 57.4280 | 58.3380 | 58.5235 | 59.4688 | 59.4688 | 59.6615 | 59.0870 | 58.5235 | 58.1537 | 57.7886 | |
| alpha | 4.8048 | 4.8166 | 4.8285 | 4.8892 | 4.9016 | 4.9646 | 4.9646 | 4.9774 | 4.9391 | 4.9016 | 4.8769 | 4.8526 | |
| util living area | 0.9855 | 0.9750 | 0.9530 | 0.8828 | 0.7460 | 0.5504 | 0.4057 | 0.4542 | 0.6991 | 0.9143 | 0.9735 | 0.9876 | (86) |
| Living | 20.0726 | 20.2068 | 20.4023 | 20.6690 | 20.8463 | 20.9217 | 20.9347 | 20.9329 | 20.8881 | 20.6570 | 20.3317 | 20.0558 | |
| Non living | 19.1164 | 19.2878 | 19.5345 | 19.8672 | 20.0671 | 20.1503 | 20.1598 | 20.1612 | 20.1184 | 19.8612 | 19.4564 | 19.1024 | |
| 24 / 16 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 24 / 9 | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |
| 16 / 9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| MIT | 21.0000 | 21.0000 | 21.0000 | 21.0000 | 21.0000 | 21.0000 | 21.0000 | 21.0000 | 21.0000 | 21.0000 | 21.0000 | 21.0000 | (87) |
| Th 2 | 20.2117 | 20.2140 | 20.2163 | 20.2276 | 20.2298 | 20.2412 | 20.2412 | 20.2435 | 20.2367 | 20.2298 | 20.2253 | 20.2208 | (88) |
| util rest of house | 0.9824 | 0.9698 | 0.9431 | 0.8595 | 0.7025 | 0.4903 | 0.3371 | 0.3819 | 0.6384 | 0.8919 | 0.9671 | 0.9850 | (89) |
| MIT 2 | 20.2117 | 20.2140 | 20.2163 | 20.2276 | 20.2298 | 20.2412 | 20.2412 | 20.2435 | 20.2367 | 20.2298 | 20.2253 | 20.2208 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.4904 | (91) |
| MIT | 20.5983 | 20.5994 | 20.6006 | 20.6064 | 20.6075 | 20.6133 | 20.6133 | 20.6145 | 20.6110 | 20.6075 | 20.6052 | 20.6029 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 20.5983 | 20.5994 | 20.6006 | 20.6064 | 20.6075 | 20.6133 | 20.6133 | 20.6145 | 20.6110 | 20.6075 | 20.6052 | 20.6029 | (93) |

8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9840 | 0.9725 | 0.9482 | 0.8715 | 0.7245 | 0.5202 | 0.3709 | 0.4176 | 0.6691 | 0.9035 | 0.9704 | 0.9863 | (94) |
| Useful gains | 530.1459 | 580.1623 | 604.8047 | 612.4983 | 539.9467 | 386.1041 | 261.9177 | 273.2851 | 402.7976 | 490.3967 | 504.6319 | 512.2686 | (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 | 1113.5494 | 1069.3087 | 957.4223 | 782.4569 | 593.4944 | 394.2884 | 263.1496 | 275.4467 | 429.6796 | 666.7858 | 905.5530 | 1106.7985 | (97) |
| Space heating kWh | 434.0522 | 328.7064 | 262.3475 | 122.3702 | 39.8395 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 131.2335 | 288.6632 | 442.3302 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 2049.5426 | |
| Solar heating kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | 434.0522 | 328.7064 | 262.3475 | 122.3702 | 39.8395 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 131.2335 | 288.6632 | 442.3302 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 2049.5426 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 25.4444 | (99) |

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

| | | |
|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | 0.0000 | (201) |
| Fraction of space heat from main system(s) | 1.0000 | (202) |
| Efficiency of main space heating system 1 (in %) | 315.7012 | (206) |
| Efficiency of main space heating system 2 (in %) | 0.0000 | (207) |
| Efficiency of secondary/supplementary heating system, % | 0.0000 | (208) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement | 434.0522 | 328.7064 | 262.3475 | 122.3702 | 39.8395 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 131.2335 | 288.6632 | 442.3302 | (98) |
| Space heating efficiency (main heating system 1) | 315.7012 | 315.7012 | 315.7012 | 315.7012 | 315.7012 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 315.7012 | 315.7012 | 315.7012 | (210) |
| Space heating fuel (main heating system) | 137.4883 | 104.1195 | 83.0999 | 38.7614 | 12.6194 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 41.5689 | 91.4356 | 140.1104 | (211) |
| Space heating efficiency (main heating system 2) | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (212) |
| Space heating fuel (main heating system 2) | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (213) |
| Space heating fuel (secondary) | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (215) |
| Water heating | | | | | | | | | | | | | |
| Water heating requirement | 226.3110 | 199.4637 | 210.2858 | 181.1275 | 173.0031 | 153.0970 | 149.1082 | 156.6200 | 160.0907 | 181.8524 | 197.4351 | 223.3548 | (64) |
| Efficiency of water heater | | | | | | | | | | | | 194.1800 | (216) |
| (217)m | 194.1800 | 194.1800 | 194.1800 | 194.1800 | 194.1800 | 194.1800 | 194.1800 | 194.1800 | 194.1800 | 194.1800 | 194.1800 | 194.1800 | (217) |
| Fuel for water heating, kWh/month | 116.5470 | 102.7211 | 108.2943 | 93.2782 | 89.0942 | 78.8428 | 76.7887 | 80.6571 | 82.4445 | 93.6515 | 101.6763 | 115.0246 | (219) |
| Space cooling fuel requirement | | | | | | | | | | | | | |
| (221)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (221) |
| Pumps and Fa | 5.9756 | 5.3973 | 5.9756 | 5.7829 | 5.9756 | 5.7829 | 5.9756 | 5.9756 | 5.7829 | 5.9756 | 5.7829 | 5.9756 | (231) |
| Lighting | 28.3822 | 22.7692 | 20.5012 | 15.0200 | 11.6019 | 9.4789 | 10.5836 | 13.7570 | 17.8690 | 23.4451 | 26.4812 | 29.1710 | (232) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (233a)m | -44.2303 | -70.4056 | -112.8608 | -131.5788 | -140.1380 | -127.9415 | -125.5741 | -118.1303 | -101.7380 | -81.9057 | -50.3336 | -36.8945 | (233a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (234a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (234a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (235a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235a) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | | |
| (235c)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235c) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (233b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (233b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (234b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (234b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (235b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235b) |

Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (235d)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235d) |

| | | |
|---|---|---|
| Annual totals kWh/year | | |
| Space heating fuel - main system 1 | 649.2033 | (211) |
| Space heating fuel - main system 2 | 0.0000 | (213) |
| Space heating fuel - secondary | 0.0000 | (215) |
| Efficiency of water heater | 194.1800 | |
| Water heating fuel used | 1139.0202 | (219) |
| Space cooling fuel | 0.0000 | (221) |
| Electricity for pumps and fans: | | |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.9500) | | |
| mechanical ventilation fans (SFP = 0.9500) | 70.3582 | (230a) |
| Total electricity for the above, kWh/year | 70.3582 | (231) |
| Electricity for lighting (calculated in Appendix L) | 229.0604 | (232) |
| Energy saving/generation technologies (Appendices M ,N and Q) | | |
| PV generation | -1141.7312 | (233) |
| Wind generation | 0.0000 | (234) |
| Hydro-electric generation (Appendix N) | 0.0000 | (235a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 | (235) |
| Appendix Q - special features | | |
| Energy saved or generated | -0.0000 | (236) |
| Energy used | 0.0000 | (237) |
| Total delivered energy for all uses | 945.9110 | (238) |

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

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| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 649.2033 | 0.1560 | 101.2908 | (261) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 1139.0202 | 0.1414 | 161.0160 | (264) |
| Space and water heating | | | 262.3068 | (265) |
| Pumps, fans and electric keep-hot | 70.3582 | 0.1387 | 9.7595 | (267) |
| Energy for lighting | 229.0604 | 0.1443 | 33.0605 | (268) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -1141.7312 | 0.1338 | -152.7438 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -152.7438 | (269) |
| Total CO2, kg/year | | | 152.3830 | (272) |
| EPC Dwelling Carbon Dioxide Emission Rate (DER) | | | 1.8900 | (273) |

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

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| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 649.2033 | 1.5776 | 1024.2025 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 1139.0202 | 1.5227 | 1734.4252 | (278) |
| Space and water heating | | | 2758.6277 | (279) |
| Pumps, fans and electric keep-hot | 70.3582 | 1.5128 | 106.4379 | (281) |
| Energy for lighting | 229.0604 | 1.5338 | 351.3405 | (282) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -1141.7312 | 1.4944 | -1706.2239 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -1706.2239 | (283) |
| Total Primary energy kWh/year | | | 1510.1822 | (286) |
| Dwelling Primary energy Rate (DPER) | | | 18.7500 | (287) |

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF TARGET EMISSIONS

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1. Overall dwelling characteristics

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| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 80.5500 | (1b) | x 2.5000 | (2b) = | 201.3750 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 80.5500 | | | | | (4) |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | | 201.3750 | (5) |

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2. Ventilation rate

---

| | m3 per hour | |
|---|---|---|
| Number of open chimneys | 0 * 80 = 0.0000 | (6a) |
| Number of open flues | 0 * 20 = 0.0000 | (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = 0.0000 | (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = 0.0000 | (6d) |
| Number of flues attached to other heater | 0 * 35 = 0.0000 | (6e) |
| Number of blocked chimneys | 0 * 20 = 0.0000 | (6f) |
| Number of intermittent extract fans | 3 * 10 = 30.0000 | (7a) |
| Number of passive vents | 0 * 10 = 0.0000 | (7b) |
| Number of flueless gas fires | 0 * 40 = 0.0000 | (7c) |
| | Air changes per hour | |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 30.0000 / (5) = 0.1490 | (8) |
| Pressure test | Yes | |

| | | |
|---|---|---|
| Pressure Test Method | Blower Door | |
| Measured/design AP50 | 5.0000 | (17) |
| Infiltration rate | 0.3990 | (18) |
| Number of sides sheltered | 2 | (19) |
| Shelter factor (20) = 1 - [0.075 x (19)] = | 0.8500 | (20) |
| Infiltration rate adjusted to include shelter factor (21) = (18) x (20) = | 0.3391 | (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.4324 | 0.4239 | 0.4154 | 0.3730 | 0.3646 | 0.3222 | 0.3222 | 0.3137 | 0.3391 | 0.3646 | 0.3815 | 0.3985 | (22b) |
| Effective ac | 0.5935 | 0.5899 | 0.5863 | 0.5696 | 0.5665 | 0.5519 | 0.5519 | 0.5492 | 0.5575 | 0.5665 | 0.5728 | 0.5794 | (25) |

## 3. Heat losses and heat loss parameter

| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | | |
| TER Opaque door | | | 2.0600 | 1.0000 | 2.0600 | | | (26) |
| TER Opening Type | | | 14.9300 | 1.1450 | 17.0954 | | | (27) |
| Heatloss Floor 1 | | | 80.5500 | 0.1300 | 10.4715 | | | (28a) |
| External Wall 1 | 54.2700 | 16.9900 | 37.2800 | 0.1800 | 6.7104 | | | (29a) |
| Corridor | 17.2800 | | 17.2800 | 0.1800 | 3.1104 | | | (29a) |
| Total net area of external elements Aum(A, m2) | | | 152.1000 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 39.4477 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall | | | 32.0000 | 0.0000 | 0.0000 | | | (32) |

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 174.2718 (35)

List of Thermal Bridges

| K1 Element | Length | Psi-value | Total |
|---|---|---|---|
| E2 Other lintels (including other steel lintels) | 9.5800 | 0.0500 | 0.4790 |
| E3 Sill | 8.6000 | 0.0500 | 0.4300 |
| E4 Jamb | 24.9000 | 0.0500 | 1.2450 |
| E7 Party floor between dwellings (in blocks of flats) | 16.2000 | 0.0700 | 1.1340 |
| E7 Party floor between dwellings (in blocks of flats) | 6.4000 | 0.0700 | 0.4480 |
| E23 Balcony within or between dwellings, balcony support penetrates wall insulation | 3.9000 | 0.0200 | 0.0780 |
| E16 Corner (normal) | 8.1000 | 0.0900 | 0.7290 |
| E17 Corner (inverted - internal area greater than external area) | 5.4000 | -0.0900 | -0.4860 |
| E17 Corner (inverted - internal area greater than external area) | 2.7000 | -0.0900 | -0.2430 |
| E18 Party wall between dwellings | 5.4000 | 0.0600 | 0.3240 |
| E18 Party wall between dwellings | 2.7000 | 0.0600 | 0.1620 |
| E25 Staggered party wall between dwellings | 2.7000 | 0.0600 | 0.1620 |
| P3 Party wall - Intermediate floor between dwellings (in blocks of flats) | 11.8500 | 0.0000 | 0.0000 |
| P1 Party wall - Ground floor | 11.8500 | 0.0800 | 0.9480 |
| E5 Ground floor (normal) | 20.1000 | 0.1600 | 3.2160 |
| E5 Ground floor (normal) | 6.4000 | 0.1600 | 1.0240 |

| | | |
|---|---|---|
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) | 9.6500 | (36) |
| Point Thermal bridges (36a) = | 0.0000 | |
| Total fabric heat loss (33) + (36) + (36a) = | 49.0977 | (37) |

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 39.4390 | 39.1978 | 38.9613 | 37.8507 | 37.6430 | 36.6757 | 36.6757 | 36.4965 | 37.0483 | 37.6430 | 38.0633 | 38.5028 | (38) |
| Heat transfer coeff | 88.5367 | 88.2955 | 88.0591 | 86.9485 | 86.7407 | 85.7734 | 85.7734 | 85.5943 | 86.1460 | 86.7407 | 87.1610 | 87.6005 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 86.9475 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.0992 | 1.0962 | 1.0932 | 1.0794 | 1.0769 | 1.0648 | 1.0648 | 1.0626 | 1.0695 | 1.0769 | 1.0821 | 1.0875 | (40) |
| HLP (average) | | | | | | | | | | | | 1.0794 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

## 4. Water heating energy requirements (kWh/year)

| | | |
|---|---|---|
| Assumed occupancy | 2.4732 | (42) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Hot water usage for mixer showers | 65.6874 | 64.7002 | 63.2617 | 60.5095 | 58.4784 | 56.2133 | 54.9259 | 56.3534 | 57.9183 | 60.3503 | 63.1617 | 65.4357 | (42a) |
| Hot water usage for baths | 28.3709 | 27.9496 | 27.3563 | 26.2622 | 25.4430 | 24.5347 | 24.0440 | 24.6332 | 25.2748 | 26.2467 | 27.3633 | 28.2750 | (42b) |
| Hot water usage for other uses | 39.9582 | 38.5052 | 37.0521 | 35.5991 | 34.1461 | 32.6931 | 32.6931 | 34.1461 | 35.5991 | 37.0521 | 38.5052 | 39.9582 | (42c) |
| Average daily hot water use (litres/day) | | | | | | | | | | | | 123.1915 | (43) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 134.0165 | 131.1550 | 127.6701 | 122.3708 | 118.0675 | 113.4411 | 111.6629 | 115.1327 | 118.7922 | 123.6492 | 129.0302 | 133.6689 | (44) |
| Energy conte | 212.2494 | 186.7629 | 196.2242 | 167.5195 | 158.9415 | 139.4890 | 135.0466 | 142.5584 | 146.4827 | 167.7908 | 183.8271 | 209.2932 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 2046.1855 | |
| Distribution loss (46)m = 0.15 x (45)m | 31.8374 | 28.0144 | 29.4336 | 25.1279 | 23.8412 | 20.9234 | 20.2570 | 21.3838 | 21.9724 | 25.1686 | 27.5741 | 31.3940 | (46) |
| Water storage loss (or HIU loss): | | | | | | | | | | | | | |
| Store volume | | | | | | | | | | | | 150.0000 | (47) |
| a) If manufacturer declared loss factor is known (kWh/day): | | | | | | | | | | | | 1.3938 | (48) |
| Temperature factor from Table 2b | | | | | | | | | | | | 0.5400 | (49) |
| Enter (49) or (54) in (55) | | | | | | | | | | | | 0.7527 | (55) |
| Total storage loss | 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (56) |
| If cylinder contains dedicated solar storage | 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (57) |
| Primary loss | 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |
| Total heat required for water heating calculated for each month | 258.8443 | 228.8487 | 242.8191 | 212.6114 | 205.5364 | 184.5808 | 181.6416 | 189.1533 | 191.5745 | 214.3857 | 228.9190 | 255.8881 | (62) |
| WWHRS | -30.0295 | -26.5584 | -27.8104 | -23.0281 | -21.4614 | -18.3646 | -17.2139 | -18.3053 | -19.0008 | -22.3998 | -25.3763 | -29.4734 | (63a) |
| PV diverter | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |
| Output from w/h | 228.8148 | 202.2903 | 215.0088 | 189.5833 | 184.0751 | 166.2162 | 164.4276 | 170.8480 | 172.5737 | 191.9859 | 203.5427 | 226.4147 | (64) |
| | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 2315.7811 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 2316 | (64) |

Electric shower(s)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |

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

Heat gains from water heating, kWh/month

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 107.8488 | 95.7673 | 102.5205 | 91.7737 | 90.1240 | 82.4536 | 82.1789 | 84.6766 | 84.7790 | 93.0664 | 97.1960 | 106.8659 | (65) |

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

Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 123.6607 | 123.6607 | 123.6607 | 123.6607 | 123.6607 | 123.6607 | 123.6607 | 123.6607 | 123.6607 | 123.6607 | 123.6607 | 123.6607 | (66) |

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 113.1275 | 125.2483 | 113.1275 | 116.8984 | 113.1275 | 116.8984 | 113.1275 | 113.1275 | 116.8984 | 113.1275 | 116.8984 | 113.1275 | (67) |

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 220.5862 | 222.8752 | 217.1070 | 204.8272 | 189.3262 | 174.7574 | 165.0245 | 162.7355 | 168.5037 | 180.7835 | 196.2846 | 210.8533 | (68) |

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 35.3661 | 35.3661 | 35.3661 | 35.3661 | 35.3661 | 35.3661 | 35.3661 | 35.3661 | 35.3661 | 35.3661 | 35.3661 | 35.3661 | (69) |
| Pumps, fans 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 3.0000 | 3.0000 | 3.0000 | (70) |

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| -98.9286 | -98.9286 | -98.9286 | -98.9286 | -98.9286 | -98.9286 | -98.9286 | -98.9286 | -98.9286 | -98.9286 | -98.9286 | -98.9286 | (71) |

Water heating gains (Table 5)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 144.9581 | 142.5108 | 137.7963 | 127.4635 | 121.1344 | 114.5188 | 110.4556 | 113.8126 | 117.7486 | 125.0892 | 134.9944 | 143.6370 | (72) |

Total internal gains

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 541.7700 | 553.7325 | 531.1290 | 512.2873 | 486.6862 | 466.2728 | 448.7058 | 449.7738 | 463.2489 | 482.0984 | 511.2756 | 530.7160 | (73) |

## 6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| North | 5.0400 | 10.6334 | 0.6300 | 0.7000 | 0.7700 | 16.3785 | (74) |
| Northeast | 1.8200 | 11.2829 | 0.6300 | 0.7000 | 0.7700 | 6.2757 | (75) |
| West | 6.2500 | 19.6403 | 0.6300 | 0.7000 | 0.7700 | 37.5145 | (80) |
| Northwest | 1.8200 | 11.2829 | 0.6300 | 0.7000 | 0.7700 | 6.2757 | (81) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 66.4445 | 130.2354 | 220.0745 | 337.2900 | 432.7163 | 452.6653 | 426.8932 | 352.8876 | 260.5986 | 155.5606 | 82.7742 | 54.7542 | (83) |
| Total gains | 608.2145 | 683.9679 | 751.2035 | 849.5773 | 919.4025 | 918.9381 | 875.5990 | 802.6614 | 723.8475 | 637.6590 | 594.0498 | 585.4702 | (84) |

## 7. Mean internal temperature (heating season)

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

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| tau | 44.0420 | 44.1623 | 44.2809 | 44.8465 | 44.9539 | 45.4608 | 45.4608 | 45.5560 | 45.2642 | 44.9539 | 44.7371 | 44.5127 | |
| alpha | 3.9361 | 3.9442 | 3.9521 | 3.9898 | 3.9969 | 4.0307 | 4.0307 | 4.0371 | 4.0176 | 3.9969 | 3.9825 | 3.9675 | |
| util living area | 0.9819 | 0.9702 | 0.9455 | 0.8749 | 0.7445 | 0.5648 | 0.4227 | 0.4760 | 0.7152 | 0.9110 | 0.9693 | 0.9843 | (86) |
| MIT | 19.4388 | 19.6564 | 19.9948 | 20.4504 | 20.7823 | 20.9465 | 20.9869 | 20.9792 | 20.8631 | 20.4280 | 19.8692 | 19.4094 | (87) |
| Th 2 | 20.0015 | 20.0040 | 20.0064 | 20.0177 | 20.0198 | 20.0296 | 20.0296 | 20.0315 | 20.0258 | 20.0198 | 20.0155 | 20.0110 | (88) |
| util rest of house | 0.9779 | 0.9637 | 0.9332 | 0.8476 | 0.6936 | 0.4901 | 0.3332 | 0.3821 | 0.6434 | 0.8852 | 0.9614 | 0.9808 | (89) |
| MIT 2 | 18.1936 | 18.4697 | 18.8948 | 19.4546 | 19.8278 | 19.9945 | 20.0241 | 20.0219 | 19.9234 | 19.4425 | 18.7496 | 18.1628 | (90) |
| Living area fraction | | | | | | | | | fLA = Living area / (4) = | | | 0.4904 | (91) |
| MIT | 18.8042 | 19.0516 | 19.4342 | 19.9429 | 20.2959 | 20.4613 | 20.4962 | 20.4913 | 20.3842 | 19.9257 | 19.2986 | 18.7741 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 18.8042 | 19.0516 | 19.4342 | 19.9429 | 20.2959 | 20.4613 | 20.4962 | 20.4913 | 20.3842 | 19.9257 | 19.2986 | 18.7741 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9715 | 0.9557 | 0.9247 | 0.8453 | 0.7087 | 0.5242 | 0.3768 | 0.4275 | 0.6714 | 0.8824 | 0.9540 | 0.9749 | (94) |
| Useful gains | 590.8832 | 653.6849 | 694.6315 | 718.1599 | 651.6179 | 481.7099 | 329.9030 | 343.1517 | 485.9870 | 562.6428 | 566.7408 | 570.7865 | (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 | 1284.1545 | 1249.5257 | 1138.9755 | 960.1668 | 745.6124 | 502.7465 | 334.1941 | 350.1960 | 541.3594 | 808.9215 | 1063.2420 | 1276.6957 | (97) |
| Space heating kWh | 515.7938 | 400.4050 | 330.5919 | 174.2449 | 69.9319 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 183.2313 | 357.4808 | 525.1965 | (98a) |

Space heating requirement - total per year (kWh/year) 2556.8762

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar heating kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |

Solar heating contribution - total per year (kWh/year) 0.0000

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating kWh | 515.7938 | 400.4050 | 330.5919 | 174.2449 | 69.9319 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 183.2313 | 357.4808 | 525.1965 | (98c) |

Space heating requirement after solar contribution - total per year (kWh/year) 2556.8762

Space heating per m2 (98c) / (4) = 31.7427 (99)

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

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

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

Efficiency of main space heating system 1 (in %) 92.3000 (206)

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

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement | 515.7938 | 400.4050 | 330.5919 | 174.2449 | 69.9319 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 183.2313 | 357.4808 | 525.1965 | (98) |
| Space heating efficiency (main heating system 1) | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 92.3000 | 92.3000 | 92.3000 | (210) |
| Space heating fuel (main heating system) | 558.8232 | 433.8083 | 358.1711 | 188.7811 | 75.7659 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 198.5172 | 387.3032 | 569.0102 | (211) |

Space heating efficiency (main heating system 2)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (212) |
| Space heating fuel (main heating system 2) | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (213) |
| Space heating fuel (secondary) | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (215) |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Water heating | | | | | | | | | | | | |
| Water heating requirement | | | | | | | | | | | | |
| | 228.8148 | 202.2903 | 215.0088 | 189.5833 | 184.0751 | 166.2162 | 164.4276 | 170.8480 | 172.5737 | 191.9859 | 203.5427 | 226.4147 (64) |
| Efficiency of water heater | | | | | | | | | | | | 79.8000 (216) |
| (217)m | 85.8255 | 85.5611 | 85.0212 | 83.8710 | 82.0906 | 79.8000 | 79.8000 | 79.8000 | 79.8000 | 83.9552 | 85.3093 | 85.8822 (217) |
| Fuel for water heating, kWh/month | | | | | | | | | | | | |
| | 266.6046 | 236.4278 | 252.8883 | 226.0414 | 224.2340 | 208.2910 | 206.0497 | 214.0953 | 216.2578 | 228.6765 | 238.5938 | 263.6340 (219) |
| Space cooling fuel requirement | | | | | | | | | | | | |
| (221)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (221) |
| Pumps and Fa | 7.3041 | 6.5973 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 (231) |
| Lighting | 23.5057 | 18.8571 | 16.9787 | 12.4394 | 9.6085 | 7.8502 | 8.7652 | 11.3933 | 14.7988 | 19.4169 | 21.9313 | 24.1590 (232) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (233a)m | -11.7980 | -18.0579 | -28.1504 | -34.4106 | -39.5949 | -37.8786 | -37.4156 | -34.0650 | -28.6395 | -21.8047 | -13.4651 | -10.0407 (233a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (234a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (234a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (235a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (235a) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | |
| (235c)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (235c) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (233b)m | -2.9447 | -6.4196 | -13.1959 | -20.4845 | -27.7585 | -28.1455 | -27.8187 | -23.2441 | -16.6355 | -9.3951 | -3.9977 | -2.3124 (233b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (234b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (234b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (235b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (235b) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | |
| (235d)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (235d) |

| | |
|---|---|
| Annual totals kWh/year | |
| Space heating fuel - main system 1 | 2770.1801 (211) |
| Space heating fuel - main system 2 | 0.0000 (213) |
| Space heating fuel - secondary | 0.0000 (215) |
| Efficiency of water heater | 79.8000 |
| Water heating fuel used | 2781.7941 (219) |
| Space cooling fuel | 0.0000 (221) |
| | |
| Electricity for pumps and fans: | |
| Total electricity for the above, kWh/year | 86.0000 (231) |
| Electricity for lighting (calculated in Appendix L) | 189.7041 (232) |
| | |
| Energy saving/generation technologies (Appendices M ,N and Q) | |
| PV generation | -497.6732 (233) |
| Wind generation | 0.0000 (234) |
| Hydro-electric generation (Appendix N) | 0.0000 (235a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 (235) |
| Appendix Q - special features | |
| Energy saved or generated | -0.0000 (236) |
| Energy used | 0.0000 (237) |
| Total delivered energy for all uses | 5330.0052 (238) |

---

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

---

| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 2770.1801 | 0.2100 | 581.7378 | (261) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 2781.7941 | 0.2100 | 584.1768 | (264) |
| Space and water heating | | | 1165.9146 | (265) |
| Pumps, fans and electric keep-hot | 86.0000 | 0.1387 | 11.9293 | (267) |
| Energy for lighting | 189.7041 | 0.1443 | 27.3802 | (268) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -315.3211 | 0.1329 | -41.9098 | |
| PV Unit electricity exported | -182.3521 | 0.1249 | -22.7832 | |
| Total | | | -64.6929 | (269) |
| Total CO2, kg/year | | | 1140.5311 | (272) |
| EPC Target Carbon Dioxide Emission Rate (TER) | | | 14.1600 | (273) |

---

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

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| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 2770.1801 | 1.1300 | 3130.3035 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 2781.7941 | 1.1300 | 3143.4274 | (278) |
| Space and water heating | | | 6273.7309 | (279) |
| Pumps, fans and electric keep-hot | 86.0000 | 1.5128 | 130.1008 | (281) |
| Energy for lighting | 189.7041 | 1.5338 | 290.9745 | (282) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -315.3211 | 1.4911 | -470.1821 | |
| PV Unit electricity exported | -182.3521 | 0.4586 | -83.6212 | |
| Total | | | -553.8034 | (283) |
| Total Primary energy kWh/year | | | 6141.0028 | (286) |
| Target Primary Energy Rate (TPER) | | | 76.2400 | (287) |

# Full SAP Calculation Printout

| | | | |
|---|---|---|---|
| Plot Reference | 2B4P End MF N | Issued on Date | 16/01/2026 |
| Assessment Reference | 2B4P End MF N | Plot Type Ref | 2B4P End MF N |
| Plot Address | | SAP Version | 10.2 |

| | | | | | |
|---|---|---|---|---|---|
| SAP Rating | 86 B | DER | 1.54 | TER | 12.28 |
| Environmental | 99 A | % DER < TER | | | 87.46 |
| $CO_2$ Emissions (t/year) | 0.09 | DFEE | 30.73 | TFEE | 29.66 |
| Compliance Check | See BREL | % DFEE < TFEE | | | -3.62 |
| % DPER < TPER | 77.00 | DPER | 15.21 | TPER | 66.12 |

| | | | |
|---|---|---|---|
| Assessor Details | Miss Eleanor Risby | Assessor ID | M976-0001 |
| Client | | | |

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SAP 10 WORKSHEET FOR New Build (As Designed)  (Version 10.2, February 2022)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE

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1. Overall dwelling characteristics

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| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 80.5500 | (1b) | x 2.5000 | (2b) = | 201.3750 | (1b) - (3b) (4) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 80.5500 | | | | | |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | 201.3750 | (5) |

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2. Ventilation rate

---

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

| | Air changes per hour | | |
|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 0.0000 / (5) = | 0.0000 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 3.0000 | (17) |
| Infiltration rate | | 0.1500 | (18) |
| Number of sides sheltered | | 2 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 0.8500 | (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.1275 | (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.1626 | 0.1594 | 0.1562 | 0.1403 | 0.1371 | 0.1211 | 0.1211 | 0.1179 | 0.1275 | 0.1371 | 0.1434 | 0.1498 | (22b) |

Balanced mechanical ventilation with heat recovery

| | | |
|---|---|---|
| If mechanical ventilation | 0.5000 | (23a) |
| If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) | 0.5000 | (23b) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = | 77.4000 | (23c) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Effective ac | 0.2756 | 0.2724 | 0.2692 | 0.2532 | 0.2501 | 0.2341 | 0.2341 | 0.2309 | 0.2405 | 0.2501 | 0.2564 | 0.2628 | (25) |

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3. Heat losses and heat loss parameter

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| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | | |
| Glazing | | | 14.9300 | 1.1450 | 17.0954 | | | (27) |
| Corridor Door | | | 2.0600 | 1.0000 | 2.0600 | | | (26) |
| External Wall 1 | 54.2700 | 16.9900 | 37.2800 | 0.1900 | 7.0832 | 14.0000 | 521.9200 | (29a) |
| Corridor | 17.2800 | | 17.2800 | 0.1600 | 2.7648 | 14.0000 | 241.9200 | (29a) |
| Total net area of external elements Aum(A, m2) | | | 71.5500 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 29.0034 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall | | | 32.0000 | 0.0000 | 0.0000 | 20.0000 | 640.0000 | (32) |
| Party Floor 1 | | | 80.5500 | | | 40.0000 | 3222.0000 | (32d) |
| Party Ceiling 1 | | | 80.5500 | | | 30.0000 | 2416.5000 | (32b) |
| Internal Wall 1 | | | 150.7500 | | | 9.0000 | 1356.7500 | (32c) |

| | | |
|---|---|---|
| Heat capacity Cm = Sum(A x k) | (28)...(30) + (32) + (32a)...(32e) = 8399.0900 | (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | 104.2718 | (35) |
| List of Thermal Bridges | | |

| | Length | Psi-value | Total |
|---|---|---|---|
| K1 Element | | | |
| E2 Other lintels (including other steel lintels) | 9.5800 | 0.1000 | 0.9580 |
| E3 Sill | 8.6000 | 0.0500 | 0.4300 |
| E4 Jamb | 24.9000 | 0.0500 | 1.2450 |
| E7 Party floor between dwellings (in blocks of flats) | 32.4000 | 0.0700 | 2.2680 |
| E7 Party floor between dwellings (in blocks of flats) | 12.8000 | 0.1000 | 1.2800 |
| E23 Balcony within or between dwellings, balcony support penetrates wall insulation | 7.8000 | 0.1500 | 1.1700 |
| E16 Corner (normal) | 8.1000 | 0.1000 | 0.8100 |
| E17 Corner (inverted - internal area greater than external area) | 5.4000 | 0.0000 | 0.0000 |
| E17 Corner (inverted - internal area greater than external area) | 2.7000 | 0.0000 | 0.0000 |
| E18 Party wall between dwellings | 5.4000 | 0.0600 | 0.3240 |
| E18 Party wall between dwellings | 2.7000 | 0.0900 | 0.2430 |
| E25 Staggered party wall between dwellings | 2.7000 | 0.0900 | 0.2430 |
| P3 Party wall - Intermediate floor between dwellings (in blocks of flats) | 23.7000 | 0.0000 | 0.0000 |

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 8.9710 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 37.9744 (37)

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 18.3122 | 18.1003 | 17.8885 | 16.8294 | 16.6176 | 15.5585 | 15.5585 | 15.3467 | 15.9821 | 16.6176 | 17.0412 | 17.4649 | (38) |
| Heat transfer coeff | 56.2866 | 56.0748 | 55.8629 | 54.8038 | 54.5920 | 53.5329 | 53.5329 | 53.3211 | 53.9565 | 54.5920 | 55.0157 | 55.4393 | (39) |

Average = Sum(39)m / 12 = 54.7509

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 0.6988 | 0.6961 | 0.6935 | 0.6804 | 0.6777 | 0.6646 | 0.6646 | 0.6620 | 0.6699 | 0.6777 | 0.6830 | 0.6883 | (40) |
| HLP (average) | | | | | | | | | | | | 0.6797 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

---

## 4. Water heating energy requirements (kWh/year)

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Assumed occupancy 2.4732 (42)

Hot water usage for mixer showers

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 65.6874 | 64.7002 | 63.2617 | 60.5095 | 58.4784 | 56.2133 | 54.9259 | 56.3534 | 57.9183 | 60.3503 | 63.1617 | 65.4357 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 28.3709 | 27.9496 | 27.3563 | 26.2622 | 25.4430 | 24.5347 | 24.0440 | 24.6332 | 25.2748 | 26.2467 | 27.3633 | 28.2750 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 39.9582 | 38.5052 | 37.0521 | 35.5991 | 34.1461 | 32.6931 | 32.6931 | 34.1461 | 35.5991 | 37.0521 | 38.5052 | 39.9582 | (42c) |

Average daily hot water use (litres/day) 123.1915 (43)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 134.0165 | 131.1550 | 127.6701 | 122.3708 | 118.0675 | 113.4411 | 111.6629 | 115.1327 | 118.7922 | 123.6492 | 129.0302 | 133.6689 | (44) |
| Energy conte | 212.2494 | 186.7629 | 196.2242 | 167.5195 | 158.9415 | 139.4890 | 135.0466 | 142.5584 | 146.4827 | 167.7908 | 183.8271 | 209.2932 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 2046.1855 | |
| Distribution loss (46)m = 0.15 x (45)m | 31.8374 | 28.0144 | 29.4336 | 25.1279 | 23.8412 | 20.9234 | 20.2570 | 21.3838 | 21.9724 | 25.1686 | 27.5741 | 31.3940 | (46) |

Water storage loss (or HIU loss):

Store volume 180.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): 0.8400 (48)
Temperature factor from Table 2b 0.5400 (49)
Enter (49) or (54) in (55) 0.4536 (55)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total storage loss | 14.0616 | 12.7008 | 14.0616 | 13.6080 | 14.0616 | 13.6080 | 14.0616 | 14.0616 | 13.6080 | 14.0616 | 13.6080 | 14.0616 | (56) |
| If cylinder contains dedicated solar storage | 14.0616 | 12.7008 | 14.0616 | 13.6080 | 14.0616 | 13.6080 | 14.0616 | 14.0616 | 13.6080 | 14.0616 | 13.6080 | 14.0616 | (57) |
| Primary 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 | (59) |
| Combi loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |
| Total heat required for water heating calculated for each month | 226.3110 | 199.4637 | 210.2858 | 181.1275 | 173.0031 | 153.0970 | 149.1082 | 156.6200 | 160.0907 | 181.8524 | 197.4351 | 223.3548 | (62) |
| WWHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63a) |
| PV diverter | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |
| Output from w/h | 226.3110 | 199.4637 | 210.2858 | 181.1275 | 173.0031 | 153.0970 | 149.1082 | 156.6200 | 160.0907 | 181.8524 | 197.4351 | 223.3548 | (64) |
| | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 2211.7495 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 2212 | (64) |
| Electric shower(s) | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |
| | | | | | | | | | | Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | | 0.0000 | (64a) |
| Heat gains from water heating, kWh/month | 70.5729 | 62.0987 | 65.2446 | 55.7002 | 52.8481 | 46.3801 | 44.9030 | 47.4007 | 48.7055 | 55.7904 | 61.1225 | 69.5900 | (65) |

---

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

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Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 123.6607 | 123.6607 | 123.6607 | 123.6607 | 123.6607 | 123.6607 | 123.6607 | 123.6607 | 123.6607 | 123.6607 | 123.6607 | 123.6607 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 115.7685 | 128.1722 | 115.7685 | 119.6274 | 115.7685 | 119.6274 | 115.7685 | 115.7685 | 119.6274 | 115.7685 | 119.6274 | 115.7685 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 220.5862 | 222.8752 | 217.1070 | 204.8272 | 189.3262 | 174.7574 | 165.0245 | 162.7355 | 168.5037 | 180.7835 | 196.2846 | 210.8533 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 35.3661 | 35.3661 | 35.3661 | 35.3661 | 35.3661 | 35.3661 | 35.3661 | 35.3661 | 35.3661 | 35.3661 | 35.3661 | 35.3661 | (69) |
| Pumps, fans | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | -98.9286 | -98.9286 | -98.9286 | -98.9286 | -98.9286 | -98.9286 | -98.9286 | -98.9286 | -98.9286 | -98.9286 | -98.9286 | -98.9286 | (71) |
| Water heating gains (Table 5) | 94.8561 | 92.4087 | 87.6943 | 77.3615 | 71.0323 | 64.4168 | 60.3535 | 63.7106 | 67.6465 | 74.9871 | 84.8924 | 93.5349 | (72) |
| Total internal gains | 491.3090 | 503.5544 | 480.6680 | 461.9143 | 436.2252 | 418.8998 | 401.2447 | 402.3128 | 415.8759 | 431.6373 | 460.9026 | 480.2550 | (73) |

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## 6. Solar gains

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| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| North | 5.0400 | 10.6334 | 0.4500 | 0.7000 | 0.7700 | 11.6989 | (74) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Northeast | | | | 1.8200 | 11.2829 | 0.4500 | 0.7000 | 0.7700 | 4.4827 | (75) |
| West | | | | 6.2500 | 19.6403 | 0.4500 | 0.7000 | 0.7700 | 26.7961 | (80) |
| Northwest | | | | 1.8200 | 11.2829 | 0.4500 | 0.7000 | 0.7700 | 4.4827 | (81) |
| Solar gains | 47.4604 | 93.0253 | 157.1961 | 240.9214 | 309.0830 | 323.3324 | 304.9237 | 252.0625 | 186.1418 | 111.1147 | 59.1244 | 39.1102 | (83) |
| Total gains | 538.7693 | 596.5797 | 637.8640 | 702.8357 | 745.3082 | 742.2322 | 706.1684 | 654.3753 | 602.0177 | 542.7521 | 520.0270 | 519.3651 | (84) |

## 7. Mean internal temperature (heating season)

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

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| tau | 41.4500 | 41.6066 | 41.7644 | 42.5715 | 42.7367 | 43.5822 | 43.5822 | 43.7553 | 43.2400 | 42.7367 | 42.4076 | 42.0835 | |
| alpha | 3.7633 | 3.7738 | 3.7843 | 3.8381 | 3.8491 | 3.9055 | 3.9055 | 3.9170 | 3.8827 | 3.8491 | 3.8272 | 3.8056 | |
| util living area | 0.9435 | 0.9176 | 0.8737 | 0.7696 | 0.6225 | 0.4492 | 0.3305 | 0.3698 | 0.5780 | 0.8113 | 0.9134 | 0.9490 | (86) |
| Living | 19.9752 | 20.1412 | 20.3654 | 20.6507 | 20.8235 | 20.9006 | 20.9162 | 20.9139 | 20.8668 | 20.6391 | 20.2826 | 19.9572 | |
| Non living | 19.1208 | 19.3299 | 19.6096 | 19.9633 | 20.1625 | 20.2539 | 20.2677 | 20.2685 | 20.2179 | 19.9580 | 19.5189 | 19.1055 | |
| 24 / 16 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 24 / 9 | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |
| 16 / 9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| MIT | 21.0000 | 21.0000 | 21.0000 | 21.0000 | 21.0000 | 21.0000 | 21.0000 | 21.0000 | 21.0000 | 21.0000 | 21.0000 | 21.0000 | (87) |
| Th 2 | 20.3419 | 20.3442 | 20.3466 | 20.3582 | 20.3605 | 20.3722 | 20.3722 | 20.3746 | 20.3675 | 20.3605 | 20.3559 | 20.3512 | (88) |
| util rest of house | 0.9368 | 0.9083 | 0.8597 | 0.7464 | 0.5892 | 0.4083 | 0.2844 | 0.3212 | 0.5338 | 0.7864 | 0.9022 | 0.9430 | (89) |
| MIT 2 | 20.3419 | 20.3442 | 20.3466 | 20.3582 | 20.3605 | 20.3722 | 20.3722 | 20.3746 | 20.3675 | 20.3605 | 20.3559 | 20.3512 | (90) |
| Living area fraction | | | | | | | | | fLA = Living area / (4) = | | | 0.4904 | (91) |
| MIT | 20.6646 | 20.6658 | 20.6670 | 20.6729 | 20.6741 | 20.6801 | 20.6801 | 20.6813 | 20.6777 | 20.6741 | 20.6717 | 20.6694 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 20.6646 | 20.6658 | 20.6670 | 20.6729 | 20.6741 | 20.6801 | 20.6801 | 20.6813 | 20.6777 | 20.6741 | 20.6717 | 20.6694 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9402 | 0.9130 | 0.8667 | 0.7581 | 0.6058 | 0.4285 | 0.3071 | 0.3452 | 0.5559 | 0.7990 | 0.9079 | 0.9460 | (94) |
| Useful gains | 506.5459 | 544.6668 | 552.8664 | 532.8063 | 451.5019 | 318.0476 | 216.8703 | 225.8652 | 334.6523 | 433.6503 | 472.1367 | 491.3402 | (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 | 921.1088 | 884.0640 | 791.4099 | 645.2015 | 489.9150 | 325.4837 | 218.4178 | 228.2814 | 354.9092 | 549.9662 | 746.6581 | 913.0500 | (97) |
| Space heating kWh | 308.4348 | 228.0749 | 177.4764 | 80.9246 | 28.5794 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 86.5391 | 197.6554 | 313.7521 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 1421.4366 | |
| Solar heating kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | 308.4348 | 228.0749 | 177.4764 | 80.9246 | 28.5794 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 86.5391 | 197.6554 | 313.7521 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 1421.4366 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 17.6466 | (99) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | | | | | | | | | | | | 0.0000 | (201) |
| Fraction of space heat from main system(s) | | | | | | | | | | | | 1.0000 | (202) |
| Efficiency of main space heating system 1 (in %) | | | | | | | | | | | | 315.4185 | (206) |
| Efficiency of main space heating system 2 (in %) | | | | | | | | | | | | 0.0000 | (207) |
| Efficiency of secondary/supplementary heating system, % | | | | | | | | | | | | 0.0000 | (208) |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| Space heating requirement | 308.4348 | 228.0749 | 177.4764 | 80.9246 | 28.5794 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 86.5391 | 197.6554 | 313.7521 | (98) |
| Space heating efficiency (main heating system 1) | 315.4185 | 315.4185 | 315.4185 | 315.4185 | 315.4185 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 315.4185 | 315.4185 | 315.4185 | (210) |
| Space heating fuel (main heating system) | 97.7859 | 72.3086 | 56.2670 | 25.6563 | 9.0608 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 27.4363 | 62.6645 | 99.4717 | (211) |
| Space heating efficiency (main heating system 2) | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (212) |
| Space heating fuel (main heating system 2) | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (213) |
| Space heating fuel (secondary) | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (215) |
| Water heating | | | | | | | | | | | | | |
| Water heating requirement | 226.3110 | 199.4637 | 210.2858 | 181.1275 | 173.0031 | 153.0970 | 149.1082 | 156.6200 | 160.0907 | 181.8524 | 197.4351 | 223.3548 | (64) |
| Efficiency of water heater | | | | | | | | | | | | 194.1800 | (216) |
| (217)m | 194.1800 | 194.1800 | 194.1800 | 194.1800 | 194.1800 | 194.1800 | 194.1800 | 194.1800 | 194.1800 | 194.1800 | 194.1800 | 194.1800 | (217) |
| Fuel for water heating, kWh/month | 116.5470 | 102.7211 | 108.2943 | 93.2782 | 89.0942 | 78.8428 | 76.7887 | 80.6571 | 82.4445 | 93.6515 | 101.6763 | 115.0246 | (219) |
| Space cooling fuel requirement | | | | | | | | | | | | | |
| (221)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (221) |
| Pumps and Fa | 6.8264 | 6.1658 | 6.8264 | 6.6062 | 6.8264 | 6.6062 | 6.8264 | 6.8264 | 6.6062 | 6.8264 | 6.6062 | 6.8264 | (231) |
| Lighting | 28.3822 | 22.7692 | 20.5012 | 15.0200 | 11.6019 | 9.4789 | 10.5836 | 13.7570 | 17.8690 | 23.4451 | 26.4812 | 29.1710 | (232) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (233a)m | -43.6678 | -69.1770 | -110.5699 | -129.5006 | -139.4752 | -128.1720 | -125.8106 | -118.3281 | -101.8725 | -80.9402 | -49.6521 | -36.4518 | (233a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (234a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (234a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (235a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235a) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | | |
| (235c)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235c) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (233b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (233b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (234b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (234b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (235b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235b) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | | |
| (235d)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235d) |
| Annual totals kWh/year | | | | | | | | | | | | | |

| | | |
|---|---|---|
| Space heating fuel - main system 1 | 450.6509 | (211) |
| Space heating fuel - main system 2 | 0.0000 | (213) |
| Space heating fuel - secondary | 0.0000 | (215) |
| Efficiency of water heater | 194.1800 | |
| Water heating fuel used | 1139.0202 | (219) |
| Space cooling fuel | 0.0000 | (221) |
| Electricity for pumps and fans: | | |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.9500) | | |
| mechanical ventilation fans (SFP = 0.9500) | 80.3752 | (230a) |
| Total electricity for the above, kWh/year | 80.3752 | (231) |
| Electricity for lighting (calculated in Appendix L) | 229.0604 | (232) |
| Energy saving/generation technologies (Appendices M ,N and Q) | | |
| PV generation | -1133.6179 | (233) |
| Wind generation | 0.0000 | (234) |
| Hydro-electric generation (Appendix N) | 0.0000 | (235a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 | (235) |
| Appendix Q - special features | | |
| Energy saved or generated | -0.0000 | (236) |
| Energy used | 0.0000 | (237) |
| Total delivered energy for all uses | 765.4889 | (238) |

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

| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 450.6509 | 0.1562 | 70.3897 | (261) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 1139.0202 | 0.1414 | 161.0160 | (264) |
| Space and water heating | | | 231.4058 | (265) |
| Pumps, fans and electric keep-hot | 80.3752 | 0.1387 | 11.1490 | (267) |
| Energy for lighting | 229.0604 | 0.1443 | 33.0605 | (268) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -1133.6179 | 0.1336 | -151.5065 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -151.5065 | (269) |
| Total CO2, kg/year | | | 124.1088 | (272) |
| EPC Dwelling Carbon Dioxide Emission Rate (DER) | | | 1.5400 | (273) |

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

| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 450.6509 | 1.5783 | 711.2427 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 1139.0202 | 1.5227 | 1734.4252 | (278) |
| Space and water heating | | | 2445.6679 | (279) |
| Pumps, fans and electric keep-hot | 80.3752 | 1.5128 | 121.5916 | (281) |
| Energy for lighting | 229.0604 | 1.5338 | 351.3405 | (282) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -1133.6179 | 1.4939 | -1693.5244 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -1693.5244 | (283) |
| Total Primary energy kWh/year | | | 1225.0755 | (286) |
| Dwelling Primary energy Rate (DPER) | | | 15.2100 | (287) |

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF TARGET EMISSIONS

1. Overall dwelling characteristics

| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 80.5500 | (1b) x | 2.5000 | (2b) = | 201.3750 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 80.5500 | | | | | (4) |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | | 201.3750 | (5) |

2. Ventilation rate

| | m3 per hour | |
|---|---|---|
| Number of open chimneys | 0 * 80 = 0.0000 | (6a) |
| Number of open flues | 0 * 20 = 0.0000 | (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = 0.0000 | (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = 0.0000 | (6d) |
| Number of flues attached to other heater | 0 * 35 = 0.0000 | (6e) |
| Number of blocked chimneys | 0 * 20 = 0.0000 | (6f) |
| Number of intermittent extract fans | 3 * 10 = 30.0000 | (7a) |
| Number of passive vents | 0 * 10 = 0.0000 | (7b) |
| Number of flueless gas fires | 0 * 40 = 0.0000 | (7c) |
| | Air changes per hour | |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 30.0000 / (5) = 0.1490 | (8) |
| Pressure test | Yes | |
| Pressure Test Method | Blower Door | |
| Measured/design AP50 | 5.0000 | (17) |
| Infiltration rate | 0.3990 | (18) |

Number of sides sheltered 2 (19)

Shelter factor (20) = 1 - [0.075 x (19)] = 0.8500 (20)
Infiltration rate adjusted to include shelter factor (21) = (18) x (20) = 0.3391 (21)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.4324 | 0.4239 | 0.4154 | 0.3730 | 0.3646 | 0.3222 | 0.3222 | 0.3137 | 0.3391 | 0.3646 | 0.3815 | 0.3985 | (22b) |
| Effective ac | 0.5935 | 0.5899 | 0.5863 | 0.5696 | 0.5665 | 0.5519 | 0.5519 | 0.5492 | 0.5575 | 0.5665 | 0.5728 | 0.5794 | (25) |

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## 3. Heat losses and heat loss parameter

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| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | | |
| TER Opaque door | | | 2.0600 | 1.0000 | 2.0600 | | | (26) |
| TER Opening Type | | | 14.9300 | 1.1450 | 17.0954 | | | (27) |
| External Wall 1 | 54.2700 | 16.9900 | 37.2800 | 0.1800 | 6.7104 | | | (29a) |
| Corridor | 17.2800 | | 17.2800 | 0.1800 | 3.1104 | | | (29a) |
| Total net area of external elements Aum(A, m2) | | | 71.5500 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 28.9762 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall | | | 32.0000 | 0.0000 | 0.0000 | | | (32) |

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 104.2718 (35)
List of Thermal Bridges

| | Length | Psi-value | Total |
|---|---|---|---|
| K1 Element | | | |
| E2 Other lintels (including other steel lintels) | 9.5800 | 0.0500 | 0.4790 |
| E3 Sill | 8.6000 | 0.0500 | 0.4300 |
| E4 Jamb | 24.9000 | 0.0500 | 1.2450 |
| E7 Party floor between dwellings (in blocks of flats) | 32.4000 | 0.0700 | 2.2680 |
| E7 Party floor between dwellings (in blocks of flats) | 12.8000 | 0.0700 | 0.8960 |
| E23 Balcony within or between dwellings, balcony support penetrates wall insulation | 7.8000 | 0.0200 | 0.1560 |
| E16 Corner (normal) | 8.1000 | 0.0900 | 0.7290 |
| E17 Corner (inverted - internal area greater than external area) | 5.4000 | -0.0900 | -0.4860 |
| E17 Corner (inverted - internal area greater than external area) | 2.7000 | -0.0900 | -0.2430 |
| E18 Party wall between dwellings | 5.4000 | 0.0600 | 0.3240 |
| E18 Party wall between dwellings | 2.7000 | 0.0600 | 0.1620 |
| E25 Staggered party wall between dwellings | 2.7000 | 0.0600 | 0.1620 |
| P3 Party wall - Intermediate floor between dwellings (in blocks of flats) | 23.7000 | 0.0000 | 0.0000 |

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 6.1220 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 35.0982 (37)

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 39.4390 | 39.1978 | 38.9613 | 37.8507 | 37.6430 | 36.6757 | 36.6757 | 36.4965 | 37.0483 | 37.6430 | 38.0633 | 38.5028 | (38) |
| Heat transfer coeff | 74.5372 | 74.2960 | 74.0596 | 72.9490 | 72.7412 | 71.7739 | 71.7739 | 71.5948 | 72.1465 | 72.7412 | 73.1615 | 73.6010 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 72.9480 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 0.9254 | 0.9224 | 0.9194 | 0.9056 | 0.9031 | 0.8910 | 0.8910 | 0.8888 | 0.8957 | 0.9031 | 0.9083 | 0.9137 | (40) |
| HLP (average) | | | | | | | | | | | | 0.9056 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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## 4. Water heating energy requirements (kWh/year)

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Assumed occupancy 2.4732 (42)
Hot water usage for mixer showers

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 65.6874 | 64.7002 | 63.2617 | 60.5095 | 58.4784 | 56.2133 | 54.9259 | 56.3534 | 57.9183 | 60.3503 | 63.1617 | 65.4357 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 28.3709 | 27.9496 | 27.3563 | 26.2622 | 25.4430 | 24.5347 | 24.0440 | 24.6332 | 25.2748 | 26.2467 | 27.3633 | 28.2750 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 39.9582 | 38.5052 | 37.0521 | 35.5991 | 34.1461 | 32.6931 | 32.6931 | 34.1461 | 35.5991 | 37.0521 | 38.5052 | 39.9582 | (42c) |

Average daily hot water use (litres/day) 123.1915 (43)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 134.0165 | 131.1550 | 127.6701 | 122.3708 | 118.0675 | 113.4411 | 111.6629 | 115.1327 | 118.7922 | 123.6492 | 129.0302 | 133.6689 | (44) |
| Energy conte | 212.2494 | 186.7629 | 196.2242 | 167.5195 | 158.9415 | 139.4890 | 135.0466 | 142.5584 | 146.4827 | 167.7908 | 183.8271 | 209.2932 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 2046.1855 | |
| Distribution loss (46)m = 0.15 x (45)m | 31.8374 | 28.0144 | 29.4336 | 25.1279 | 23.8412 | 20.9234 | 20.2570 | 21.3838 | 21.9724 | 25.1686 | 27.5741 | 31.3940 | (46) |
| Water storage loss (or HIU loss): | | | | | | | | | | | | | |
| Store volume | | | | | | | | | | | | 150.0000 | (47) |
| a) If manufacturer declared loss factor is known (kWh/day): | | | | | | | | | | | | 1.3938 | (48) |
| Temperature factor from Table 2b | | | | | | | | | | | | 0.5400 | (49) |
| Enter (49) or (54) in (55) | | | | | | | | | | | | 0.7527 | (55) |
| Total storage loss | 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (56) |
| If cylinder contains dedicated solar storage | 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (57) |
| Primary loss | 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |
| Total heat required for water heating calculated for each month | 258.8443 | 228.8487 | 242.8191 | 212.6114 | 205.5364 | 184.5808 | 181.6416 | 189.1533 | 191.5745 | 214.3857 | 228.9190 | 255.8881 | (62) |
| WWHRS | -30.0295 | -26.5584 | -27.8104 | -23.0281 | -21.4614 | -18.3646 | -17.2139 | -18.3053 | -19.0008 | -22.3998 | -25.3763 | -29.4734 | (63a) |
| PV diverter | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |
| Output from w/h | 228.8148 | 202.2903 | 215.0088 | 189.5833 | 184.0751 | 166.2162 | 164.4276 | 170.8480 | 172.5737 | 191.9859 | 203.5427 | 226.4147 | (64) |
| | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 2315.7811 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 2316 | (64) |
| Electric shower(s) | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |
| | | | | | | | | | | Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | | 0.0000 | (64a) |
| Heat gains from water heating, kWh/month | 107.8488 | 95.7673 | 102.5205 | 91.7737 | 90.1240 | 82.4536 | 82.1789 | 84.6766 | 84.7790 | 93.0664 | 97.1960 | 106.8659 | (65) |

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Metabolic gains (Table 5), Watts | | | | | | | | | | | | | |
| (66)m | 123.6607 | 123.6607 | 123.6607 | 123.6607 | 123.6607 | 123.6607 | 123.6607 | 123.6607 | 123.6607 | 123.6607 | 123.6607 | 123.6607 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | | | | | | | | | | | | | |
| | 113.1275 | 125.2483 | 113.1275 | 116.8984 | 113.1275 | 116.8984 | 113.1275 | 113.1275 | 116.8984 | 113.1275 | 116.8984 | 113.1275 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | | | | | | | | | | | | | |
| | 220.5862 | 222.8752 | 217.1070 | 204.8272 | 189.3262 | 174.7574 | 165.0245 | 162.7355 | 168.5037 | 180.7835 | 196.2846 | 210.8533 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | | | | | | | | | | | | | |
| | 35.3661 | 35.3661 | 35.3661 | 35.3661 | 35.3661 | 35.3661 | 35.3661 | 35.3661 | 35.3661 | 35.3661 | 35.3661 | 35.3661 | (69) |
| Pumps, fans | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 3.0000 | 3.0000 | 3.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | | | | | | | | | | | | | |
| | -98.9286 | -98.9286 | -98.9286 | -98.9286 | -98.9286 | -98.9286 | -98.9286 | -98.9286 | -98.9286 | -98.9286 | -98.9286 | -98.9286 | (71) |
| Water heating gains (Table 5) | | | | | | | | | | | | | |
| | 144.9581 | 142.5108 | 137.7963 | 127.4635 | 121.1344 | 114.5188 | 110.4556 | 113.8126 | 117.7486 | 125.0892 | 134.9944 | 143.6370 | (72) |
| Total internal gains | | | | | | | | | | | | | |
| | 541.7700 | 553.7325 | 531.1290 | 512.2873 | 486.6862 | 466.2728 | 448.7058 | 449.7738 | 463.2489 | 482.0984 | 511.2756 | 530.7160 | (73) |

## 6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| North | 5.0400 | 10.6334 | 0.6300 | 0.7000 | 0.7700 | 16.3785 | (74) |
| Northeast | 1.8200 | 11.2829 | 0.6300 | 0.7000 | 0.7700 | 6.2757 | (75) |
| West | 6.2500 | 19.6403 | 0.6300 | 0.7000 | 0.7700 | 37.5145 | (80) |
| Northwest | 1.8200 | 11.2829 | 0.6300 | 0.7000 | 0.7700 | 6.2757 | (81) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 66.4445 | 130.2354 | 220.0745 | 337.2900 | 432.7163 | 452.6653 | 426.8932 | 352.8876 | 260.5986 | 155.5606 | 82.7742 | 54.7542 | (83) |
| Total gains | 608.2145 | 683.9679 | 751.2035 | 849.5773 | 919.4025 | 918.9381 | 875.5990 | 802.6614 | 723.8475 | 637.6590 | 594.0498 | 585.4702 | (84) |

## 7. Mean internal temperature (heating season)

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

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| tau | 31.3009 | 31.4025 | 31.5028 | 31.9824 | 32.0737 | 32.5060 | 32.5060 | 32.5873 | 32.3381 | 32.0737 | 31.8894 | 31.6990 | |
| alpha | 3.0867 | 3.0935 | 3.1002 | 3.1322 | 3.1382 | 3.1671 | 3.1671 | 3.1725 | 3.1559 | 3.1382 | 3.1260 | 3.1133 | |
| util living area | | | | | | | | | | | | | |
| | 0.9408 | 0.9154 | 0.8709 | 0.7723 | 0.6326 | 0.4704 | 0.3514 | 0.3956 | 0.6042 | 0.8188 | 0.9131 | 0.9462 | (86) |
| MIT | 19.2036 | 19.4758 | 19.8768 | 20.3905 | 20.7444 | 20.9268 | 20.9781 | 20.9681 | 20.8368 | 20.3688 | 19.7246 | 19.1692 | (87) |
| Th 2 | 20.1460 | 20.1485 | 20.1510 | 20.1627 | 20.1649 | 20.1751 | 20.1751 | 20.1770 | 20.1712 | 20.1649 | 20.1605 | 20.1558 | (88) |
| util rest of house | | | | | | | | | | | | | |
| | 0.9330 | 0.9047 | 0.8547 | 0.7452 | 0.5921 | 0.4172 | 0.2888 | 0.3297 | 0.5492 | 0.7903 | 0.9004 | 0.9391 | (89) |
| MIT 2 | 18.0429 | 18.3847 | 18.8838 | 19.5119 | 19.9182 | 20.1170 | 20.1621 | 20.1571 | 20.0310 | 19.5021 | 18.7097 | 18.0062 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.4904 | (91) |
| MIT | 18.6121 | 18.9198 | 19.3708 | 19.9427 | 20.3234 | 20.5141 | 20.5623 | 20.5548 | 20.4261 | 19.9271 | 19.2074 | 18.5765 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 18.6121 | 18.9198 | 19.3708 | 19.9427 | 20.3234 | 20.5141 | 20.5623 | 20.5548 | 20.4261 | 19.9271 | 19.2074 | 18.5765 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9156 | 0.8862 | 0.8375 | 0.7375 | 0.6001 | 0.4395 | 0.3185 | 0.3604 | 0.5668 | 0.7813 | 0.8830 | 0.9224 | (94) |
| Useful gains | 556.9013 | 606.1262 | 629.1533 | 626.5328 | 551.7067 | 403.8660 | 278.8835 | 289.3003 | 410.2838 | 498.2218 | 524.5657 | 540.0616 | (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 | | | | | | | | | | | | | |
| | 1066.7839 | 1041.6134 | 953.2030 | 805.5547 | 627.2758 | 424.4771 | 284.3864 | 297.4595 | 456.4082 | 678.4657 | 885.7952 | 1058.1269 | (97) |
| Space heating kWh | | | | | | | | | | | | | |
| | 379.3526 | 292.6474 | 241.0930 | 128.8958 | 56.2234 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 134.1014 | 260.0852 | 385.4406 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 1877.8395 | |
| Solar heating kWh | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | | | | | | | | | | | | | |
| | 379.3526 | 292.6474 | 241.0930 | 128.8958 | 56.2234 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 134.1014 | 260.0852 | 385.4406 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 1877.8395 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 23.3127 | (99) |

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

| | | |
|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | 0.0000 | (201) |
| Fraction of space heat from main system(s) | 1.0000 | (202) |
| Efficiency of main space heating system 1 (in %) | 92.3000 | (206) |
| Efficiency of main space heating system 2 (in %) | 0.0000 | (207) |
| Efficiency of secondary/supplementary heating system, % | 0.0000 | (208) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement | | | | | | | | | | | | | |
| | 379.3526 | 292.6474 | 241.0930 | 128.8958 | 56.2234 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 134.1014 | 260.0852 | 385.4406 | (98) |
| Space heating efficiency (main heating system 1) | | | | | | | | | | | | | |
| | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 92.3000 | 92.3000 | 92.3000 | (210) |
| Space heating fuel (main heating system) | | | | | | | | | | | | | |
| | 410.9996 | 317.0611 | 261.2058 | 139.6488 | 60.9138 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 145.2887 | 281.7825 | 417.5955 | (211) |
| Space heating efficiency (main heating system 2) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (212) |
| Space heating fuel (main heating system 2) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (213) |
| Space heating fuel (secondary) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (215) |

Water heating

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Water heating requirement | | | | | | | | | | | | | |
| | 228.8148 | 202.2903 | 215.0088 | 189.5833 | 184.0751 | 166.2162 | 164.4276 | 170.8480 | 172.5737 | 191.9859 | 203.5427 | 226.4147 | (64) |
| Efficiency of water heater | | | | | | | | | | | | 79.8000 | (216) |
| (217)m | 85.1854 | 84.8870 | 84.3172 | 83.2133 | 81.7383 | 79.8000 | 79.8000 | 79.8000 | 79.8000 | 83.2707 | 84.6106 | 85.2424 | (217) |
| Fuel for water heating, kWh/month | | | | | | | | | | | | | |
| | 268.6081 | 238.3053 | 254.9999 | 227.8280 | 225.2005 | 208.2910 | 206.0497 | 214.0953 | 216.2578 | 230.5563 | 240.5640 | 265.6126 | (219) |
| Space cooling fuel requirement | | | | | | | | | | | | | |
| (221)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (221) |
| Pumps and Fa | 7.3041 | 6.5973 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 | (231) |
| Lighting | 23.5057 | 18.8571 | 16.9787 | 12.4394 | 9.6085 | 7.8502 | 8.7652 | 11.3933 | 14.7988 | 19.4169 | 21.9313 | 24.1590 | (232) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (233a)m | -11.7980 | -18.0579 | -28.1504 | -34.4106 | -39.5949 | -37.8786 | -37.4156 | -34.0650 | -28.6395 | -21.8047 | -13.4651 | -10.0407 | (233a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (234a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (234a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (235a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235a) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | | |
| (235c)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235c) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (233b)m | -2.9447 | -6.4196 | -13.1959 | -20.4845 | -27.7585 | -28.1455 | -27.8187 | -23.2441 | -16.6355 | -9.3951 | -3.9977 | -2.3124 | (233b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (234b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (234b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (235b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235b) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | | |
| (235d)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235d) |

| | | |
|---|---|---|
| Annual totals kWh/year | | |
| Space heating fuel - main system 1 | 2034.4957 | (211) |
| Space heating fuel - main system 2 | 0.0000 | (213) |
| Space heating fuel - secondary | 0.0000 | (215) |
| Efficiency of water heater | 79.8000 | |
| Water heating fuel used | 2796.3685 | (219) |
| Space cooling fuel | 0.0000 | (221) |
| | | |
| Electricity for pumps and fans: | | |
| Total electricity for the above, kWh/year | 86.0000 | (231) |
| Electricity for lighting (calculated in Appendix L) | 189.7041 | (232) |
| | | |
| Energy saving/generation technologies (Appendices M ,N and Q) | | |
| PV generation | -497.6732 | (233) |
| Wind generation | 0.0000 | (234) |
| Hydro-electric generation (Appendix N) | 0.0000 | (235a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 | (235) |
| Appendix Q - special features | | |
| Energy saved or generated | -0.0000 | (236) |
| Energy used | 0.0000 | (237) |
| Total delivered energy for all uses | 4608.8951 | (238) |

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

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| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 2034.4957 | 0.2100 | 427.2441 | (261) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 2796.3685 | 0.2100 | 587.2374 | (264) |
| Space and water heating | | | 1014.4815 | (265) |
| Pumps, fans and electric keep-hot | 86.0000 | 0.1387 | 11.9293 | (267) |
| Energy for lighting | 189.7041 | 0.1443 | 27.3802 | (268) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -315.3211 | 0.1329 | -41.9098 | |
| PV Unit electricity exported | -182.3521 | 0.1249 | -22.7832 | |
| Total | | | -64.6929 | (269) |
| Total CO2, kg/year | | | 989.0980 | (272) |
| EPC Target Carbon Dioxide Emission Rate (TER) | | | 12.2800 | (273) |

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

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| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 2034.4957 | 1.1300 | 2298.9801 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 2796.3685 | 1.1300 | 3159.8963 | (278) |
| Space and water heating | | | 5458.8765 | (279) |
| Pumps, fans and electric keep-hot | 86.0000 | 1.5128 | 130.1008 | (281) |
| Energy for lighting | 189.7041 | 1.5338 | 290.9745 | (282) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -315.3211 | 1.4911 | -470.1821 | |
| PV Unit electricity exported | -182.3521 | 0.4586 | -83.6212 | |
| Total | | | -553.8034 | (283) |
| Total Primary energy kWh/year | | | 5326.1484 | (286) |
| Target Primary Energy Rate (TPER) | | | 66.1200 | (287) |

# Full SAP Calculation Printout

| | | | |
|---|---|---|---|
| **Plot Reference** | 2B4P End TF N | **Issued on Date** | 16/01/2026 |
| **Assessment Reference** | 2B4P End TF N | **Plot Type Ref** | 2B4P End MF N |
| **Plot Address** | | **SAP Version** | 10.2 |

| | | | | | |
|---|---|---|---|---|---|
| **SAP Rating** | 84 B | **DER** | 1.94 | **TER** | 15.09 |
| **Environmental** | 98 A | **% DER < TER** | | | 87.14 |
| **$CO_2$ Emissions (t/year)** | 0.11 | **DFEE** | 39.76 | **TFEE** | 42.72 |
| **Compliance Check** | See BREL | **% DFEE < TFEE** | | | 6.93 |
| **% DPER < TPER** | 76.28 | **DPER** | 19.27 | **TPER** | 81.25 |

| | | | |
|---|---|---|---|
| **Assessor Details** | Miss Eleanor Risby | **Assessor ID** | M976-0001 |
| **Client** | | | |

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE

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## 1. Overall dwelling characteristics

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| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 80.5500 | (1b) | x 2.5000 | (2b) = | 201.3750 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 80.5500 | | | | | (4) |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | 201.3750 | (5) |

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## 2. Ventilation rate

---

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

| | Air changes per hour | | |
|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 0.0000 / (5) = | 0.0000 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 3.0000 | (17) |
| Infiltration rate | | 0.1500 | (18) |
| Number of sides sheltered | | 2 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 0.8500 | (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.1275 | (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.1626 | 0.1594 | 0.1562 | 0.1403 | 0.1371 | 0.1211 | 0.1211 | 0.1179 | 0.1275 | 0.1371 | 0.1434 | 0.1498 | (22b) |

Balanced mechanical ventilation with heat recovery

| | |
|---|---|
| If mechanical ventilation | 0.5000 (23a) |
| If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) | 0.5000 (23b) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = | 77.4000 (23c) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Effective ac | 0.2756 | 0.2724 | 0.2692 | 0.2532 | 0.2501 | 0.2341 | 0.2341 | 0.2309 | 0.2405 | 0.2501 | 0.2564 | 0.2628 | (25) |

---

## 3. Heat losses and heat loss parameter

---

| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | | |
| Glazing | | | 14.9300 | 1.1450 | 17.0954 | | | (27) |
| Corridor Door | | | 2.0600 | 1.0000 | 2.0600 | | | (26) |
| External Wall 1 | 54.2700 | 16.9900 | 37.2800 | 0.1900 | 7.0832 | 14.0000 | 521.9200 | (29a) |
| Corridor | 17.2800 | | 17.2800 | 0.1600 | 2.7648 | 14.0000 | 241.9200 | (29a) |
| Main Roof | 80.5500 | | 80.5500 | 0.1000 | 8.0550 | 100.0000 | 8055.0000 | (30) |
| Total net area of external elements Aum(A, m2) | | | 152.1000 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 37.0584 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall | | | 32.0000 | 0.0000 | 0.0000 | 20.0000 | 640.0000 | (32) |
| Party Floor 1 | | | 80.5500 | | | 40.0000 | 3222.0000 | (32d) |
| Internal Wall 1 | | | 150.7500 | | | 9.0000 | 1356.7500 | (32c) |

| | | |
|---|---|---|
| Heat capacity Cm = Sum(A x k) | (28)...(30) + (32) + (32a)...(32e) = | 14037.5900 (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | | 174.2718 (35) |
| List of Thermal Bridges | | |

| | Length | Psi-value | Total |
|---|---|---|---|
| K1 Element | | | |
| E2 Other lintels (including other steel lintels) | 9.5800 | 0.1000 | 0.9580 |
| E3 Sill | 8.6000 | 0.0500 | 0.4300 |
| E4 Jamb | 24.9000 | 0.0500 | 1.2450 |
| E7 Party floor between dwellings (in blocks of flats) | 16.2000 | 0.0700 | 1.1340 |
| E7 Party floor between dwellings (in blocks of flats) | 6.4000 | 0.1000 | 0.6400 |
| E23 Balcony within or between dwellings, balcony support penetrates wall insulation | 3.9000 | 0.1500 | 0.5850 |
| E16 Corner (normal) | 8.1000 | 0.1000 | 0.8100 |
| E17 Corner (inverted - internal area greater than external area) | 5.4000 | 0.0000 | 0.0000 |
| E17 Corner (inverted - internal area greater than external area) | 2.7000 | 0.0000 | 0.0000 |
| E18 Party wall between dwellings | 5.4000 | 0.0600 | 0.3240 |
| E18 Party wall between dwellings | 2.7000 | 0.0900 | 0.2430 |
| E25 Staggered party wall between dwellings | 2.7000 | 0.0900 | 0.2430 |
| P3 Party wall - Intermediate floor between dwellings (in blocks of flats) | 11.8500 | 0.0000 | 0.0000 |
| E15 Flat roof with parapet | 20.1000 | 0.3000 | 6.0300 |
| E14 Flat roof | 6.4000 | 0.1600 | 1.0240 |
| P4 Party wall - Roof (insulation at ceiling level) | 11.8500 | 0.0500 | 0.5925 |

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 14.2585 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 51.3169 (37)

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 18.3122 | 18.1003 | 17.8885 | 16.8294 | 16.6176 | 15.5585 | 15.5585 | 15.3467 | 15.9821 | 16.6176 | 17.0412 | 17.4649 | (38) |
| Heat transfer coeff | 69.6291 | 69.4173 | 69.2054 | 68.1463 | 67.9345 | 66.8754 | 66.8754 | 66.6636 | 67.2990 | 67.9345 | 68.3582 | 68.7818 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 68.0934 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 0.8644 | 0.8618 | 0.8592 | 0.8460 | 0.8434 | 0.8302 | 0.8302 | 0.8276 | 0.8355 | 0.8434 | 0.8486 | 0.8539 | (40) |
| HLP (average) | | | | | | | | | | | | 0.8454 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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## 4. Water heating energy requirements (kWh/year)

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Assumed occupancy 2.4732 (42)
Hot water usage for mixer showers

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 65.6874 | 64.7002 | 63.2617 | 60.5095 | 58.4784 | 56.2133 | 54.9259 | 56.3534 | 57.9183 | 60.3503 | 63.1617 | 65.4357 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 28.3709 | 27.9496 | 27.3563 | 26.2622 | 25.4430 | 24.5347 | 24.0440 | 24.6332 | 25.2748 | 26.2467 | 27.3633 | 28.2750 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 39.9582 | 38.5052 | 37.0521 | 35.5991 | 34.1461 | 32.6931 | 32.6931 | 34.1461 | 35.5991 | 37.0521 | 38.5052 | 39.9582 | (42c) |

Average daily hot water use (litres/day) 123.1915 (43)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 134.0165 | 131.1550 | 127.6701 | 122.3708 | 118.0675 | 113.4411 | 111.6629 | 115.1327 | 118.7922 | 123.6492 | 129.0302 | 133.6689 | (44) |
| Energy conte | 212.2494 | 186.7629 | 196.2242 | 167.5195 | 158.9415 | 139.4890 | 135.0466 | 142.5584 | 146.4827 | 167.7908 | 183.8271 | 209.2932 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 2046.1855 | |
| Distribution loss (46)m = 0.15 x (45)m | 31.8374 | 28.0144 | 29.4336 | 25.1279 | 23.8412 | 20.9234 | 20.2570 | 21.3838 | 21.9724 | 25.1686 | 27.5741 | 31.3940 | (46) |
| Water storage loss (or HIU loss): | | | | | | | | | | | | | |
| Store volume | | | | | | | | | | | | 180.0000 | (47) |
| a) If manufacturer declared loss factor is known (kWh/day): | | | | | | | | | | | | 0.8400 | (48) |
| Temperature factor from Table 2b | | | | | | | | | | | | 0.5400 | (49) |
| Enter (49) or (54) in (55) | | | | | | | | | | | | 0.4536 | (55) |
| Total storage loss | 14.0616 | 12.7008 | 14.0616 | 13.6080 | 14.0616 | 13.6080 | 14.0616 | 14.0616 | 13.6080 | 14.0616 | 13.6080 | 14.0616 | (56) |
| If cylinder contains dedicated solar storage | 14.0616 | 12.7008 | 14.0616 | 13.6080 | 14.0616 | 13.6080 | 14.0616 | 14.0616 | 13.6080 | 14.0616 | 13.6080 | 14.0616 | (57) |
| Primary 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 | (59) |
| Combi loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |
| Total heat required for water heating calculated for each month | 226.3110 | 199.4637 | 210.2858 | 181.1275 | 173.0031 | 153.0970 | 149.1082 | 156.6200 | 160.0907 | 181.8524 | 197.4351 | 223.3548 | (62) |
| WWHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63a) |
| PV diverter | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |
| Output from w/h | 226.3110 | 199.4637 | 210.2858 | 181.1275 | 173.0031 | 153.0970 | 149.1082 | 156.6200 | 160.0907 | 181.8524 | 197.4351 | 223.3548 | (64) |
| | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 2211.7495 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 2212 | (64) |
| Electric shower(s) | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |
| | | | | | | | | | | Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | | 0.0000 | (64a) |
| Heat gains from water heating, kWh/month | 70.5729 | 62.0987 | 65.2446 | 55.7002 | 52.8481 | 46.3801 | 44.9030 | 47.4007 | 48.7055 | 55.7904 | 61.1225 | 69.5900 | (65) |

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

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Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 123.6607 | 123.6607 | 123.6607 | 123.6607 | 123.6607 | 123.6607 | 123.6607 | 123.6607 | 123.6607 | 123.6607 | 123.6607 | 123.6607 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 115.7685 | 128.1722 | 115.7685 | 119.6274 | 115.7685 | 119.6274 | 115.7685 | 115.7685 | 119.6274 | 115.7685 | 119.6274 | 115.7685 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 220.5862 | 222.8752 | 217.1070 | 204.8272 | 189.3262 | 174.7574 | 165.0245 | 162.7355 | 168.5037 | 180.7835 | 196.2846 | 210.8533 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 35.3661 | 35.3661 | 35.3661 | 35.3661 | 35.3661 | 35.3661 | 35.3661 | 35.3661 | 35.3661 | 35.3661 | 35.3661 | 35.3661 | (69) |
| Pumps, fans | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | -98.9286 | -98.9286 | -98.9286 | -98.9286 | -98.9286 | -98.9286 | -98.9286 | -98.9286 | -98.9286 | -98.9286 | -98.9286 | -98.9286 | (71) |
| Water heating gains (Table 5) | 94.8561 | 92.4087 | 87.6943 | 77.3615 | 71.0323 | 64.4168 | 60.3535 | 63.7106 | 67.6465 | 74.9871 | 84.8924 | 93.5349 | (72) |
| Total internal gains | 491.3090 | 503.5544 | 480.6680 | 461.9143 | 436.2252 | 418.8998 | 401.2447 | 402.3128 | 415.8759 | 431.6373 | 460.9026 | 480.2550 | (73) |

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## 6. Solar gains

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

| | | W/m2 | or Table 6b | or Table 6c | Table 6d | | |
|---|---|---|---|---|---|---|---|
| North | | 5.0400 | 10.6334 | 0.4500 | 0.7000 | 0.7700 | 11.6989 (74) |
| Northeast | | 1.8200 | 11.2829 | 0.4500 | 0.7000 | 0.7700 | 4.4827 (75) |
| West | | 6.2500 | 19.6403 | 0.4500 | 0.7000 | 0.7700 | 26.7961 (80) |
| Northwest | | 1.8200 | 11.2829 | 0.4500 | 0.7000 | 0.7700 | 4.4827 (81) |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 47.4604 | 93.0253 | 157.1961 | 240.9214 | 309.0830 | 323.3324 | 304.9237 | 252.0625 | 186.1418 | 111.1147 | 59.1244 | 39.1102 (83) |
| Total gains | 538.7693 | 596.5797 | 637.8640 | 702.8357 | 745.3082 | 742.2322 | 706.1684 | 654.3753 | 602.0177 | 542.7521 | 520.0270 | 519.3651 (84) |

7. Mean internal temperature (heating season)

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

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| tau | 56.0015 | 56.1723 | 56.3443 | 57.2200 | 57.3984 | 58.3074 | 58.3074 | 58.4927 | 57.9404 | 57.3984 | 57.0427 | 56.6913 | |
| alpha | 4.7334 | 4.7448 | 4.7563 | 4.8147 | 4.8266 | 4.8872 | 4.8872 | 4.8995 | 4.8627 | 4.8266 | 4.8028 | 4.7794 | |
| util living area | 0.9858 | 0.9756 | 0.9544 | 0.8869 | 0.7536 | 0.5594 | 0.4133 | 0.4625 | 0.7075 | 0.9173 | 0.9742 | 0.9878 | (86) |
| Living | 20.0447 | 20.1798 | 20.3782 | 20.6509 | 20.8365 | 20.9185 | 20.9332 | 20.9311 | 20.8818 | 20.6403 | 20.3081 | 20.0277 | |
| Non living | 19.0700 | 19.2425 | 19.4931 | 19.8337 | 20.0438 | 20.1334 | 20.1443 | 20.1455 | 20.0989 | 19.8294 | 19.4155 | 19.0556 | |
| 24 / 16 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 24 / 9 | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |
| 16 / 9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| MIT | 21.0000 | 21.0000 | 21.0000 | 21.0000 | 21.0000 | 21.0000 | 21.0000 | 21.0000 | 21.0000 | 21.0000 | 21.0000 | 21.0000 | (87) |
| Th 2 | 20.1978 | 20.2001 | 20.2024 | 20.2136 | 20.2159 | 20.2272 | 20.2272 | 20.2295 | 20.2227 | 20.2159 | 20.2114 | 20.2069 | (88) |
| util rest of house | 0.9827 | 0.9705 | 0.9447 | 0.8640 | 0.7099 | 0.4978 | 0.3423 | 0.3877 | 0.6461 | 0.8953 | 0.9679 | 0.9852 | (89) |
| MIT 2 | 20.1978 | 20.2001 | 20.2024 | 20.2136 | 20.2159 | 20.2272 | 20.2272 | 20.2295 | 20.2227 | 20.2159 | 20.2114 | 20.2069 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.4904 | (91) |
| MIT | 20.5912 | 20.5924 | 20.5935 | 20.5993 | 20.6004 | 20.6062 | 20.6062 | 20.6073 | 20.6039 | 20.6004 | 20.5981 | 20.5958 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 20.5912 | 20.5924 | 20.5935 | 20.5993 | 20.6004 | 20.6062 | 20.6062 | 20.6073 | 20.6039 | 20.6004 | 20.5981 | 20.5958 | (93) |

8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9843 | 0.9732 | 0.9497 | 0.8758 | 0.7321 | 0.5285 | 0.3773 | 0.4247 | 0.6773 | 0.9067 | 0.9712 | 0.9866 | (94) |
| Useful gains | 530.3125 | 580.5729 | 605.7989 | 615.5096 | 545.6084 | 392.2441 | 266.4513 | 277.9338 | 407.7186 | 492.1400 | 505.0403 | 512.3991 | (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 | 1134.3417 | 1089.3202 | 975.3470 | 797.2610 | 604.6444 | 401.6649 | 267.9141 | 280.4752 | 437.7035 | 679.3724 | 922.7051 | 1127.7325 | (97) |
| Space heating kWh | 449.3977 | 341.8782 | 274.9438 | 130.8610 | 43.9228 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 139.3009 | 300.7187 | 457.8081 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 2138.8311 | |
| Solar heating kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | 449.3977 | 341.8782 | 274.9438 | 130.8610 | 43.9228 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 139.3009 | 300.7187 | 457.8081 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 2138.8311 | |
| Space heating per m2 | | | | | | | | | | (98c) / (4) = | | 26.5528 | (99) |

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

| | | |
|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | 0.0000 | (201) |
| Fraction of space heat from main system(s) | 1.0000 | (202) |
| Efficiency of main space heating system 1 (in %) | 315.3286 | (206) |
| Efficiency of main space heating system 2 (in %) | 0.0000 | (207) |
| Efficiency of secondary/supplementary heating system, % | 0.0000 | (208) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement | 449.3977 | 341.8782 | 274.9438 | 130.8610 | 43.9228 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 139.3009 | 300.7187 | 457.8081 | (98) |
| Space heating efficiency (main heating system 1) | 315.3286 | 315.3286 | 315.3286 | 315.3286 | 315.3286 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 315.3286 | 315.3286 | 315.3286 | (210) |
| Space heating fuel (main heating system) | 142.5173 | 108.4197 | 87.1928 | 41.4999 | 13.9292 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 44.1764 | 95.3668 | 145.1845 | (211) |
| Space heating efficiency (main heating system 2) | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (212) |
| Space heating fuel (main heating system 2) | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (213) |
| Space heating fuel (secondary) | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (215) |
| Water heating | | | | | | | | | | | | | |
| Water heating requirement | 226.3110 | 199.4637 | 210.2858 | 181.1275 | 173.0031 | 153.0970 | 149.1082 | 156.6200 | 160.0907 | 181.8524 | 197.4351 | 223.3548 | (64) |
| Efficiency of water heater | | | | | | | | | | | | 194.1800 | (216) |
| (217)m | 194.1800 | 194.1800 | 194.1800 | 194.1800 | 194.1800 | 194.1800 | 194.1800 | 194.1800 | 194.1800 | 194.1800 | 194.1800 | 194.1800 | (217) |
| Fuel for water heating, kWh/month | 116.5470 | 102.7211 | 108.2943 | 93.2782 | 89.0942 | 78.8428 | 76.7887 | 80.6571 | 82.4445 | 93.6515 | 101.6763 | 115.0246 | (219) |
| Space cooling fuel requirement | | | | | | | | | | | | | |
| (221)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (221) |
| Pumps and Fa | 5.9057 | 5.3342 | 5.9057 | 5.7152 | 5.9057 | 5.7152 | 5.9057 | 5.9057 | 5.7152 | 5.9057 | 5.7152 | 5.9057 | (231) |
| Lighting | 28.3822 | 22.7692 | 20.5012 | 15.0200 | 11.6019 | 9.4789 | 10.5836 | 13.7570 | 17.8690 | 23.4451 | 26.4812 | 29.1710 | (232) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (233a)m | -44.2982 | -70.5654 | -113.2027 | -132.0219 | -140.4399 | -127.9226 | -125.5546 | -118.1140 | -101.7270 | -82.0856 | -50.4236 | -36.9471 | (233a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (234a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (234a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (235a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235a) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | | |
| (235c)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235c) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (233b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (233b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (234b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (234b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (235b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235b) |

Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (235d)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235d) |

| | | |
|---|---|---|
| Annual totals kWh/year | | |
| Space heating fuel - main system 1 | 678.2865 | (211) |
| Space heating fuel - main system 2 | 0.0000 | (213) |
| Space heating fuel - secondary | 0.0000 | (215) |
| Efficiency of water heater | 194.1800 | |
| Water heating fuel used | 1139.0202 | (219) |
| Space cooling fuel | 0.0000 | (221) |
| Electricity for pumps and fans: | | |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.9500) | | |
| mechanical ventilation fans (SFP = 0.9500) | 69.5345 | (230a) |
| Total electricity for the above, kWh/year | 69.5345 | (231) |
| Electricity for lighting (calculated in Appendix L) | 229.0604 | (232) |
| Energy saving/generation technologies (Appendices M ,N and Q) | | |
| PV generation | -1143.3026 | (233) |
| Wind generation | 0.0000 | (234) |
| Hydro-electric generation (Appendix N) | 0.0000 | (235a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 | (235) |
| Appendix Q - special features | | |
| Energy saved or generated | -0.0000 | (236) |
| Energy used | 0.0000 | (237) |
| Total delivered energy for all uses | 972.5990 | (238) |

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

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| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 678.2865 | 0.1559 | 105.7645 | (261) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 1139.0202 | 0.1414 | 161.0160 | (264) |
| Space and water heating | | | 266.7806 | (265) |
| Pumps, fans and electric keep-hot | 69.5345 | 0.1387 | 9.6453 | (267) |
| Energy for lighting | 229.0604 | 0.1443 | 33.0605 | (268) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -1143.3026 | 0.1338 | -152.9750 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -152.9750 | (269) |
| Total CO2, kg/year | | | 156.5113 | (272) |
| EPC Dwelling Carbon Dioxide Emission Rate (DER) | | | 1.9400 | (273) |

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

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| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 678.2865 | 1.5773 | 1069.8497 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 1139.0202 | 1.5227 | 1734.4252 | (278) |
| Space and water heating | | | 2804.2749 | (279) |
| Pumps, fans and electric keep-hot | 69.5345 | 1.5128 | 105.1918 | (281) |
| Energy for lighting | 229.0604 | 1.5338 | 351.3405 | (282) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -1143.3026 | 1.4945 | -1708.6517 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -1708.6517 | (283) |
| Total Primary energy kWh/year | | | 1552.1555 | (286) |
| Dwelling Primary energy Rate (DPER) | | | 19.2700 | (287) |

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF TARGET EMISSIONS

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1. Overall dwelling characteristics

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| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 80.5500 | (1b) | x 2.5000 | (2b) = | 201.3750 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 80.5500 | | | | | (4) |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | | 201.3750 | (5) |

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2. Ventilation rate

---

| | m3 per hour | |
|---|---|---|
| Number of open chimneys | 0 * 80 = 0.0000 | (6a) |
| Number of open flues | 0 * 20 = 0.0000 | (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = 0.0000 | (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = 0.0000 | (6d) |
| Number of flues attached to other heater | 0 * 35 = 0.0000 | (6e) |
| Number of blocked chimneys | 0 * 20 = 0.0000 | (6f) |
| Number of intermittent extract fans | 3 * 10 = 30.0000 | (7a) |
| Number of passive vents | 0 * 10 = 0.0000 | (7b) |
| Number of flueless gas fires | 0 * 40 = 0.0000 | (7c) |
| | Air changes per hour | |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 30.0000 / (5) = 0.1490 | (8) |
| Pressure test | Yes | |

| | | |
|---|---|---|
| Pressure Test Method | Blower Door | |
| Measured/design AP50 | 5.0000 | (17) |
| Infiltration rate | 0.3990 | (18) |
| Number of sides sheltered | 2 | (19) |
| Shelter factor (20) = 1 - [0.075 x (19)] = | 0.8500 | (20) |
| Infiltration rate adjusted to include shelter factor (21) = (18) x (20) = | 0.3391 | (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.4324 | 0.4239 | 0.4154 | 0.3730 | 0.3646 | 0.3222 | 0.3222 | 0.3137 | 0.3391 | 0.3646 | 0.3815 | 0.3985 | (22b) |
| Effective ac | 0.5935 | 0.5899 | 0.5863 | 0.5696 | 0.5665 | 0.5519 | 0.5519 | 0.5492 | 0.5575 | 0.5665 | 0.5728 | 0.5794 | (25) |

## 3. Heat losses and heat loss parameter

| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | | |
| TER Opaque door | | | 2.0600 | 1.0000 | 2.0600 | | | (26) |
| TER Opening Type | | | 14.9300 | 1.1450 | 17.0954 | | | (27) |
| External Wall 1 | 54.2700 | 16.9900 | 37.2800 | 0.1800 | 6.7104 | | | (29a) |
| Corridor | 17.2800 | | 17.2800 | 0.1800 | 3.1104 | | | (29a) |
| Main Roof | 80.5500 | | 80.5500 | 0.1100 | 8.8605 | | | (30) |
| Total net area of external elements Aum(A, m2) | | | 152.1000 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 37.8367 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall | | | 32.0000 | 0.0000 | 0.0000 | | | (32) |

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 174.2718 (35)

List of Thermal Bridges

| K1 Element | Length | Psi-value | Total |
|---|---|---|---|
| E2 Other lintels (including other steel lintels) | 9.5800 | 0.0500 | 0.4790 |
| E3 Sill | 8.6000 | 0.0500 | 0.4300 |
| E4 Jamb | 24.9000 | 0.0500 | 1.2450 |
| E7 Party floor between dwellings (in blocks of flats) | 16.2000 | 0.0700 | 1.1340 |
| E7 Party floor between dwellings (in blocks of flats) | 6.4000 | 0.0700 | 0.4480 |
| E23 Balcony within or between dwellings, balcony support penetrates wall insulation | 3.9000 | 0.0200 | 0.0780 |
| E16 Corner (normal) | 8.1000 | 0.0900 | 0.7290 |
| E17 Corner (inverted - internal area greater than external area) | 5.4000 | -0.0900 | -0.4860 |
| E17 Corner (inverted - internal area greater than external area) | 2.7000 | -0.0900 | -0.2430 |
| E18 Party wall between dwellings | 5.4000 | 0.0600 | 0.3240 |
| E18 Party wall between dwellings | 2.7000 | 0.0600 | 0.1620 |
| E25 Staggered party wall between dwellings | 2.7000 | 0.0600 | 0.1620 |
| P3 Party wall - Intermediate floor between dwellings (in blocks of flats) | 11.8500 | 0.0000 | 0.0000 |
| E15 Flat roof with parapet | 20.1000 | 0.5600 | 11.2560 |
| E14 Flat roof | 6.4000 | 0.0800 | 0.5120 |
| P4 Party wall - Roof (insulation at ceiling level) | 11.8500 | 0.1200 | 1.4220 |

| | | |
|---|---|---|
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) | 17.6520 | (36) |
| Point Thermal bridges (36a) = | 0.0000 | |
| Total fabric heat loss (33) + (36) + (36a) = | 55.4887 | (37) |

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 39.4390 | 39.1978 | 38.9613 | 37.8507 | 37.6430 | 36.6757 | 36.6757 | 36.4965 | 37.0483 | 37.6430 | 38.0633 | 38.5028 | (38) |
| Heat transfer coeff | 94.9277 | 94.6865 | 94.4501 | 93.3395 | 93.1317 | 92.1644 | 92.1644 | 91.9853 | 92.5370 | 93.1317 | 93.5520 | 93.9915 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 93.3385 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.1785 | 1.1755 | 1.1726 | 1.1588 | 1.1562 | 1.1442 | 1.1442 | 1.1420 | 1.1488 | 1.1562 | 1.1614 | 1.1669 | (40) |
| HLP (average) | | | | | | | | | | | | 1.1588 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

## 4. Water heating energy requirements (kWh/year)

| | | |
|---|---|---|
| Assumed occupancy | 2.4732 | (42) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Hot water usage for mixer showers | 65.6874 | 64.7002 | 63.2617 | 60.5095 | 58.4784 | 56.2133 | 54.9259 | 56.3534 | 57.9183 | 60.3503 | 63.1617 | 65.4357 | (42a) |
| Hot water usage for baths | 28.3709 | 27.9496 | 27.3563 | 26.2622 | 25.4430 | 24.5347 | 24.0440 | 24.6332 | 25.2748 | 26.2467 | 27.3633 | 28.2750 | (42b) |
| Hot water usage for other uses | 39.9582 | 38.5052 | 37.0521 | 35.5991 | 34.1461 | 32.6931 | 32.6931 | 34.1461 | 35.5991 | 37.0521 | 38.5052 | 39.9582 | (42c) |
| Average daily hot water use (litres/day) | | | | | | | | | | | | 123.1915 | (43) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 134.0165 | 131.1550 | 127.6701 | 122.3708 | 118.0675 | 113.4411 | 111.6629 | 115.1327 | 118.7922 | 123.6492 | 129.0302 | 133.6689 | (44) |
| Energy conte | 212.2494 | 186.7629 | 196.2242 | 167.5195 | 158.9415 | 139.4890 | 135.0466 | 142.5584 | 146.4827 | 167.7908 | 183.8271 | 209.2932 | (45) |
| Energy content (annual) | | | | | | | | | | | Total = Sum(45)m = | 2046.1855 | |
| Distribution loss (46)m = 0.15 x (45)m | 31.8374 | 28.0144 | 29.4336 | 25.1279 | 23.8412 | 20.9234 | 20.2570 | 21.3838 | 21.9724 | 25.1686 | 27.5741 | 31.3940 | (46) |
| Water storage loss (or HIU loss): | | | | | | | | | | | | | |
| Store volume | | | | | | | | | | | | 150.0000 | (47) |
| a) If manufacturer declared loss factor is known (kWh/day): | | | | | | | | | | | | 1.3938 | (48) |
| Temperature factor from Table 2b | | | | | | | | | | | | 0.5400 | (49) |
| Enter (49) or (54) in (55) | | | | | | | | | | | | 0.7527 | (55) |
| Total storage loss | 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (56) |
| If cylinder contains dedicated solar storage | 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (57) |
| Primary loss | 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |
| Total heat required for water heating calculated for each month | 258.8443 | 228.8487 | 242.8191 | 212.6114 | 205.5364 | 184.5808 | 181.6416 | 189.1533 | 191.5745 | 214.3857 | 228.9190 | 255.8881 | (62) |
| WWHRS | -30.0295 | -26.5584 | -27.8104 | -23.0281 | -21.4614 | -18.3646 | -17.2139 | -18.3053 | -19.0008 | -22.3998 | -25.3763 | -29.4734 | (63a) |
| PV diverter | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |
| Output from w/h | 228.8148 | 202.2903 | 215.0088 | 189.5833 | 184.0751 | 166.2162 | 164.4276 | 170.8480 | 172.5737 | 191.9859 | 203.5427 | 226.4147 | (64) |
| | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 2315.7811 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 2316 | (64) |

Electric shower(s)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |

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

Heat gains from water heating, kWh/month

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 107.8488 | 95.7673 | 102.5205 | 91.7737 | 90.1240 | 82.4536 | 82.1789 | 84.6766 | 84.7790 | 93.0664 | 97.1960 | 106.8659 | (65) |

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

Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 123.6607 | 123.6607 | 123.6607 | 123.6607 | 123.6607 | 123.6607 | 123.6607 | 123.6607 | 123.6607 | 123.6607 | 123.6607 | 123.6607 | (66) |

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 113.1275 | 125.2483 | 113.1275 | 116.8984 | 113.1275 | 116.8984 | 113.1275 | 113.1275 | 116.8984 | 113.1275 | 116.8984 | 113.1275 | (67) |

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 220.5862 | 222.8752 | 217.1070 | 204.8272 | 189.3262 | 174.7574 | 165.0245 | 162.7355 | 168.5037 | 180.7835 | 196.2846 | 210.8533 | (68) |

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 35.3661 | 35.3661 | 35.3661 | 35.3661 | 35.3661 | 35.3661 | 35.3661 | 35.3661 | 35.3661 | 35.3661 | 35.3661 | 35.3661 | (69) |
| Pumps, fans | | | | | | | | | | | | |
| 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 3.0000 | 3.0000 | 3.0000 | (70) |

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| -98.9286 | -98.9286 | -98.9286 | -98.9286 | -98.9286 | -98.9286 | -98.9286 | -98.9286 | -98.9286 | -98.9286 | -98.9286 | -98.9286 | (71) |

Water heating gains (Table 5)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 144.9581 | 142.5108 | 137.7963 | 127.4635 | 121.1344 | 114.5188 | 110.4556 | 113.8126 | 117.7486 | 125.0892 | 134.9944 | 143.6370 | (72) |

Total internal gains

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 541.7700 | 553.7325 | 531.1290 | 512.2873 | 486.6862 | 466.2728 | 448.7058 | 449.7738 | 463.2489 | 482.0984 | 511.2756 | 530.7160 | (73) |

## 6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| North | 5.0400 | 10.6334 | 0.6300 | 0.7000 | 0.7700 | 16.3785 | (74) |
| Northeast | 1.8200 | 11.2829 | 0.6300 | 0.7000 | 0.7700 | 6.2757 | (75) |
| West | 6.2500 | 19.6403 | 0.6300 | 0.7000 | 0.7700 | 37.5145 | (80) |
| Northwest | 1.8200 | 11.2829 | 0.6300 | 0.7000 | 0.7700 | 6.2757 | (81) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 66.4445 | 130.2354 | 220.0745 | 337.2900 | 432.7163 | 452.6653 | 426.8932 | 352.8876 | 260.5986 | 155.5606 | 82.7742 | 54.7542 | (83) |
| Total gains | 608.2145 | 683.9679 | 751.2035 | 849.5773 | 919.4025 | 918.9381 | 875.5990 | 802.6614 | 723.8475 | 637.6590 | 594.0498 | 585.4702 | (84) |

## 7. Mean internal temperature (heating season)

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

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| tau | 41.0768 | 41.1815 | 41.2846 | 41.7758 | 41.8690 | 42.3084 | 42.3084 | 42.3908 | 42.1381 | 41.8690 | 41.6809 | 41.4860 | |
| alpha | 3.7385 | 3.7454 | 3.7523 | 3.7851 | 3.7913 | 3.8206 | 3.8206 | 3.8261 | 3.8092 | 3.7913 | 3.7787 | 3.7657 | |
| util living area | | | | | | | | | | | | | |
| | 0.9827 | 0.9720 | 0.9497 | 0.8866 | 0.7670 | 0.5940 | 0.4497 | 0.5046 | 0.7397 | 0.9190 | 0.9712 | 0.9849 | (86) |
| MIT | 19.2835 | 19.5049 | 19.8581 | 20.3432 | 20.7189 | 20.9229 | 20.9793 | 20.9683 | 20.8196 | 20.3316 | 19.7375 | 19.2529 | (87) |
| Th 2 | 19.9372 | 19.9397 | 19.9420 | 19.9531 | 19.9552 | 19.9649 | 19.9649 | 19.9667 | 19.9612 | 19.9552 | 19.9510 | 19.9466 | (88) |
| util rest of house | | | | | | | | | | | | | |
| | 0.9787 | 0.9656 | 0.9379 | 0.8602 | 0.7154 | 0.5135 | 0.3498 | 0.4008 | 0.6659 | 0.8942 | 0.9635 | 0.9814 | (89) |
| MIT 2 | 17.9543 | 18.2355 | 18.6801 | 19.2789 | 19.7062 | 19.9142 | 19.9563 | 19.9523 | 19.8256 | 19.2802 | 18.5406 | 17.9217 | (90) |
| Living area fraction | | | | | | | | | fLA = Living area / (4) = | | | 0.4904 | (91) |
| MIT | 18.6061 | 18.8580 | 19.2577 | 19.8008 | 20.2028 | 20.4088 | 20.4580 | 20.4505 | 20.3131 | 19.7958 | 19.1275 | 18.5745 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 18.6061 | 18.8580 | 19.2577 | 19.8008 | 20.2028 | 20.4088 | 20.4580 | 20.4505 | 20.3131 | 19.7958 | 19.1275 | 18.5745 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9720 | 0.9572 | 0.9285 | 0.8558 | 0.7286 | 0.5493 | 0.3983 | 0.4507 | 0.6928 | 0.8897 | 0.9557 | 0.9752 | (94) |
| Useful gains | 591.1663 | 654.6900 | 697.4795 | 727.0340 | 669.8507 | 504.7390 | 348.7294 | 361.7268 | 501.4835 | 567.2984 | 567.7117 | 570.9707 | (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 | | | | | | | | | | | | | |
| | 1358.0471 | 1321.6310 | 1204.9679 | 1017.4729 | 791.8807 | 535.3690 | 355.5689 | 372.5867 | 574.9380 | 856.4174 | 1125.2001 | 1351.0793 | (97) |
| Space heating kWh | | | | | | | | | | | | | |
| | 570.5594 | 448.1844 | 377.5713 | 209.1160 | 90.7903 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 215.1046 | 401.3917 | 580.4009 | (98a) |

Space heating requirement - total per year (kWh/year) 2893.1185

Solar heating kWh

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |

Solar heating contribution - total per year (kWh/year) 0.0000

Space heating kWh

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 570.5594 | 448.1844 | 377.5713 | 209.1160 | 90.7903 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 215.1046 | 401.3917 | 580.4009 | (98c) |

Space heating requirement after solar contribution - total per year (kWh/year) 2893.1185

Space heating per m2 (98c) / (4) = 35.9171 (99)

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

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

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

Efficiency of main space heating system 1 (in %) 92.3000 (206)

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

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement | | | | | | | | | | | | | |
| | 570.5594 | 448.1844 | 377.5713 | 209.1160 | 90.7903 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 215.1046 | 401.3917 | 580.4009 | (98) |
| Space heating efficiency (main heating system 1) | | | | | | | | | | | | | |
| | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 92.3000 | 92.3000 | 92.3000 | (210) |
| Space heating fuel (main heating system) | | | | | | | | | | | | | |
| | 618.1575 | 485.5735 | 409.0697 | 226.5612 | 98.3644 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 233.0494 | 434.8772 | 628.8200 | (211) |
| Space heating efficiency (main heating system 2) | | | | | | | | | | | | | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (212) |
| Space heating fuel (main heating system 2) | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (213) |
| Space heating fuel (secondary) | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (215) |
| Water heating | | | | | | | | | | | | |
| Water heating requirement | | | | | | | | | | | | |
| | 228.8148 | 202.2903 | 215.0088 | 189.5833 | 184.0751 | 166.2162 | 164.4276 | 170.8480 | 172.5737 | 191.9859 | 203.5427 | 226.4147 (64) |
| Efficiency of water heater | | | | | | | | | | | | 79.8000 (216) |
| (217)m | 86.0229 | 85.7910 | 85.3090 | 84.2802 | 82.5640 | 79.8000 | 79.8000 | 79.8000 | 79.8000 | 84.3154 | 85.5534 | 86.0757 (217) |
| Fuel for water heating, kWh/month | | | | | | | | | | | | |
| | 265.9928 | 235.7944 | 252.0351 | 224.9440 | 222.9483 | 208.2910 | 206.0497 | 214.0953 | 216.2578 | 227.6997 | 237.9129 | 263.0413 (219) |
| Space cooling fuel requirement | | | | | | | | | | | | |
| (221)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (221) |
| Pumps and Fa | 7.3041 | 6.5973 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 (231) |
| Lighting | 23.5057 | 18.8571 | 16.9787 | 12.4394 | 9.6085 | 7.8502 | 8.7652 | 11.3933 | 14.7988 | 19.4169 | 21.9313 | 24.1590 (232) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (233a)m | -11.7980 | -18.0579 | -28.1504 | -34.4106 | -39.5949 | -37.8786 | -37.4156 | -34.0650 | -28.6395 | -21.8047 | -13.4651 | -10.0407 (233a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (234a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (234a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (235a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (235a) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | |
| (235c)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (235c) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (233b)m | -2.9447 | -6.4196 | -13.1959 | -20.4845 | -27.7585 | -28.1455 | -27.8187 | -23.2441 | -16.6355 | -9.3951 | -3.9977 | -2.3124 (233b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (234b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (234b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (235b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (235b) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | |
| (235d)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (235d) |

| | | |
|---|---|---|
| Annual totals kWh/year | | |
| Space heating fuel - main system 1 | 3134.4729 | (211) |
| Space heating fuel - main system 2 | 0.0000 | (213) |
| Space heating fuel - secondary | 0.0000 | (215) |
| Efficiency of water heater | 79.8000 | |
| Water heating fuel used | 2775.0624 | (219) |
| Space cooling fuel | 0.0000 | (221) |
| | | |
| Electricity for pumps and fans: | | |
| Total electricity for the above, kWh/year | 86.0000 | (231) |
| Electricity for lighting (calculated in Appendix L) | 189.7041 | (232) |
| | | |
| Energy saving/generation technologies (Appendices M ,N and Q) | | |
| PV generation | -497.6732 | (233) |
| Wind generation | 0.0000 | (234) |
| Hydro-electric generation (Appendix N) | 0.0000 | (235a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 | (235) |
| Appendix Q - special features | | |
| Energy saved or generated | -0.0000 | (236) |
| Energy used | 0.0000 | (237) |
| Total delivered energy for all uses | 5687.5662 | (238) |

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

| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 3134.4729 | 0.2100 | 658.2393 | (261) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 2775.0624 | 0.2100 | 582.7631 | (264) |
| Space and water heating | | | 1241.0024 | (265) |
| Pumps, fans and electric keep-hot | 86.0000 | 0.1387 | 11.9293 | (267) |
| Energy for lighting | 189.7041 | 0.1443 | 27.3802 | (268) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -315.3211 | 0.1329 | -41.9098 | |
| PV Unit electricity exported | -182.3521 | 0.1249 | -22.7832 | |
| Total | | | -64.6929 | (269) |
| Total CO2, kg/year | | | 1215.6189 | (272) |
| EPC Target Carbon Dioxide Emission Rate (TER) | | | 15.0900 | (273) |

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

| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 3134.4729 | 1.1300 | 3541.9544 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 2775.0624 | 1.1300 | 3135.8205 | (278) |
| Space and water heating | | | 6677.7748 | (279) |
| Pumps, fans and electric keep-hot | 86.0000 | 1.5128 | 130.1008 | (281) |
| Energy for lighting | 189.7041 | 1.5338 | 290.9745 | (282) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -315.3211 | 1.4911 | -470.1821 | |
| PV Unit electricity exported | -182.3521 | 0.4586 | -83.6212 | |
| Total | | | -553.8034 | (283) |
| Total Primary energy kWh/year | | | 6545.0468 | (286) |
| Target Primary Energy Rate (TPER) | | | 81.2500 | (287) |

# Full SAP Calculation Printout

| | | | |
|---|---|---|---|
| Plot Reference | 2B4P Mid MF E | Issued on Date | 16/01/2026 |
| Assessment Reference | 2B4P Mid MF E | Plot Type Ref | 2B4P End MF N |
| Plot Address | | SAP Version | 10.2 |

| | | | | | |
|---|---|---|---|---|---|
| SAP Rating | 87 B | DER | 1.43 | TER | 11.72 |
| Environmental | 99 A | % DER < TER | | | 87.80 |
| $CO_2$ Emissions (t/year) | 0.07 | DFEE | 23.67 | TFEE | 22.78 |
| Compliance Check | See BREL | % DFEE < TFEE | | | -3.91 |
| % DPER < TPER | 77.61 | DPER | 14.19 | TPER | 63.38 |

| | | | |
|---|---|---|---|
| Assessor Details | Miss Eleanor Risby | Assessor ID | M976-0001 |
| Client | | | |

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE

## 1. Overall dwelling characteristics

| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 68.4500 | (1b) | x 2.5000 | (2b) = | 171.1250 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 68.4500 | | | | | (4) |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | 171.1250 | (5) |

## 2. Ventilation rate

| | | m3 per hour | |
|---|---|---|---|
| Number of open chimneys | 0 * 80 = | 0.0000 | (6a) |
| Number of open flues | 0 * 20 = | 0.0000 | (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 | (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 | (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 | (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 | (6f) |
| Number of intermittent extract fans | 0 * 10 = | 0.0000 | (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 | (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 | (7c) |
| | Air changes per hour | | |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 0.0000 / (5) = | 0.0000 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 3.0000 | (17) |
| Infiltration rate | | 0.1500 | (18) |
| Number of sides sheltered | | 3 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 0.7750 | (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.1162 | (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.1482 | 0.1453 | 0.1424 | 0.1279 | 0.1250 | 0.1104 | 0.1104 | 0.1075 | 0.1162 | 0.1250 | 0.1308 | 0.1366 | (22b) |

Balanced mechanical ventilation with heat recovery

| | |
|---|---|
| If mechanical ventilation | 0.5000 (23a) |
| If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) | 0.5276 (23b) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = | 77.4000 (23c) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Effective ac | 0.2675 | 0.2645 | 0.2616 | 0.2471 | 0.2442 | 0.2297 | 0.2297 | 0.2268 | 0.2355 | 0.2442 | 0.2500 | 0.2558 | (25) |

## 3. Heat losses and heat loss parameter

| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | | |
| Glazing | | | 9.1400 | 1.1450 | 10.4656 | | | (27) |
| Corridor Door | | | 2.0600 | 1.0000 | 2.0600 | | | (26) |
| External Wall 1 | 24.3000 | 11.2000 | 13.1000 | 0.1900 | 2.4890 | 14.0000 | 183.4000 | (29a) |
| Corridor | 24.3000 | | 24.3000 | 0.1600 | 3.8880 | 14.0000 | 340.2000 | (29a) |
| Total net area of external elements Aum(A, m2) | | | 48.6000 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | | (26)...(30) + (32) = | 18.9026 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall | | | 41.0400 | 0.0000 | 0.0000 | 20.0000 | 820.8000 | (32) |
| Party Floor 1 | | | 68.4500 | | | 40.0000 | 2738.0000 | (32d) |
| Party Ceiling 1 | | | 68.4500 | | | 30.0000 | 2053.5000 | (32b) |
| Internal Wall 1 | | | 133.7500 | | | 9.0000 | 1203.7500 | (32c) |

| | |
|---|---|
| Heat capacity Cm = Sum(A x k) | (28)...(30) + (32) + (32a)...(32e) = 7339.6500 (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | 107.2264 (35) |
| List of Thermal Bridges | |

| K1 Element | Length | Psi-value | Total | |
|---|---|---|---|---|
| E7 Party floor between dwellings (in blocks of flats) | 10.2000 | 0.0700 | 0.7140 | |
| E7 Party floor between dwellings (in blocks of flats) | 18.0000 | 0.1000 | 1.8000 | |
| E23 Balcony within or between dwellings, balcony support penetrates wall insulation | 7.8000 | 0.1500 | 1.1700 | |
| E16 Corner (normal) | 8.1000 | 0.1000 | 0.8100 | |
| E18 Party wall between dwellings | 5.4000 | 0.0600 | 0.3240 | |
| E18 Party wall between dwellings | 5.4000 | 0.0900 | 0.4860 | |
| P3 Party wall - Intermediate floor between dwellings (in blocks of flats) | 30.4000 | 0.0000 | 0.0000 | |
| E2 Other lintels (including other steel lintels) | 6.0800 | 0.1000 | 0.6080 | |
| E3 Sill | 5.1000 | 0.0500 | 0.2550 | |
| E4 Jamb | 15.0000 | 0.0500 | 0.7500 | |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) | | | 6.9170 | (36) |
| Point Thermal bridges | | (36a) = | 0.0000 | |
| Total fabric heat loss | | (33) + (36) + (36a) = | 25.8196 | (37) |

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 15.1035 | 14.9394 | 14.7752 | 13.9546 | 13.7905 | 12.9699 | 12.9699 | 12.8058 | 13.2982 | 13.7905 | 14.1188 | 14.4470 | (38) |
| Heat transfer coeff | 40.9231 | 40.7590 | 40.5949 | 39.7743 | 39.6102 | 38.7896 | 38.7896 | 38.6255 | 39.1178 | 39.6102 | 39.9384 | 40.2667 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 39.7333 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 0.5979 | 0.5955 | 0.5931 | 0.5811 | 0.5787 | 0.5667 | 0.5667 | 0.5643 | 0.5715 | 0.5787 | 0.5835 | 0.5883 | (40) |
| HLP (average) | | | | | | | | | | | | 0.5805 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

## 4. Water heating energy requirements (kWh/year)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Assumed occupancy | | | | | | | | | | | 2.2079 | (42) |
| Hot water usage for mixer showers | 61.2391 | 60.3188 | 58.9777 | 56.4118 | 54.5183 | 52.4066 | 51.2063 | 52.5372 | 53.9962 | 56.2635 | 58.8845 | 61.0045 | (42a) |
| Hot water usage for baths | 26.4580 | 26.0651 | 25.5118 | 24.4915 | 23.7275 | 22.8804 | 22.4229 | 22.9723 | 23.5706 | 24.4770 | 25.5183 | 26.3686 | (42b) |
| Hot water usage for other uses | 37.2412 | 35.8870 | 34.5328 | 33.1786 | 31.8243 | 30.4701 | 30.4701 | 31.8243 | 33.1786 | 34.5328 | 35.8870 | 37.2412 | (42c) |
| Average daily hot water use (litres/day) | | | | | | | | | | | | 114.8468 | (43) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 124.9384 | 122.2709 | 119.0223 | 114.0819 | 110.0701 | 105.7571 | 104.0993 | 107.3339 | 110.7453 | 115.2733 | 120.2898 | 124.6143 | (44) |
| Energy conte | 197.8718 | 174.1121 | 182.9328 | 156.1724 | 148.1756 | 130.0407 | 125.8991 | 132.9018 | 136.5601 | 156.4248 | 171.3749 | 195.1159 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1907.5819 | |
| Distribution loss (46)m = 0.15 x (45)m | 29.6808 | 26.1168 | 27.4399 | 23.4259 | 22.2263 | 19.5061 | 18.8849 | 19.9353 | 20.4840 | 23.4637 | 25.7062 | 29.2674 | (46) |
| Water storage loss (or HIU loss): | | | | | | | | | | | | | |
| Store volume | | | | | | | | | | | | 180.0000 | (47) |
| a) If manufacturer declared loss factor is known (kWh/day): | | | | | | | | | | | | 0.8400 | (48) |
| Temperature factor from Table 2b | | | | | | | | | | | | 0.5400 | (49) |
| Enter (49) or (54) in (55) | | | | | | | | | | | | 0.4536 | (55) |
| Total storage loss | 14.0616 | 12.7008 | 14.0616 | 13.6080 | 14.0616 | 13.6080 | 14.0616 | 14.0616 | 13.6080 | 14.0616 | 13.6080 | 14.0616 | (56) |
| If cylinder contains dedicated solar storage | 14.0616 | 12.7008 | 14.0616 | 13.6080 | 14.0616 | 13.6080 | 14.0616 | 14.0616 | 13.6080 | 14.0616 | 13.6080 | 14.0616 | (57) |
| Primary 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 | (59) |
| Combi loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |
| Total heat required for water heating calculated for each month | 211.9334 | 186.8129 | 196.9944 | 169.7804 | 162.2372 | 143.6487 | 139.9607 | 146.9634 | 150.1681 | 170.4864 | 184.9829 | 209.1775 | (62) |
| WWHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63a) |
| PV diverter | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |
| Output from w/h | 211.9334 | 186.8129 | 196.9944 | 169.7804 | 162.2372 | 143.6487 | 139.9607 | 146.9634 | 150.1681 | 170.4864 | 184.9829 | 209.1775 | (64) |
| | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 2073.1459 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 2073 | (64) |
| Electric shower(s) | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |
| | | | | | | | | | | Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | | 0.0000 | (64a) |
| Heat gains from water heating, kWh/month | 65.7924 | 57.8923 | 60.8252 | 51.9273 | 49.2684 | 43.2385 | 41.8614 | 44.1898 | 45.4062 | 52.0112 | 56.9821 | 64.8760 | (65) |

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

Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 110.3957 | 110.3957 | 110.3957 | 110.3957 | 110.3957 | 110.3957 | 110.3957 | 110.3957 | 110.3957 | 110.3957 | 110.3957 | 110.3957 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 109.0583 | 120.7431 | 109.0583 | 112.6936 | 109.0583 | 112.6936 | 109.0583 | 109.0583 | 112.6936 | 109.0583 | 112.6936 | 109.0583 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 193.6527 | 195.6623 | 190.5984 | 179.8179 | 166.2095 | 153.4196 | 144.8751 | 142.8656 | 147.9295 | 158.7100 | 172.3183 | 185.1083 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 34.0396 | 34.0396 | 34.0396 | 34.0396 | 34.0396 | 34.0396 | 34.0396 | 34.0396 | 34.0396 | 34.0396 | 34.0396 | 34.0396 | (69) |
| Pumps, fans | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | -88.3165 | -88.3165 | -88.3165 | -88.3165 | -88.3165 | -88.3165 | -88.3165 | -88.3165 | -88.3165 | -88.3165 | -88.3165 | -88.3165 | (71) |
| Water heating gains (Table 5) | 88.4306 | 86.1492 | 81.7542 | 72.1213 | 66.2209 | 60.0535 | 56.2654 | 59.3950 | 63.0642 | 69.9076 | 79.1419 | 87.1990 | (72) |
| Total internal gains | 447.2604 | 458.6733 | 437.5296 | 420.7515 | 397.6075 | 382.2854 | 366.3175 | 367.4376 | 379.8060 | 393.7945 | 420.2725 | 437.4842 | (73) |

## 6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| East | 6.2500 | 19.6403 | 0.4500 | 0.7000 | 0.7700 | 26.7961 | (76) |
| Southeast | 2.8900 | 36.7938 | 0.4500 | 0.7000 | 0.7700 | 23.2122 | (77) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 50.0083 | 91.9578 | 140.4253 | 192.9330 | 229.3779 | 232.4884 | 222.2378 | 195.0275 | 158.9788 | 105.8983 | 61.2144 | 41.9006 | (83) |
| Total gains | 497.2687 | 550.6311 | 577.9549 | 613.6845 | 626.9854 | 614.7738 | 588.5553 | 562.4650 | 538.7848 | 499.6929 | 481.4869 | 479.3848 | (84) |

---

7. Mean internal temperature (heating season)

---

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

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| tau | 49.8200 | 50.0206 | 50.2229 | 51.2590 | 51.4714 | 52.5603 | 52.5603 | 52.7836 | 52.1193 | 51.4714 | 51.0484 | 50.6323 | |
| alpha | 4.3213 | 4.3347 | 4.3482 | 4.4173 | 4.4314 | 4.5040 | 4.5040 | 4.5189 | 4.4746 | 4.4314 | 4.4032 | 4.3755 | |
| util living area | 0.9155 | 0.8762 | 0.8204 | 0.7052 | 0.5632 | 0.3997 | 0.2892 | 0.3147 | 0.4894 | 0.7297 | 0.8679 | 0.9234 | (86) |
| Living | 20.3302 | 20.4727 | 20.6281 | 20.8020 | 20.8899 | 20.9247 | 20.9301 | 20.9298 | 20.9143 | 20.8052 | 20.5677 | 20.3139 | |
| Non living | 19.6362 | 19.8135 | 20.0048 | 20.2198 | 20.3201 | 20.3664 | 20.3712 | 20.3732 | 20.3525 | 20.2287 | 19.9423 | 19.6234 | |
| 24 / 16 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 24 / 9 | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |
| 16 / 9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| MIT | 21.0000 | 21.0000 | 21.0000 | 21.0000 | 21.0000 | 21.0000 | 21.0000 | 21.0000 | 21.0000 | 21.0000 | 21.0000 | 21.0000 | (87) |
| Th 2 | 20.4319 | 20.4341 | 20.4363 | 20.4471 | 20.4492 | 20.4601 | 20.4601 | 20.4622 | 20.4557 | 20.4492 | 20.4449 | 20.4406 | (88) |
| util rest of house | 0.9069 | 0.8645 | 0.8042 | 0.6823 | 0.5341 | 0.3671 | 0.2540 | 0.2783 | 0.4535 | 0.7034 | 0.8538 | 0.9155 | (89) |
| MIT 2 | 20.4319 | 20.4341 | 20.4363 | 20.4471 | 20.4492 | 20.4601 | 20.4601 | 20.4622 | 20.4557 | 20.4492 | 20.4449 | 20.4406 | (90) |
| Living area fraction | | | | | | | | | fLA = Living area / (4) = | | | 0.4383 | (91) |
| MIT | 20.6809 | 20.6821 | 20.6833 | 20.6894 | 20.6906 | 20.6967 | 20.6967 | 20.6979 | 20.6943 | 20.6906 | 20.6882 | 20.6858 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 20.6809 | 20.6821 | 20.6833 | 20.6894 | 20.6906 | 20.6967 | 20.6967 | 20.6979 | 20.6943 | 20.6906 | 20.6882 | 20.6858 | (93) |

---

8. Space heating requirement

---

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9108 | 0.8698 | 0.8115 | 0.6925 | 0.5470 | 0.3815 | 0.2695 | 0.2943 | 0.4694 | 0.7152 | 0.8602 | 0.9191 | (94) |
| Useful gains | 452.8951 | 478.9425 | 468.9979 | 424.9857 | 342.9661 | 234.5099 | 158.5908 | 165.5376 | 252.8833 | 357.3722 | 414.1522 | 440.5837 | (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 | 670.3578 | 643.2634 | 575.7707 | 468.9152 | 356.1201 | 236.4889 | 158.9097 | 166.0096 | 257.9536 | 399.6913 | 542.6907 | 663.8263 | (97) |
| Space heating kWh | 161.7923 | 110.4237 | 79.4390 | 31.6293 | 9.7866 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 31.4854 | 92.5477 | 166.0925 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 683.1964 | |
| Solar heating kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | 161.7923 | 110.4237 | 79.4390 | 31.6293 | 9.7866 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 31.4854 | 92.5477 | 166.0925 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 683.1964 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 9.9810 | (99) |

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

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| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | | | | | | | | | | | | 0.0000 | (201) |
| Fraction of space heat from main system(s) | | | | | | | | | | | | 1.0000 | (202) |
| Efficiency of main space heating system 1 (in %) | | | | | | | | | | | | 299.9818 | (206) |
| Efficiency of main space heating system 2 (in %) | | | | | | | | | | | | 0.0000 | (207) |
| Efficiency of secondary/supplementary heating system, % | | | | | | | | | | | | 0.0000 | (208) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement | 161.7923 | 110.4237 | 79.4390 | 31.6293 | 9.7866 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 31.4854 | 92.5477 | 166.0925 | (98) |
| Space heating efficiency (main heating system 1) | 299.9818 | 299.9818 | 299.9818 | 299.9818 | 299.9818 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 299.9818 | 299.9818 | 299.9818 | (210) |
| Space heating fuel (main heating system) | 53.9340 | 36.8101 | 26.4813 | 10.5437 | 3.2624 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 10.4958 | 30.8511 | 55.3675 | (211) |
| Space heating efficiency (main heating system 2) | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (212) |
| Space heating fuel (main heating system 2) | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (213) |
| Space heating fuel (secondary) | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (215) |
| Water heating | | | | | | | | | | | | | |
| Water heating requirement | 211.9334 | 186.8129 | 196.9944 | 169.7804 | 162.2372 | 143.6487 | 139.9607 | 146.9634 | 150.1681 | 170.4864 | 184.9829 | 209.1775 | (64) |
| Efficiency of water heater | | | | | | | | | | | | 194.1800 | (216) |
| (217)m | 194.1800 | 194.1800 | 194.1800 | 194.1800 | 194.1800 | 194.1800 | 194.1800 | 194.1800 | 194.1800 | 194.1800 | 194.1800 | 194.1800 | (217) |
| Fuel for water heating, kWh/month | 109.1428 | 96.2061 | 101.4494 | 87.4345 | 83.5499 | 73.9771 | 72.0778 | 75.6841 | 77.3345 | 87.7981 | 95.2636 | 107.7235 | (219) |
| Space cooling fuel requirement | | | | | | | | | | | | | |
| (221)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (221) |
| Pumps and Fa | 7.5815 | 6.8478 | 7.5815 | 7.3369 | 7.5815 | 7.3369 | 7.5815 | 7.5815 | 7.3369 | 7.5815 | 7.3369 | 7.5815 | (231) |
| Lighting | 25.7239 | 20.6366 | 18.5810 | 13.6132 | 10.5153 | 8.5911 | 9.5924 | 12.4685 | 16.1954 | 21.2492 | 24.0010 | 26.4388 | (232) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (233a)m | -37.0119 | -58.5999 | -93.9592 | -111.3567 | -121.8469 | -113.4089 | -111.3440 | -104.3496 | -89.2725 | -69.2453 | -42.1397 | -30.8979 | (233a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (234a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (234a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (235a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235a) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | | |
| (235c)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235c) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (233b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (233b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (234b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (234b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (235b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235b) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | | |
| (235d)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235d) |
| Annual totals kWh/year | | | | | | | | | | | | | |
| Space heating fuel - main system 1 | | | | | | | | | | | | 227.7460 | (211) |
| Space heating fuel - main system 2 | | | | | | | | | | | | 0.0000 | (213) |
| Space heating fuel - secondary | | | | | | | | | | | | 0.0000 | (215) |
| Efficiency of water heater | | | | | | | | | | | | 194.1800 | |
| Water heating fuel used | | | | | | | | | | | | 1067.6413 | (219) |

| | | |
|---|---|---|
| Space cooling fuel | 0.0000 | (221) |
| Electricity for pumps and fans: | | |
| (BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.9500) | | |
| mechanical ventilation fans (SFP = 0.9500) | 89.2658 | (230a) |
| Total electricity for the above, kWh/year | 89.2658 | (231) |
| Electricity for lighting (calculated in Appendix L) | 207.6064 | (232) |
| Energy saving/generation technologies (Appendices M ,N and Q) | | |
| PV generation | -983.4324 | (233) |
| Wind generation | 0.0000 | (234) |
| Hydro-electric generation (Appendix N) | 0.0000 | (235a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 | (235) |
| Appendix Q - special features | | |
| Energy saved or generated | -0.0000 | (236) |
| Energy used | 0.0000 | (237) |
| Total delivered energy for all uses | 608.8270 | (238) |

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

| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 227.7460 | 0.1571 | 35.7817 | (261) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 1067.6413 | 0.1413 | 150.9103 | (264) |
| Space and water heating | | | 186.6920 | (265) |
| Pumps, fans and electric keep-hot | 89.2658 | 0.1387 | 12.3823 | (267) |
| Energy for lighting | 207.6064 | 0.1443 | 29.9640 | (268) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -983.4324 | 0.1334 | -131.1559 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -131.1559 | (269) |
| Total CO2, kg/year | | | 97.8824 | (272) |
| EPC Dwelling Carbon Dioxide Emission Rate (DER) | | | 1.4300 | (273) |

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

| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 227.7460 | 1.5816 | 360.2077 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 1067.6413 | 1.5227 | 1625.6766 | (278) |
| Space and water heating | | | 1985.8843 | (279) |
| Pumps, fans and electric keep-hot | 89.2658 | 1.5128 | 135.0413 | (281) |
| Energy for lighting | 207.6064 | 1.5338 | 318.4336 | (282) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -983.4324 | 1.4928 | -1468.1106 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -1468.1106 | (283) |
| Total Primary energy kWh/year | | | 971.2486 | (286) |
| Dwelling Primary energy Rate (DPER) | | | 14.1900 | (287) |

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF TARGET EMISSIONS

1. Overall dwelling characteristics

| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 68.4500 | (1b) x | 2.5000 | (2b) = | 171.1250 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 68.4500 | | | | | (4) |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | | 171.1250 | (5) |

2. Ventilation rate

| | | m3 per hour | |
|---|---|---|---|
| Number of open chimneys | 0 * 80 = | 0.0000 | (6a) |
| Number of open flues | 0 * 20 = | 0.0000 | (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 | (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 | (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 | (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 | (6f) |
| Number of intermittent extract fans | 2 * 10 = | 20.0000 | (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 | (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 | (7c) |
| | Air changes per hour | | |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 20.0000 / (5) = | 0.1169 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 5.0000 | (17) |
| Infiltration rate | | 0.3669 | (18) |
| Number of sides sheltered | | 3 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 0.7750 | (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.2843 | (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | | | | | | | | | | | | | |
| | 0.3625 | 0.3554 | 0.3483 | 0.3128 | 0.3057 | 0.2701 | 0.2701 | 0.2630 | 0.2843 | 0.3057 | 0.3199 | 0.3341 | (22b) |
| Effective ac | 0.5657 | 0.5632 | 0.5607 | 0.5489 | 0.5467 | 0.5365 | 0.5365 | 0.5346 | 0.5404 | 0.5467 | 0.5512 | 0.5558 | (25) |

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## 3. Heat losses and heat loss parameter

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| Element | Gross | Openings | NetArea | U-value | A x U | K-value | A x K | |
|---|---|---|---|---|---|---|---|---|
| | m2 | m2 | m2 | W/m2K | W/K | kJ/m2K | kJ/K | |
| Main dwelling | | | | | | | | |
| TER Opaque door | | | 2.0600 | 1.0000 | 2.0600 | | | (26) |
| TER Opening Type | | | 9.1400 | 1.1450 | 10.4656 | | | (27) |
| External Wall 1 | 24.3000 | 11.2000 | 13.1000 | 0.1800 | 2.3580 | | | (29a) |
| Corridor | 24.3000 | | 24.3000 | 0.1800 | 4.3740 | | | (29a) |
| Total net area of external elements Aum(A, m2) | | | 48.6000 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | | (26)...(30) + (32) = | 19.2576 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall | | | 41.0400 | 0.0000 | 0.0000 | | | (32) |

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 107.2264 (35)

List of Thermal Bridges

| K1 Element | Length | Psi-value | Total |
|---|---|---|---|
| E7 Party floor between dwellings (in blocks of flats) | 10.2000 | 0.0700 | 0.7140 |
| E7 Party floor between dwellings (in blocks of flats) | 18.0000 | 0.0700 | 1.2600 |
| E23 Balcony within or between dwellings, balcony support penetrates wall insulation | 7.8000 | 0.0200 | 0.1560 |
| E16 Corner (normal) | 8.1000 | 0.0900 | 0.7290 |
| E18 Party wall between dwellings | 5.4000 | 0.0600 | 0.3240 |
| E18 Party wall between dwellings | 5.4000 | 0.0600 | 0.3240 |
| P3 Party wall - Intermediate floor between dwellings (in blocks of flats) | 30.4000 | 0.0000 | 0.0000 |
| E2 Other lintels (including other steel lintels) | 6.0800 | 0.0500 | 0.3040 |
| E3 Sill | 5.1000 | 0.0500 | 0.2550 |
| E4 Jamb | 15.0000 | 0.0500 | 0.7500 |

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 4.8160 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 24.0736 (37)

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 31.9463 | 31.8022 | 31.6610 | 30.9976 | 30.8735 | 30.2957 | 30.2957 | 30.1887 | 30.5182 | 30.8735 | 31.1246 | 31.3871 | (38) |
| Heat transfer coeff | | | | | | | | | | | | | |
| | 56.0200 | 55.8759 | 55.7346 | 55.0712 | 54.9471 | 54.3693 | 54.3693 | 54.2623 | 54.5919 | 54.9471 | 55.1982 | 55.4607 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 55.0707 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 0.8184 | 0.8163 | 0.8142 | 0.8045 | 0.8027 | 0.7943 | 0.7943 | 0.7927 | 0.7975 | 0.8027 | 0.8064 | 0.8102 | (40) |
| HLP (average) | | | | | | | | | | | | 0.8045 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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## 4. Water heating energy requirements (kWh/year)

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Assumed occupancy 2.2079 (42)

Hot water usage for mixer showers

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 61.2391 | 60.3188 | 58.9777 | 56.4118 | 54.5183 | 52.4066 | 51.2063 | 52.5372 | 53.9962 | 56.2635 | 58.8845 | 61.0045 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 26.4580 | 26.0651 | 25.5118 | 24.4915 | 23.7275 | 22.8804 | 22.4229 | 22.9723 | 23.5706 | 24.4770 | 25.5183 | 26.3686 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 37.2412 | 35.8870 | 34.5328 | 33.1786 | 31.8243 | 30.4701 | 30.4701 | 31.8243 | 33.1786 | 34.5328 | 35.8870 | 37.2412 | (42c) |

Average daily hot water use (litres/day) 114.8468 (43)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | | | | | | | | | | | | | |
| | 124.9384 | 122.2709 | 119.0223 | 114.0819 | 110.0701 | 105.7571 | 104.0993 | 107.3339 | 110.7453 | 115.2733 | 120.2898 | 124.6143 | (44) |
| Energy conte | 197.8718 | 174.1121 | 182.9328 | 156.1724 | 148.1756 | 130.0407 | 125.8991 | 132.9018 | 136.5601 | 156.4248 | 171.3749 | 195.1159 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1907.5819 | |
| Distribution loss (46)m = 0.15 x (45)m | | | | | | | | | | | | | |
| | 29.6808 | 26.1168 | 27.4399 | 23.4259 | 22.2263 | 19.5061 | 18.8849 | 19.9353 | 20.4840 | 23.4637 | 25.7062 | 29.2674 | (46) |

Water storage loss (or HIU loss):

Store volume 150.0000 (47)

a) If manufacturer declared loss factor is known (kWh/day): 1.3938 (48)

Temperature factor from Table 2b 0.5400 (49)

Enter (49) or (54) in (55) 0.7527 (55)

Total storage loss

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (56) |

If cylinder contains dedicated solar storage

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (57) |
| Primary loss 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |

Total heat required for water heating calculated for each month

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 244.4667 | 216.1978 | 229.5277 | 201.2642 | 194.7705 | 175.1326 | 172.4940 | 179.4967 | 181.6519 | 203.0197 | 216.4667 | 241.7108 | (62) |
| WWHRS -27.9960 | -24.7599 | -25.9271 | -21.4687 | -20.0080 | -17.1210 | -16.0482 | -17.0657 | -17.7140 | -20.8829 | -23.6578 | -27.4775 | (63a) |
| PV diverter -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |
| Output from w/h | | | | | | | | | | | | | |
| 216.4708 | 191.4380 | 203.6006 | 179.7956 | 174.7625 | 158.0116 | 156.4458 | 162.4310 | 163.9379 | 182.1368 | 192.8089 | 214.2333 | (64) |
| | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 2196.0726 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | 2196 | (64) | |

Electric shower(s)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |

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

Heat gains from water heating, kWh/month

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 103.0683 | 91.5609 | 98.1011 | 88.0008 | 86.5443 | 79.3120 | 79.1374 | 81.4658 | 81.4797 | 89.2872 | 93.0556 | 102.1519 | (65) |

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

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Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 110.3957 | 110.3957 | 110.3957 | 110.3957 | 110.3957 | 110.3957 | 110.3957 | 110.3957 | 110.3957 | 110.3957 | 110.3957 | 110.3957 | (66) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 105.8807 | 117.2251 | 105.8807 | 109.4100 | 105.8807 | 109.4100 | 105.8807 | 105.8807 | 109.4100 | 105.8807 | 109.4100 | 105.8807 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | | | | | | | | | | | | | |
| | 193.6527 | 195.6623 | 190.5984 | 179.8179 | 166.2095 | 153.4196 | 144.8751 | 142.8656 | 147.9295 | 158.7100 | 172.3183 | 185.1083 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | | | | | | | | | | | | | |
| | 34.0396 | 34.0396 | 34.0396 | 34.0396 | 34.0396 | 34.0396 | 34.0396 | 34.0396 | 34.0396 | 34.0396 | 34.0396 | 34.0396 | (69) |
| Pumps, fans | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 3.0000 | 3.0000 | 3.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | | | | | | | | | | | | | |
| | -88.3165 | -88.3165 | -88.3165 | -88.3165 | -88.3165 | -88.3165 | -88.3165 | -88.3165 | -88.3165 | -88.3165 | -88.3165 | -88.3165 | (71) |
| Water heating gains (Table 5) | | | | | | | | | | | | | |
| | 138.5327 | 136.2513 | 131.8563 | 122.2233 | 116.3230 | 110.1556 | 106.3674 | 109.4970 | 113.1662 | 120.0096 | 129.2439 | 137.3010 | (72) |
| Total internal gains | | | | | | | | | | | | | |
| | 497.1848 | 508.2573 | 487.4540 | 470.5700 | 447.5319 | 429.1039 | 413.2419 | 414.3620 | 426.6245 | 443.7190 | 470.0910 | 487.4087 | (73) |

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6. Solar gains

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| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| East | 6.2500 | 19.6403 | 0.6300 | 0.7000 | 0.7700 | 37.5145 | (76) |
| Southeast | 2.8900 | 36.7938 | 0.6300 | 0.7000 | 0.7700 | 32.4971 | (77) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 70.0116 | 128.7409 | 196.5954 | 270.1062 | 321.1291 | 325.4838 | 311.1330 | 273.0385 | 222.5703 | 148.2577 | 85.7002 | 58.6609 | (83) |
| Total gains | 567.1964 | 636.9982 | 684.0494 | 740.6762 | 768.6610 | 754.5877 | 724.3749 | 687.4005 | 649.1948 | 591.9766 | 555.7912 | 546.0695 | (84) |

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7. Mean internal temperature (heating season)

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| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature during heating periods in the living area from Table 9, Th1 (C) | | | | | | | | | | | | 21.0000 | (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a) | | | | | | | | | | | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| tau | 36.3940 | 36.4879 | 36.5803 | 37.0210 | 37.1046 | 37.4989 | 37.4989 | 37.5729 | 37.3461 | 37.1046 | 36.9358 | 36.7610 | |
| alpha | 3.4263 | 3.4325 | 3.4387 | 3.4681 | 3.4736 | 3.4999 | 3.4999 | 3.5049 | 3.4897 | 3.4736 | 3.4624 | 3.4507 | |
| util living area | | | | | | | | | | | | | |
| | 0.9204 | 0.8861 | 0.8345 | 0.7335 | 0.6005 | 0.4441 | 0.3256 | 0.3564 | 0.5403 | 0.7626 | 0.8817 | 0.9278 | (86) |
| MIT | 19.6735 | 19.9238 | 20.2374 | 20.6031 | 20.8405 | 20.9583 | 20.9892 | 20.9851 | 20.9162 | 20.6127 | 20.1066 | 19.6320 | (87) |
| Th 2 | 20.2374 | 20.2392 | 20.2410 | 20.2494 | 20.2510 | 20.2583 | 20.2583 | 20.2596 | 20.2555 | 20.2510 | 20.2478 | 20.2445 | (88) |
| util rest of house | | | | | | | | | | | | | |
| | 0.9110 | 0.8733 | 0.8163 | 0.7063 | 0.5629 | 0.3971 | 0.2724 | 0.3014 | 0.4912 | 0.7320 | 0.8664 | 0.9192 | (89) |
| MIT 2 | 18.6890 | 18.9998 | 19.3856 | 19.8278 | 20.0971 | 20.2249 | 20.2518 | 20.2502 | 20.1842 | 19.8494 | 19.2380 | 18.6426 | (90) |
| Living area fraction | | | | | | | | | fLA = Living area / (4) = | | | 0.4383 | (91) |
| MIT | 19.1205 | 19.4048 | 19.7589 | 20.1676 | 20.4229 | 20.5464 | 20.5750 | 20.5723 | 20.5050 | 20.1839 | 19.6187 | 19.0762 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 19.1205 | 19.4048 | 19.7589 | 20.1676 | 20.4229 | 20.5464 | 20.5750 | 20.5723 | 20.5050 | 20.1839 | 19.6187 | 19.0762 | (93) |

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8. Space heating requirement

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| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.8946 | 0.8573 | 0.8036 | 0.7032 | 0.5718 | 0.4156 | 0.2953 | 0.3248 | 0.5080 | 0.7290 | 0.8519 | 0.9032 | (94) |
| Useful gains | 507.4180 | 546.0930 | 549.7300 | 520.8323 | 439.5141 | 313.5716 | 213.9065 | 223.2800 | 329.8104 | 431.5764 | 473.4671 | 493.1965 | (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 | | | | | | | | | | | | | |
| | 830.2433 | 810.4680 | 738.9811 | 620.5208 | 479.2991 | 323.2993 | 216.1158 | 226.3972 | 349.6624 | 526.6074 | 691.0076 | 825.0472 | (97) |
| Space heating kWh | | | | | | | | | | | | | |
| | 240.1820 | 177.6600 | 140.8028 | 71.7757 | 29.6001 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 70.7031 | 156.6292 | 246.8969 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 1134.2497 | |
| Solar heating kWh | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | | | | | | | | | | | | | |
| | 240.1820 | 177.6600 | 140.8028 | 71.7757 | 29.6001 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 70.7031 | 156.6292 | 246.8969 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 1134.2497 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 16.5705 | (99) |

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

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| | | |
|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | 0.0000 | (201) |
| Fraction of space heat from main system(s) | 1.0000 | (202) |
| Efficiency of main space heating system 1 (in %) | 92.3000 | (206) |
| Efficiency of main space heating system 2 (in %) | 0.0000 | (207) |
| Efficiency of secondary/supplementary heating system, % | 0.0000 | (208) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement | | | | | | | | | | | | | |
| | 240.1820 | 177.6600 | 140.8028 | 71.7757 | 29.6001 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 70.7031 | 156.6292 | 246.8969 | (98) |
| Space heating efficiency (main heating system 1) | | | | | | | | | | | | | |
| | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 92.3000 | 92.3000 | 92.3000 | (210) |
| Space heating fuel (main heating system) | | | | | | | | | | | | | |
| | 260.2189 | 192.4810 | 152.5491 | 77.7635 | 32.0694 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 76.6014 | 169.6957 | 267.4939 | (211) |
| Space heating efficiency (main heating system 2) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (212) |
| Space heating fuel (main heating system 2) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (213) |
| Space heating fuel (secondary) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (215) |
| Water heating | | | | | | | | | | | | | |
| Water heating requirement | | | | | | | | | | | | | |
| | 216.4708 | 191.4380 | 203.6006 | 179.7956 | 174.7625 | 158.0116 | 156.4458 | 162.4310 | 163.9379 | 182.1368 | 192.8089 | 214.2333 | (64) |
| Efficiency of water heater | | | | | | | | | | | | 79.8000 | (216) |
| (217)m | 84.2934 | 83.8926 | 83.2495 | 82.1763 | 80.9889 | 79.8000 | 79.8000 | 79.8000 | 79.8000 | 82.1276 | 83.5978 | 84.3788 | (217) |
| Fuel for water heating, kWh/month | | | | | | | | | | | | | |
| | 256.8062 | 228.1941 | 244.5668 | 218.7926 | 215.7857 | 198.0095 | 196.0473 | 203.5477 | 205.4359 | 221.7729 | 230.6389 | 253.8945 | (219) |
| Space cooling fuel requirement | | | | | | | | | | | | | |
| (221)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (221) |
| Pumps and Fa | 7.3041 | 6.5973 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 | (231) |
| Lighting | 21.9999 | 17.6492 | 15.8911 | 11.6425 | 8.9930 | 7.3474 | 8.2037 | 10.6635 | 13.8508 | 18.1730 | 20.5264 | 22.6114 | (232) |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (233a)m | -10.0790 | -15.4554 | -24.1369 | -29.5607 | -34.0673 | -32.6149 | -32.2242 | -29.3192 | -24.6142 | -18.6937 | -11.5154 | -8.5752 (233a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (234a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (234a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (235a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (235a) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | |
| (235c)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (235c) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (233b)m | -2.4491 | -5.3453 | -10.9984 | -17.0883 | -23.1684 | -23.4913 | -23.2108 | -19.3811 | -13.8597 | -7.8194 | -3.3242 | -1.9223 (233b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (234b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (234b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | |
| (235b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (235b) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | |
| (235d)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (235d) |

| | | |
|---|---|---|
| Annual totals kWh/year | | |
| Space heating fuel - main system 1 | 1228.8729 | (211) |
| Space heating fuel - main system 2 | 0.0000 | (213) |
| Space heating fuel - secondary | 0.0000 | (215) |
| Efficiency of water heater | 79.8000 | |
| Water heating fuel used | 2673.4921 | (219) |
| Space cooling fuel | 0.0000 | (221) |
| | | |
| Electricity for pumps and fans: | | |
| Total electricity for the above, kWh/year | 86.0000 | (231) |
| Electricity for lighting (calculated in Appendix L) | 177.5519 | (232) |
| | | |
| Energy saving/generation technologies (Appendices M ,N and Q) | | |
| PV generation | -422.9141 | (233) |
| Wind generation | 0.0000 | (234) |
| Hydro-electric generation (Appendix N) | 0.0000 | (235a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 | (235) |
| Appendix Q - special features | | |
| Energy saved or generated | -0.0000 | (236) |
| Energy used | 0.0000 | (237) |
| Total delivered energy for all uses | 3743.0029 | (238) |

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

| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 1228.8729 | 0.2100 | 258.0633 | (261) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 2673.4921 | 0.2100 | 561.4333 | (264) |
| Space and water heating | | | 819.4967 | (265) |
| Pumps, fans and electric keep-hot | 86.0000 | 0.1387 | 11.9293 | (267) |
| Energy for lighting | 177.5519 | 0.1443 | 25.6262 | (268) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -270.8560 | 0.1329 | -35.9890 | |
| PV Unit electricity exported | -152.0581 | 0.1249 | -18.9956 | |
| Total | | | -54.9846 | (269) |
| Total CO2, kg/year | | | 802.0675 | (272) |
| EPC Target Carbon Dioxide Emission Rate (TER) | | | 11.7200 | (273) |

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

| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 1228.8729 | 1.1300 | 1388.6264 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 2673.4921 | 1.1300 | 3021.0460 | (278) |
| Space and water heating | | | 4409.6725 | (279) |
| Pumps, fans and electric keep-hot | 86.0000 | 1.5128 | 130.1008 | (281) |
| Energy for lighting | 177.5519 | 1.5338 | 272.3351 | (282) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -270.8560 | 1.4910 | -403.8386 | |
| PV Unit electricity exported | -152.0581 | 0.4585 | -69.7197 | |
| Total | | | -473.5582 | (283) |
| Total Primary energy kWh/year | | | 4338.5501 | (286) |
| Target Primary Energy Rate (TPER) | | | 63.3800 | (287) |

# Full SAP Calculation Printout

| | | | |
|---|---|---|---|
| Plot Reference | 3.2 End Terrace | Issued on Date | 16/01/2026 |
| Assessment Reference | 3.2 End Terrace | Plot Type Ref | 3.2 End Terrace |
| Plot Address | | SAP Version | 10.2 |

| | | | | | |
|---|---|---|---|---|---|
| SAP Rating | 91 B | DER | 1.73 | TER | 11.11 |
| Environmental | 99 A | % DER < TER | | | 84.43 |
| $CO_2$ Emissions (t/year) | 0.09 | DFEE | 35.32 | TFEE | 37.93 |
| Compliance Check | See BREL | % DFEE < TFEE | | | 6.87 |
| % DPER < TPER | 57.65 | DPER | 24.57 | TPER | 58.00 |

| | | | |
|---|---|---|---|
| Assessor Details | Miss Eleanor Risby | Assessor ID | M976-0001 |
| Client | | | |

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE

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## 1. Overall dwelling characteristics

| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 46.7000 (1b) | x | 2.5200 (2b) | = | 117.6840 | (1b) - (3b) |
| First floor | 46.7000 (1c) | x | 2.7700 (2c) | = | 129.3590 | (1c) - (3c) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 93.4000 | | | | | (4) |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = | 247.0430 | (5) |

## 2. Ventilation rate

| | m3 per hour | |
|---|---|---|
| Number of open chimneys | 0 * 80 = | 0.0000 (6a) |
| Number of open flues | 0 * 20 = | 0.0000 (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 (6f) |
| Number of intermittent extract fans | 5 * 10 = | 50.0000 (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 (7c) |

| | Air changes per hour | |
|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 50.0000 / (5) = | 0.2024 (8) |
| Pressure test | | Yes |
| Pressure Test Method | | Blower Door |
| Measured/design AP50 | | 4.0000 (17) |
| Infiltration rate | | 0.4024 (18) |
| Number of sides sheltered | | 2 (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 0.8500 (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.3420 (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.4361 | 0.4275 | 0.4190 | 0.3762 | 0.3677 | 0.3249 | 0.3249 | 0.3164 | 0.3420 | 0.3677 | 0.3848 | 0.4019 | (22b) |
| Effective ac | 0.5951 | 0.5914 | 0.5878 | 0.5708 | 0.5676 | 0.5528 | 0.5528 | 0.5500 | 0.5585 | 0.5676 | 0.5740 | 0.5808 | (25) |

## 3. Heat losses and heat loss parameter

| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | | |
| W | | | 15.1700 | 1.1450 | 17.3702 | | | (27) |
| D | | | 2.1500 | 1.2000 | 2.5800 | | | (26) |
| Heatloss Floor 1 | | | 46.7000 | 0.1000 | 4.6700 | 75.0000 | 3502.5000 | (28a) |
| External Wall 1 | 102.6300 | 17.3200 | 85.3100 | 0.1900 | 16.2089 | 60.0000 | 5118.6000 | (29a) |
| Main Roof | 46.7000 | | 46.7000 | 0.0800 | 3.7360 | 9.0000 | 420.3000 | (30) |
| Total net area of external elements Aum(A, m2) | | | 196.0300 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 44.5651 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall | | | 47.6100 | 0.0000 | 0.0000 | 70.0000 | 3332.7000 | (32) |
| Internal Wall 1 | | | 166.7300 | | | 9.0000 | 1500.5700 | (32c) |
| Internal Floor 1 | | | 46.7000 | | | 18.0000 | 840.6000 | (32d) |
| Internal Ceiling 1 | | | 46.7000 | | | 9.0000 | 420.3000 | (32e) |

| | | |
|---|---|---|
| Heat capacity Cm = Sum(A x k) | (28)...(30) + (32) + (32a)...(32e) = | 15135.5700 (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | | 162.0511 (35) |

List of Thermal Bridges

| | Length | Psi-value | Total |
|---|---|---|---|
| K1 Element | | | |
| E5 Ground floor (normal) | 19.4000 | 0.0620 | 1.2028 |
| E10 Eaves (insulation at ceiling level) | 9.2000 | 0.0620 | 0.5704 |

| | | | | |
|---|---|---|---|---|
| E16 Corner (normal) | 10.5800 | 0.0560 | 0.5925 | |
| E6 Intermediate floor within a dwelling | 19.4000 | 0.0020 | 0.0388 | |
| E2 Other lintels (including other steel lintels) | 12.2200 | 0.0200 | 0.2444 | |
| E3 Sill | 11.2000 | 0.0180 | 0.2016 | |
| E4 Jamb | 23.7600 | 0.0130 | 0.3089 | |
| E12 Gable (insulation at ceiling level) | 10.4000 | 0.0980 | 1.0192 | |
| E18 Party wall between dwellings | 10.5800 | 0.0200 | 0.2116 | |
| P1 Party wall - Ground floor | 9.0000 | 0.0500 | 0.4500 | |
| P2 Party wall - Intermediate floor within a dwelling | 9.0000 | 0.0000 | 0.0000 | |
| P4 Party wall - Roof (insulation at ceiling level) | 9.0000 | 0.0500 | 0.4500 | |

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 5.2902 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 49.8553 (37)

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 48.5142 | 48.2131 | 47.9181 | 46.5322 | 46.2729 | 45.0658 | 45.0658 | 44.8423 | 45.5308 | 46.2729 | 46.7974 | 47.3458 | (38) |
| Heat transfer coeff | 98.3695 | 98.0684 | 97.7734 | 96.3875 | 96.1282 | 94.9211 | 94.9211 | 94.6976 | 95.3861 | 96.1282 | 96.6527 | 97.2011 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 96.3862 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.0532 | 1.0500 | 1.0468 | 1.0320 | 1.0292 | 1.0163 | 1.0163 | 1.0139 | 1.0213 | 1.0292 | 1.0348 | 1.0407 | (40) |
| HLP (average) | | | | | | | | | | | | 1.0320 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

## 4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.6695 (42)

Hot water usage for mixer showers

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 68.9778 | 67.9412 | 66.4307 | 63.5405 | 61.4077 | 59.0292 | 57.6772 | 59.1763 | 60.8196 | 63.3734 | 66.3256 | 68.7135 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 29.7859 | 29.3436 | 28.7206 | 27.5720 | 26.7120 | 25.7583 | 25.2432 | 25.8618 | 26.5353 | 27.5558 | 28.7280 | 29.6852 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 41.9679 | 40.4418 | 38.9157 | 37.3896 | 35.8635 | 34.3374 | 34.3374 | 35.8635 | 37.3896 | 38.9157 | 40.4418 | 41.9679 | (42c) |

Average daily hot water use (litres/day) 129.3641 (43)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 140.7317 | 137.7266 | 134.0670 | 128.5022 | 123.9832 | 119.1249 | 117.2578 | 120.9016 | 124.7445 | 129.8449 | 135.4954 | 140.3667 | (44) |
| Energy conte | 222.8845 | 196.1208 | 206.0560 | 175.9131 | 166.9052 | 146.4779 | 141.8132 | 149.7014 | 153.8225 | 176.1983 | 193.0381 | 219.7803 | (45) |
| Energy content (annual) | | | | | | | | | | | Total = Sum(45)m = | 2148.7113 | |
| Distribution loss (46)m = 0.15 x (45)m | 33.4327 | 29.4181 | 30.9084 | 26.3870 | 25.0358 | 21.9717 | 21.2720 | 22.4552 | 23.0734 | 26.4297 | 28.9557 | 32.9670 | (46) |

Water storage loss (or HIU loss):
Store volume 210.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): 1.4200 (48)
Temperature factor from Table 2b 0.5400 (49)
Enter (49) or (54) in (55) 0.7668 (55)
Total storage loss

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23.7708 | 21.4704 | 23.7708 | 23.0040 | 23.7708 | 23.0040 | 23.7708 | 23.7708 | 23.0040 | 23.7708 | 23.0040 | 23.7708 | (56) |

If cylinder contains dedicated solar storage

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23.7708 | 21.4704 | 23.7708 | 23.0040 | 23.7708 | 23.0040 | 23.7708 | 23.7708 | 23.0040 | 23.7708 | 23.0040 | 23.7708 | (57) |
| Primary loss 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |

Total heat required for water heating calculated for each month

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 269.9177 | 238.6024 | 253.0892 | 221.4291 | 213.9384 | 191.9939 | 188.8464 | 196.7346 | 199.3385 | 223.2315 | 238.5541 | 266.8135 | (62) |
| WWHRS 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63a) |
| PV diverter -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |
| Output from w/h | 269.9177 | 238.6024 | 253.0892 | 221.4291 | 213.9384 | 191.9939 | 188.8464 | 196.7346 | 199.3385 | 223.2315 | 238.5541 | 266.8135 | (64) |
| | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 2702.4893 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 2702 | (64) |

Electric shower(s)

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

Heat gains from water heating, kWh/month

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 111.7357 | 99.1955 | 106.1402 | 94.9039 | 93.1225 | 85.1167 | 84.7794 | 87.4023 | 87.5588 | 96.2125 | 100.5980 | 110.7035 | (65) |

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

Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 133.4729 | 133.4729 | 133.4729 | 133.4729 | 133.4729 | 133.4729 | 133.4729 | 133.4729 | 133.4729 | 133.4729 | 133.4729 | 133.4729 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 128.2979 | 142.0441 | 128.2979 | 132.5745 | 128.2979 | 132.5745 | 128.2979 | 128.2979 | 132.5745 | 128.2979 | 132.5745 | 128.2979 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 245.1957 | 247.7401 | 241.3283 | 227.6786 | 210.4482 | 194.2540 | 183.4353 | 180.8910 | 187.3027 | 200.9525 | 218.1829 | 234.3770 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 36.3473 | 36.3473 | 36.3473 | 36.3473 | 36.3473 | 36.3473 | 36.3473 | 36.3473 | 36.3473 | 36.3473 | 36.3473 | 36.3473 | (69) |
| Pumps, fans 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (70) | |
| Losses e.g. evaporation (negative values) (Table 5) | -106.7783 | -106.7783 | -106.7783 | -106.7783 | -106.7783 | -106.7783 | -106.7783 | -106.7783 | -106.7783 | -106.7783 | -106.7783 | -106.7783 | (71) |
| Water heating gains (Table 5) | 150.1824 | 147.6123 | 142.6615 | 131.8110 | 125.1647 | 118.2177 | 113.9509 | 117.4762 | 121.6094 | 129.3179 | 139.7194 | 148.7950 | (72) |
| Total internal gains | 586.7178 | 600.4383 | 575.3296 | 555.1059 | 526.9526 | 508.0880 | 488.7259 | 489.7069 | 504.5284 | 521.6101 | 553.5186 | 574.5118 | (73) |

## 6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| North | 9.9100 | 10.6334 | 0.4500 | 0.7100 | 0.7700 | 23.3319 | (74) |
| South | 5.2600 | 46.7521 | 0.4500 | 0.7100 | 0.7700 | 54.4491 | (78) |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains 77.7810 | 133.7620 | 189.3579 | 250.0834 | 297.7247 | 304.2524 | 289.6504 | 252.1626 | 209.7555 | 149.2587 | 93.3236 | 66.4996 | (83) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total gains | 664.4988 | 734.2003 | 764.6875 | 805.1893 | 824.6773 | 812.3404 | 778.3763 | 741.8696 | 714.2840 | 670.8688 | 646.8422 | 641.0114 | (84) |

7. Mean internal temperature (heating season)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature during heating periods in the living area from Table 9, Th1 (C) | | | | | | | | | | | | 21.0000 | (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a) | | | | | | | | | | | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| tau | 42.7401 | 42.8713 | 43.0007 | 43.6190 | 43.7367 | 44.2928 | 44.2928 | 44.3974 | 44.0769 | 43.7367 | 43.4993 | 43.2539 | |
| alpha | 3.8493 | 3.8581 | 3.8667 | 3.9079 | 3.9158 | 3.9529 | 3.9529 | 3.9598 | 3.9385 | 3.9158 | 3.9000 | 3.8836 | |
| util living area | | | | | | | | | | | | | |
| | 0.9815 | 0.9714 | 0.9555 | 0.9131 | 0.8274 | 0.6695 | 0.5143 | 0.5555 | 0.7636 | 0.9197 | 0.9692 | 0.9837 | (86) |
| Living | 19.3857 | 19.5880 | 19.8784 | 20.2936 | 20.6529 | 20.8952 | 20.9715 | 20.9613 | 20.8148 | 20.3724 | 19.8266 | 19.3611 | |
| Non living | 18.1600 | 18.4176 | 18.7854 | 19.3076 | 19.7324 | 19.9941 | 20.0562 | 20.0519 | 19.9179 | 19.4123 | 18.7307 | 18.1358 | |
| 24 / 16 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 24 / 9 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 16 / 9 | 28 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 | |
| MIT | 20.1742 | 19.5880 | 19.8784 | 20.2936 | 20.6529 | 20.8952 | 20.9715 | 20.9613 | 20.8148 | 20.3724 | 19.8266 | 19.5904 | (87) |
| Th 2 | 20.0392 | 20.0419 | 20.0445 | 20.0568 | 20.0591 | 20.0698 | 20.0698 | 20.0718 | 20.0657 | 20.0591 | 20.0544 | 20.0496 | (88) |
| util rest of house | | | | | | | | | | | | | |
| | 0.9776 | 0.9655 | 0.9457 | 0.8931 | 0.7861 | 0.5950 | 0.4149 | 0.4560 | 0.6986 | 0.8972 | 0.9617 | 0.9803 | (89) |
| MIT 2 | 19.2901 | 18.4176 | 18.7854 | 19.3076 | 19.7324 | 19.9941 | 20.0562 | 20.0519 | 19.9179 | 19.4123 | 18.7307 | 18.4807 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.2848 | (91) |
| MIT | 19.5419 | 18.7509 | 19.0967 | 19.5884 | 19.9945 | 20.2508 | 20.3169 | 20.3109 | 20.1733 | 19.6857 | 19.0428 | 18.7967 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 19.5419 | 18.7509 | 19.0967 | 19.5884 | 19.9945 | 20.2508 | 20.3169 | 20.3109 | 20.1733 | 19.6857 | 19.0428 | 18.7967 | (93) |

8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9752 | 0.9549 | 0.9334 | 0.8812 | 0.7829 | 0.6104 | 0.4422 | 0.4827 | 0.7068 | 0.8864 | 0.9512 | 0.9744 | (94) |
| Useful gains | 648.0437 | 701.1128 | 713.7747 | 709.5153 | 645.6653 | 495.8735 | 344.1876 | 358.1162 | 504.8721 | 594.6674 | 615.2803 | 624.6132 | (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 | | | | | | | | | | | | | |
| | 1499.3332 | 1358.3400 | 1231.6180 | 1030.2280 | 797.3380 | 536.3762 | 352.8102 | 370.3512 | 579.3124 | 873.3964 | 1154.3037 | 1418.8178 | (97) |
| Space heating kWh | | | | | | | | | | | | | |
| | 633.3594 | 441.6566 | 385.2754 | 230.9131 | 112.8445 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 207.3744 | 388.0968 | 590.8882 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 2990.4084 | |
| Solar heating kWh | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | | | | | | | | | | | | | |
| | 633.3594 | 441.6566 | 385.2754 | 230.9131 | 112.8445 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 207.3744 | 388.0968 | 590.8882 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 2990.4084 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 32.0172 | (99) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | | | | | | | | | | | | 0.0000 | (201) |
| Fraction of space heat from main system(s) | | | | | | | | | | | | 1.0000 | (202) |
| Efficiency of main space heating system 1 (in %) | | | | | | | | | | | | 297.3542 | (206) |
| Efficiency of main space heating system 2 (in %) | | | | | | | | | | | | 0.0000 | (207) |
| Efficiency of secondary/supplementary heating system, % | | | | | | | | | | | | 0.0000 | (208) |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| Space heating requirement | | | | | | | | | | | | | |
| | 633.3594 | 441.6566 | 385.2754 | 230.9131 | 112.8445 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 207.3744 | 388.0968 | 590.8882 | (98) |
| Space heating efficiency (main heating system 1) | | | | | | | | | | | | | |
| | 297.3542 | 297.3542 | 297.3542 | 297.3542 | 297.3542 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 297.3542 | 297.3542 | 297.3542 | (210) |
| Space heating fuel (main heating system) | | | | | | | | | | | | | |
| | 212.9983 | 148.5288 | 129.5678 | 77.6559 | 37.9495 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 69.7399 | 130.5167 | 198.7153 | (211) |
| Space heating efficiency (main heating system 2) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (212) |
| Space heating fuel (main heating system 2) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (213) |
| Space heating fuel (secondary) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (215) |
| Water heating | | | | | | | | | | | | | |
| Water heating requirement | | | | | | | | | | | | | |
| | 269.9177 | 238.6024 | 253.0892 | 221.4291 | 213.9384 | 191.9939 | 188.8464 | 196.7346 | 199.3385 | 223.2315 | 238.5541 | 266.8135 | (64) |
| Efficiency of water heater | | | | | | | | | | | | 202.4559 | (216) |
| (217)m | 202.4559 | 202.4559 | 202.4559 | 202.4559 | 202.4559 | 202.4559 | 202.4559 | 202.4559 | 202.4559 | 202.4559 | 202.4559 | 202.4559 | (217) |
| Fuel for water heating, kWh/month | | | | | | | | | | | | | |
| | 133.3218 | 117.8540 | 125.0096 | 109.3715 | 105.6716 | 94.8325 | 93.2778 | 97.1741 | 98.4602 | 110.2618 | 117.8302 | 131.7885 | (219) |
| Space cooling fuel requirement | | | | | | | | | | | | | |
| (221)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (221) |
| Pumps and Fa | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (231) |
| Lighting | 24.7318 | 19.8408 | 17.8644 | 13.0883 | 10.1097 | 8.2597 | 9.2224 | 11.9877 | 15.5708 | 20.4298 | 23.0754 | 25.4192 | (232) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (233a)m | -28.8395 | -46.9332 | -78.5470 | -98.5278 | -111.3851 | -102.1416 | -100.1784 | -90.9278 | -74.4530 | -56.5486 | -33.1619 | -23.9425 | (233a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (234a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (234a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (235a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235a) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | | |
| (235c)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235c) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (233b)m | -7.5847 | -19.5797 | -48.6926 | -90.1776 | -136.0050 | -146.5537 | -142.9456 | -112.2686 | -71.7203 | -32.3959 | -11.2033 | -5.7383 | (233b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (234b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (234b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (235b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235b) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | | |
| (235d)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235d) |
| Annual totals kWh/year | | | | | | | | | | | | | |
| Space heating fuel - main system 1 | | | | | | | | | | | | 1005.6723 | (211) |
| Space heating fuel - main system 2 | | | | | | | | | | | | 0.0000 | (213) |
| Space heating fuel - secondary | | | | | | | | | | | | 0.0000 | (215) |
| Efficiency of water heater | | | | | | | | | | | | 202.4559 | |
| Water heating fuel used | | | | | | | | | | | | 1334.8535 | (219) |
| Space cooling fuel | | | | | | | | | | | | 0.0000 | (221) |

| | | |
|---|---|---|
| Electricity for pumps and fans: | | |
| Total electricity for the above, kWh/year | 0.0000 | (231) |
| Electricity for lighting (calculated in Appendix L) | 199.6001 | (232) |
| Energy saving/generation technologies (Appendices M ,N and Q) | | |
| PV generation | -1670.4518 | (233) |
| Wind generation | 0.0000 | (234) |
| Hydro-electric generation (Appendix N) | 0.0000 | (235a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 | (235) |
| Appendix Q - special features | | |
| Energy saved or generated | -0.0000 | (236) |
| Energy used | 0.0000 | (237) |
| Total delivered energy for all uses | 869.6742 | (238) |

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

| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 1005.6723 | 0.1551 | 156.0046 | (261) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 1334.8535 | 0.1410 | 188.2022 | (264) |
| Space and water heating | | | 344.2068 | (265) |
| Pumps, fans and electric keep-hot | 0.0000 | 0.0000 | 0.0000 | (267) |
| Energy for lighting | 199.6001 | 0.1443 | 28.8085 | (268) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -845.5864 | 0.1328 | -112.2648 | |
| PV Unit electricity exported | -824.8654 | 0.1207 | -99.5801 | |
| Total | | | -211.8449 | (269) |
| Total CO2, kg/year | | | 161.1703 | (272) |
| EPC Dwelling Carbon Dioxide Emission Rate (DER) | | | 1.7300 | (273) |

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

| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 1005.6723 | 1.5743 | 1583.2098 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 1334.8535 | 1.5213 | 2030.7631 | (278) |
| Space and water heating | | | 3613.9728 | (279) |
| Pumps, fans and electric keep-hot | 0.0000 | 0.0000 | 0.0000 | (281) |
| Energy for lighting | 199.6001 | 1.5338 | 306.1533 | (282) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -845.5864 | 1.4906 | -1260.4244 | |
| PV Unit electricity exported | -824.8654 | 0.4428 | -365.2873 | |
| Total | | | -1625.7117 | (283) |
| Total Primary energy kWh/year | | | 2294.4145 | (286) |
| Dwelling Primary energy Rate (DPER) | | | 24.5700 | (287) |

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF TARGET EMISSIONS

1. Overall dwelling characteristics

| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 46.7000 | (1b) x | 2.5200 | (2b) = | 117.6840 | (1b) - (3b) |
| First floor | 46.7000 | (1c) x | 2.7700 | (2c) = | 129.3590 | (1c) - (3c) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 93.4000 | | | | | (4) |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | | 247.0430 | (5) |

2. Ventilation rate

| | | m3 per hour | |
|---|---|---|---|
| Number of open chimneys | 0 * 80 = | 0.0000 | (6a) |
| Number of open flues | 0 * 20 = | 0.0000 | (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 | (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 | (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 | (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 | (6f) |
| Number of intermittent extract fans | 3 * 10 = | 30.0000 | (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 | (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 | (7c) |
| | Air changes per hour | | |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 30.0000 / (5) = | 0.1214 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 5.0000 | (17) |
| Infiltration rate | | 0.3714 | (18) |
| Number of sides sheltered | | 2 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 0.8500 | (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.3157 | (21) |

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate | | | | | | | | | | | | |
| | 0.4025 | 0.3947 | 0.3868 | 0.3473 | 0.3394 | 0.2999 | 0.2999 | 0.2920 | 0.3157 | 0.3394 | 0.3552 | 0.3710 (22b) |
| Effective ac | 0.5810 | 0.5779 | 0.5748 | 0.5603 | 0.5576 | 0.5450 | 0.5450 | 0.5426 | 0.5498 | 0.5576 | 0.5631 | 0.5688 (25) |

## 3. Heat losses and heat loss parameter

| Element | Gross | Openings | NetArea | U-value | A x U | K-value | A x K | |
|---|---|---|---|---|---|---|---|---|
| | m2 | m2 | m2 | W/m2K | W/K | kJ/m2K | kJ/K | |
| Main dwelling | | | | | | | | |
| TER Opaque door | | | 2.1500 | 1.0000 | 2.1500 | | | (26) |
| TER Opening Type | | | 15.1700 | 1.1450 | 17.3702 | | | (27) |
| Heatloss Floor 1 | | | 46.7000 | 0.1300 | 6.0710 | | | (28a) |
| External Wall 1 | 102.6300 | 17.3200 | 85.3100 | 0.1800 | 15.3558 | | | (29a) |
| Main Roof | 46.7000 | | 46.7000 | 0.1100 | 5.1370 | | | (30) |
| Total net area of external elements Aum(A, m2) | | | 196.0300 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | | (26)...(30) + (32) = | 46.0840 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall | | | 47.6100 | 0.0000 | 0.0000 | | | (32) |

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 162.0511 (35)

List of Thermal Bridges

| K1 Element | Length | Psi-value | Total | |
|---|---|---|---|---|
| E5 Ground floor (normal) | 19.4000 | 0.1600 | 3.1040 | |
| E10 Eaves (insulation at ceiling level) | 9.2000 | 0.0600 | 0.5520 | |
| E16 Corner (normal) | 10.5800 | 0.0900 | 0.9522 | |
| E6 Intermediate floor within a dwelling | 19.4000 | 0.0000 | 0.0000 | |
| E2 Other lintels (including other steel lintels) | 12.2200 | 0.0500 | 0.6110 | |
| E3 Sill | 11.2000 | 0.0500 | 0.5600 | |
| E4 Jamb | 23.7600 | 0.0500 | 1.1880 | |
| E12 Gable (insulation at ceiling level) | 10.4000 | 0.0600 | 0.6240 | |
| E18 Party wall between dwellings | 10.5800 | 0.0600 | 0.6348 | |
| P1 Party wall - Ground floor | 9.0000 | 0.0800 | 0.7200 | |
| P2 Party wall - Intermediate floor within a dwelling | 9.0000 | 0.0000 | 0.0000 | |
| P4 Party wall - Roof (insulation at ceiling level) | 9.0000 | 0.1200 | 1.0800 | |

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 10.0260 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 56.1100 (37)

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 47.3673 | 47.1108 | 46.8594 | 45.6785 | 45.4576 | 44.4291 | 44.4291 | 44.2386 | 44.8252 | 45.4576 | 45.9045 | 46.3718 | (38) |
| Heat transfer coeff | 103.4773 | 103.2208 | 102.9694 | 101.7885 | 101.5676 | 100.5391 | 100.5391 | 100.3487 | 100.9353 | 101.5676 | 102.0146 | 102.4818 | (39) |

Average = Sum(39)m / 12 = 101.7875

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.1079 | 1.1051 | 1.1025 | 1.0898 | 1.0874 | 1.0764 | 1.0764 | 1.0744 | 1.0807 | 1.0874 | 1.0922 | 1.0972 | (40) |
| HLP (average) | | | | | | | | | | | | 1.0898 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

## 4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.6695 (42)

Hot water usage for mixer showers

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 68.9778 | 67.9412 | 66.4307 | 63.5405 | 61.4077 | 59.0292 | 57.6772 | 59.1763 | 60.8196 | 63.3734 | 66.3256 | 68.7135 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 29.7859 | 29.3436 | 28.7206 | 27.5720 | 26.7120 | 25.7583 | 25.2432 | 25.8618 | 26.5353 | 27.5558 | 28.7280 | 29.6852 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 41.9679 | 40.4418 | 38.9157 | 37.3896 | 35.8635 | 34.3374 | 34.3374 | 35.8635 | 37.3896 | 38.9157 | 40.4418 | 41.9679 | (42c) |

Average daily hot water use (litres/day) 129.3641 (43)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 140.7317 | 137.7266 | 134.0670 | 128.5022 | 123.9832 | 119.1249 | 117.2578 | 120.9016 | 124.7445 | 129.8449 | 135.4954 | 140.3667 | (44) |
| Energy conte | 222.8845 | 196.1208 | 206.0560 | 175.9131 | 166.9052 | 146.4779 | 141.8132 | 149.7014 | 153.8225 | 176.1983 | 193.0381 | 219.7803 | (45) |
| Energy content (annual) | | | | | | | | | | | Total = Sum(45)m = | 2148.7113 | |

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

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 33.4327 | 29.4181 | 30.9084 | 26.3870 | 25.0358 | 21.9717 | 21.2720 | 22.4552 | 23.0734 | 26.4297 | 28.9557 | 32.9670 | (46) |

Water storage loss (or HIU loss):

Store volume 210.0000 (47)

a) If manufacturer declared loss factor is known (kWh/day): 1.7016 (48)

Temperature factor from Table 2b 0.5400 (49)

Enter (49) or (54) in (55) 0.9188 (55)

Total storage loss

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 28.4842 | 25.7277 | 28.4842 | 27.5653 | 28.4842 | 27.5653 | 28.4842 | 28.4842 | 27.5653 | 28.4842 | 27.5653 | 28.4842 | (56) |

If cylinder contains dedicated solar storage

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 28.4842 | 25.7277 | 28.4842 | 27.5653 | 28.4842 | 27.5653 | 28.4842 | 28.4842 | 27.5653 | 28.4842 | 27.5653 | 28.4842 | (57) |
| Primary loss 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |

Total heat required for water heating calculated for each month

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 274.6311 | 242.8597 | 257.8026 | 225.9904 | 218.6518 | 196.5553 | 193.5597 | 201.4480 | 203.8998 | 227.9449 | 243.1155 | 271.5269 | (62) |
| WWHRS -31.5338 | -27.8887 | -29.2035 | -24.1816 | -22.5364 | -19.2846 | -18.0762 | -19.2222 | -19.9526 | -23.5219 | -26.6474 | -30.9498 | (63a) |
| PV diverter -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |

Output from w/h

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 243.0974 | 214.9709 | 228.5991 | 201.8088 | 196.1154 | 177.2707 | 175.4835 | 182.2258 | 183.9473 | 204.4230 | 216.4680 | 240.5771 | (64) |
| | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 2464.9870 | (64) |

12Total per year (kWh/year) 2465 (64)

Electric shower(s)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |

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

Heat gains from water heating, kWh/month

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 115.5064 | 102.6013 | 109.9109 | 98.5530 | 96.8932 | 88.7658 | 88.5501 | 91.1730 | 91.2078 | 99.9832 | 104.2470 | 114.4742 | (65) |

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

Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 133.4729 | 133.4729 | 133.4729 | 133.4729 | 133.4729 | 133.4729 | 133.4729 | 133.4729 | 133.4729 | 133.4729 | 133.4729 | 133.4729 | (66) |

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
128.6475 142.4312 128.6475 132.9358 128.6475 132.9358 128.6475 128.6475 132.9358 128.6475 132.9358 128.6475 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
245.1957 247.7401 241.3283 227.6786 210.4482 194.2540 183.4353 180.8910 187.3027 200.9525 218.1829 234.3770 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
36.3473 36.3473 36.3473 36.3473 36.3473 36.3473 36.3473 36.3473 36.3473 36.3473 36.3473 36.3473 (69)
Pumps, fans 3.0000 3.0000 3.0000 3.0000 3.0000 0.0000 0.0000 0.0000 0.0000 3.0000 3.0000 3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
-106.7783 -106.7783 -106.7783 -106.7783 -106.7783 -106.7783 -106.7783 -106.7783 -106.7783 -106.7783 -106.7783 -106.7783 (71)
Water heating gains (Table 5)
155.2505 152.6804 147.7297 136.8791 130.2329 123.2858 119.0190 122.5444 126.6776 134.3860 144.7876 153.8632 (72)
Total internal gains
595.1356 608.8935 583.7474 563.5353 535.3704 513.5175 494.1437 495.1247 509.9579 530.0279 561.9481 582.9296 (73)

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6. Solar gains

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| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| North | 9.9100 | 10.6334 | 0.6300 | 0.7000 | 0.7700 | 32.2046 | (74) |
| South | 5.2600 | 46.7521 | 0.6300 | 0.7000 | 0.7700 | 75.1551 | (78) |

Solar gains 107.3596 184.6292 261.3673 345.1856 410.9439 419.9540 399.7991 348.0555 289.5217 206.0191 128.8129 91.7882 (83)
Total gains 702.4952 793.5228 845.1147 908.7209 946.3143 933.4715 893.9429 843.1802 799.4796 736.0470 690.7609 674.7178 (84)

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7. Mean internal temperature (heating season)

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Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| tau | 40.6304 | 40.7314 | 40.8308 | 41.3045 | 41.3944 | 41.8178 | 41.8178 | 41.8972 | 41.6537 | 41.3944 | 41.2130 | 41.0251 | |
| alpha | 3.7087 | 3.7154 | 3.7221 | 3.7536 | 3.7596 | 3.7879 | 3.7879 | 3.7931 | 3.7769 | 3.7596 | 3.7475 | 3.7350 | |
| util living area | 0.9786 | 0.9654 | 0.9440 | 0.8904 | 0.7892 | 0.6264 | 0.4768 | 0.5208 | 0.7330 | 0.9050 | 0.9642 | 0.9814 | (86) |
| MIT | 19.3278 | 19.5595 | 19.8812 | 20.3180 | 20.6805 | 20.9049 | 20.9739 | 20.9635 | 20.8213 | 20.3697 | 19.7868 | 19.2927 | (87) |
| Th 2 | 19.9944 | 19.9966 | 19.9988 | 20.0092 | 20.0111 | 20.0201 | 20.0201 | 20.0218 | 20.0166 | 20.0111 | 20.0072 | 20.0031 | (88) |
| util rest of house | 0.9741 | 0.9583 | 0.9320 | 0.8663 | 0.7426 | 0.5495 | 0.3782 | 0.4208 | 0.6634 | 0.8790 | 0.9555 | 0.9775 | (89) |
| MIT 2 | 18.0567 | 18.3503 | 18.7551 | 19.2974 | 19.7180 | 19.9537 | 20.0082 | 20.0038 | 19.8780 | 19.3709 | 18.6477 | 18.0181 | (90) |
| Living area fraction | | | | | | | | | fLA = Living area / (4) = | | | 0.2848 | (91) |
| MIT | 18.4187 | 18.6947 | 19.0758 | 19.5880 | 19.9921 | 20.2246 | 20.2832 | 20.2771 | 20.1466 | 19.6554 | 18.9721 | 18.3811 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 18.4187 | 18.6947 | 19.0758 | 19.5880 | 19.9921 | 20.2246 | 20.2832 | 20.2771 | 20.1466 | 19.6554 | 18.9721 | 18.3811 | (93) |

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8. Space heating requirement

---

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9645 | 0.9461 | 0.9181 | 0.8542 | 0.7416 | 0.5665 | 0.4055 | 0.4479 | 0.6735 | 0.8678 | 0.9437 | 0.9687 | (94) |
| Useful gains | 677.5706 | 750.7913 | 775.9262 | 776.2499 | 701.8020 | 528.7676 | 362.4940 | 377.6375 | 538.4372 | 638.7299 | 651.8680 | 653.5796 | (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 | 1460.9694 | 1423.8954 | 1294.9238 | 1087.9194 | 842.2107 | 565.4906 | 370.3091 | 389.0650 | 610.3179 | 919.7312 | 1211.1267 | 1453.3099 | (97) |
| Space heating kWh | 582.8487 | 452.3260 | 386.1342 | 224.4020 | 104.4641 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 209.0650 | 402.6663 | 594.9993 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 2956.9056 | |
| Solar heating kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | 582.8487 | 452.3260 | 386.1342 | 224.4020 | 104.4641 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 209.0650 | 402.6663 | 594.9993 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 2956.9056 | |
| Space heating per m2 | | | | | | | | | | (98c) / (4) = | | 31.6585 | (99) |

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

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Fraction of space heat from secondary/supplementary system (Table 11) 0.0000 (201)
Fraction of space heat from main system(s) 1.0000 (202)
Efficiency of main space heating system 1 (in %) 92.3000 (206)
Efficiency of main space heating system 2 (in %) 0.0000 (207)
Efficiency of secondary/supplementary heating system, % 0.0000 (208)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement | 582.8487 | 452.3260 | 386.1342 | 224.4020 | 104.4641 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 209.0650 | 402.6663 | 594.9993 | (98) |
| Space heating efficiency (main heating system 1) | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 92.3000 | 92.3000 | 92.3000 | (210) |
| Space heating fuel (main heating system) | 631.4721 | 490.0606 | 418.3469 | 243.1224 | 113.1788 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 226.5060 | 436.2581 | 644.6363 | (211) |
| Space heating efficiency (main heating system 2) | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (212) |
| Space heating fuel (main heating system 2) | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (213) |
| Space heating fuel (secondary) | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (215) |
| Water heating | | | | | | | | | | | | | |
| Water heating requirement | 243.0974 | 214.9709 | 228.5991 | 201.8088 | 196.1154 | 177.2707 | 175.4835 | 182.2258 | 183.9473 | 204.4230 | 216.4680 | 240.5771 | (64) |
| Efficiency of water heater | | | | | | | | | | | | 79.8000 | (216) |
| (217)m | 85.9470 | 85.6868 | 85.2256 | 84.2983 | 82.7135 | 79.8000 | 79.8000 | 79.8000 | 79.8000 | 84.1102 | 85.4313 | 86.0072 | (217) |
| Fuel for water heating, kWh/month | 282.8456 | 250.8800 | 268.2281 | 239.3983 | 237.1020 | 222.1438 | 219.9042 | 228.3531 | 230.5104 | 243.0419 | 253.3827 | 279.7174 | (219) |
| Space cooling fuel requirement | | | | | | | | | | | | | |
| (221)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (221) |
| Pumps and Fa | 7.3041 | 6.5973 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 | (231) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lighting | 26.7304 | 21.4441 | 19.3081 | 14.1459 | 10.9267 | 8.9272 | 9.9677 | 12.9564 | 16.8291 | 22.0807 | 24.9401 | 27.4733 | (232) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (233a)m | -43.0109 | -60.2877 | -86.1555 | -96.2755 | -103.2944 | -96.1990 | -94.9780 | -89.9005 | -80.8866 | -68.6291 | -47.1488 | -37.2239 | (233a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (234a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (234a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (235a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235a) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | | |
| (235c)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235c) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (233b)m | -25.3671 | -53.2421 | -105.6129 | -158.3343 | -209.0980 | -210.0284 | -207.5861 | -175.9057 | -129.1039 | -76.0791 | -33.8456 | -20.0714 | (233b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (234b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (234b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (235b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235b) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | | |
| (235d)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235d) |

| | | |
|---|---|---|
| Annual totals kWh/year | | |
| Space heating fuel - main system 1 | 3203.5814 | (211) |
| Space heating fuel - main system 2 | 0.0000 | (213) |
| Space heating fuel - secondary | 0.0000 | (215) |
| Efficiency of water heater | 79.8000 | |
| Water heating fuel used | 2955.5075 | (219) |
| Space cooling fuel | 0.0000 | (221) |
| | | |
| Electricity for pumps and fans: | | |
| Total electricity for the above, kWh/year | 86.0000 | (231) |
| Electricity for lighting (calculated in Appendix L) | 215.7298 | (232) |
| | | |
| Energy saving/generation technologies (Appendices M ,N and Q) | | |
| PV generation | -2308.2645 | (233) |
| Wind generation | 0.0000 | (234) |
| Hydro-electric generation (Appendix N) | 0.0000 | (235a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 | (235) |
| Appendix Q - special features | | |
| Energy saved or generated | -0.0000 | (236) |
| Energy used | 0.0000 | (237) |
| Total delivered energy for all uses | 4152.5541 | (238) |

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

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| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 3203.5814 | 0.2100 | 672.7521 | (261) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 2955.5075 | 0.2100 | 620.6566 | (264) |
| Space and water heating | | | 1293.4087 | (265) |
| Pumps, fans and electric keep-hot | 86.0000 | 0.1387 | 11.9293 | (267) |
| Energy for lighting | 215.7298 | 0.1443 | 31.1365 | (268) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -903.9898 | 0.1347 | -121.7848 | |
| PV Unit electricity exported | -1404.2747 | 0.1259 | -176.8635 | |
| Total | | | -298.6483 | (269) |
| Total CO2, kg/year | | | 1037.8261 | (272) |
| EPC Target Carbon Dioxide Emission Rate (TER) | | | 11.1100 | (273) |

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

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| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 3203.5814 | 1.1300 | 3620.0470 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 2955.5075 | 1.1300 | 3339.7235 | (278) |
| Space and water heating | | | 6959.7704 | (279) |
| Pumps, fans and electric keep-hot | 86.0000 | 1.5128 | 130.1008 | (281) |
| Energy for lighting | 215.7298 | 1.5338 | 330.8935 | (282) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -903.9898 | 1.4979 | -1354.0927 | |
| PV Unit electricity exported | -1404.2747 | 0.4623 | -649.2135 | |
| Total | | | -2003.3062 | (283) |
| Total Primary energy kWh/year | | | 5417.4585 | (286) |
| Target Primary Energy Rate (TPER) | | | 58.0000 | (287) |

# Full SAP Calculation Printout

| | | | |
|---|---|---|---|
| Plot Reference | 3.2 Mid Terrace | Issued on Date | 16/01/2026 |
| Assessment Reference | 3.2 Mid Terrace | Plot Type Ref | 3.2 End Terrace |
| Plot Address | | SAP Version | 10.2 |

| | | | | | |
|---|---|---|---|---|---|
| SAP Rating | 92 A | DER | 1.45 | TER | 10.01 |
| Environmental | 99 A | % DER < TER | | | 85.51 |
| $CO_2$ Emissions (t/year) | 0.07 | DFEE | 29.73 | TFEE | 32.85 |
| Compliance Check | See BREL | % DFEE < TFEE | | | 9.50 |
| % DPER < TPER | 58.21 | DPER | 21.77 | TPER | 52.10 |

| | | | |
|---|---|---|---|
| Assessor Details | Miss Eleanor Risby | Assessor ID | M976-0001 |
| Client | | | |

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE

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1. Overall dwelling characteristics

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| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 46.7000 (1b) | x | 2.5200 (2b) | = | 117.6840 | (1b) - (3b) |
| First floor | 46.7000 (1c) | x | 2.7700 (2c) | = | 129.3590 | (1c) - (3c) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 93.4000 | | | | | (4) |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = | 247.0430 | (5) |

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2. Ventilation rate

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| | m3 per hour | |
|---|---|---|
| Number of open chimneys | 0 * 80 = | 0.0000 (6a) |
| Number of open flues | 0 * 20 = | 0.0000 (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 (6f) |
| Number of intermittent extract fans | 5 * 10 = | 50.0000 (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 (7c) |

| | Air changes per hour | |
|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 50.0000 / (5) = | 0.2024 (8) |
| Pressure test | | Yes |
| Pressure Test Method | | Blower Door |
| Measured/design AP50 | | 4.0000 (17) |
| Infiltration rate | | 0.4024 (18) |
| Number of sides sheltered | | 2 (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 0.8500 (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.3420 (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.4361 | 0.4275 | 0.4190 | 0.3762 | 0.3677 | 0.3249 | 0.3249 | 0.3164 | 0.3420 | 0.3677 | 0.3848 | 0.4019 | (22b) |
| Effective ac | 0.5951 | 0.5914 | 0.5878 | 0.5708 | 0.5676 | 0.5528 | 0.5528 | 0.5500 | 0.5585 | 0.5676 | 0.5740 | 0.5808 | (25) |

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3. Heat losses and heat loss parameter

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| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | | |
| W | | | 15.1700 | 1.1450 | 17.3702 | | | (27) |
| D | | | 2.1500 | 1.2000 | 2.5800 | | | (26) |
| Heatloss Floor 1 | | | 46.7000 | 0.1000 | 4.6700 | 75.0000 | 3502.5000 | (28a) |
| External Wall 1 | 55.0200 | 17.3200 | 37.7000 | 0.1900 | 7.1630 | 60.0000 | 2262.0000 | (29a) |
| Main Roof | 46.7000 | | 46.7000 | 0.0800 | 3.7360 | 9.0000 | 420.3000 | (30) |
| Total net area of external elements Aum(A, m2) | | | 148.4200 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 35.5192 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall | | | 95.2200 | 0.0000 | 0.0000 | 70.0000 | 6665.4000 | (32) |
| Internal Wall 1 | | | 166.7300 | | | 9.0000 | 1500.5700 | (32c) |
| Internal Floor 1 | | | 46.7000 | | | 18.0000 | 840.6000 | (32d) |
| Internal Ceiling 1 | | | 46.7000 | | | 9.0000 | 420.3000 | (32e) |

| | |
|---|---|
| Heat capacity Cm = Sum(A x k) | (28)...(30) + (32) + (32a)...(32e) = 15611.6700 (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | 167.1485 (35) |

List of Thermal Bridges

| | Length | Psi-value | Total |
|---|---|---|---|
| K1 Element | | | |
| E5 Ground floor (normal) | 10.4000 | 0.0620 | 0.6448 |
| E6 Intermediate floor within a dwelling | 10.4000 | 0.0020 | 0.0208 |

| | | | | |
|---|---|---|---|---|
| E2 Other lintels (including other steel lintels) | 12.2200 | 0.0200 | 0.2444 | |
| E3 Sill | 11.2000 | 0.0180 | 0.2016 | |
| E4 Jamb | 23.7600 | 0.0130 | 0.3089 | |
| E12 Gable (insulation at ceiling level) | 10.4000 | 0.0980 | 1.0192 | |
| E18 Party wall between dwellings | 21.1600 | 0.0200 | 0.4232 | |
| P1 Party wall - Ground floor | 18.0000 | 0.0500 | 0.9000 | |
| P2 Party wall - Intermediate floor within a dwelling | 18.0000 | 0.0000 | 0.0000 | |
| P4 Party wall - Roof (insulation at ceiling level) | 18.0000 | 0.0500 | 0.9000 | |

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 4.6629 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 40.1821 (37)

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 48.5142 | 48.2131 | 47.9181 | 46.5322 | 46.2729 | 45.0658 | 45.0658 | 44.8423 | 45.5308 | 46.2729 | 46.7974 | 47.3458 | (38) |
| Heat transfer coeff | 88.6963 | 88.3952 | 88.1002 | 86.7143 | 86.4550 | 85.2479 | 85.2479 | 85.0244 | 85.7129 | 86.4550 | 86.9796 | 87.5279 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 86.7131 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 0.9496 | 0.9464 | 0.9433 | 0.9284 | 0.9256 | 0.9127 | 0.9127 | 0.9103 | 0.9177 | 0.9256 | 0.9313 | 0.9371 | (40) |
| HLP (average) | | | | | | | | | | | | 0.9284 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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## 4. Water heating energy requirements (kWh/year)

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Assumed occupancy 2.6695 (42)

Hot water usage for mixer showers

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 68.9778 | 67.9412 | 66.4307 | 63.5405 | 61.4077 | 59.0292 | 57.6772 | 59.1763 | 60.8196 | 63.3734 | 66.3256 | 68.7135 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 29.7859 | 29.3436 | 28.7206 | 27.5720 | 26.7120 | 25.7583 | 25.2432 | 25.8618 | 26.5353 | 27.5558 | 28.7280 | 29.6852 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 41.9679 | 40.4418 | 38.9157 | 37.3896 | 35.8635 | 34.3374 | 34.3374 | 35.8635 | 37.3896 | 38.9157 | 40.4418 | 41.9679 | (42c) |

Average daily hot water use (litres/day) 129.3641 (43)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 140.7317 | 137.7266 | 134.0670 | 128.5022 | 123.9832 | 119.1249 | 117.2578 | 120.9016 | 124.7445 | 129.8449 | 135.4954 | 140.3667 | (44) |
| Energy conte | 222.8845 | 196.1208 | 206.0560 | 175.9131 | 166.9052 | 146.4779 | 141.8132 | 149.7014 | 153.8225 | 176.1983 | 193.0381 | 219.7803 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 2148.7113 | |
| Distribution loss (46)m = 0.15 x (45)m | 33.4327 | 29.4181 | 30.9084 | 26.3870 | 25.0358 | 21.9717 | 21.2720 | 22.4552 | 23.0734 | 26.4297 | 28.9557 | 32.9670 | (46) |
| Water storage loss (or HIU loss): | | | | | | | | | | | | | |
| Store volume | | | | | | | | | | | | 210.0000 | (47) |
| a) If manufacturer declared loss factor is known (kWh/day): | | | | | | | | | | | | 1.4200 | (48) |
| Temperature factor from Table 2b | | | | | | | | | | | | 0.5400 | (49) |
| Enter (49) or (54) in (55) | | | | | | | | | | | | 0.7668 | (55) |
| Total storage loss | 23.7708 | 21.4704 | 23.7708 | 23.0040 | 23.7708 | 23.0040 | 23.7708 | 23.7708 | 23.0040 | 23.7708 | 23.0040 | 23.7708 | (56) |
| If cylinder contains dedicated solar storage | 23.7708 | 21.4704 | 23.7708 | 23.0040 | 23.7708 | 23.0040 | 23.7708 | 23.7708 | 23.0040 | 23.7708 | 23.0040 | 23.7708 | (57) |
| Primary loss | 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |
| Total heat required for water heating calculated for each month | 269.9177 | 238.6024 | 253.0892 | 221.4291 | 213.9384 | 191.9939 | 188.8464 | 196.7346 | 199.3385 | 223.2315 | 238.5541 | 266.8135 | (62) |
| WWHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63a) |
| PV diverter | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |
| Output from w/h | 269.9177 | 238.6024 | 253.0892 | 221.4291 | 213.9384 | 191.9939 | 188.8464 | 196.7346 | 199.3385 | 223.2315 | 238.5541 | 266.8135 | (64) |
| | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 2702.4893 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 2702 | (64) |
| Electric shower(s) | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |
| | | | | | | | | | | Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | | 0.0000 | (64a) |
| Heat gains from water heating, kWh/month | 111.7357 | 99.1955 | 106.1402 | 94.9039 | 93.1225 | 85.1167 | 84.7794 | 87.4023 | 87.5588 | 96.2125 | 100.5980 | 110.7035 | (65) |

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

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Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 133.4729 | 133.4729 | 133.4729 | 133.4729 | 133.4729 | 133.4729 | 133.4729 | 133.4729 | 133.4729 | 133.4729 | 133.4729 | 133.4729 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 128.2979 | 142.0441 | 128.2979 | 132.5745 | 128.2979 | 132.5745 | 128.2979 | 128.2979 | 132.5745 | 128.2979 | 132.5745 | 128.2979 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 245.1957 | 247.7401 | 241.3283 | 227.6786 | 210.4482 | 194.2540 | 183.4353 | 180.8910 | 187.3027 | 200.9525 | 218.1829 | 234.3770 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 36.3473 | 36.3473 | 36.3473 | 36.3473 | 36.3473 | 36.3473 | 36.3473 | 36.3473 | 36.3473 | 36.3473 | 36.3473 | 36.3473 | (69) |
| Pumps, fans | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | -106.7783 | -106.7783 | -106.7783 | -106.7783 | -106.7783 | -106.7783 | -106.7783 | -106.7783 | -106.7783 | -106.7783 | -106.7783 | -106.7783 | (71) |
| Water heating gains (Table 5) | 150.1824 | 147.6123 | 142.6615 | 131.8110 | 125.1647 | 118.2177 | 113.9509 | 117.4762 | 121.6094 | 129.3179 | 139.7194 | 148.7950 | (72) |
| Total internal gains | 586.7178 | 600.4383 | 575.3296 | 555.1059 | 526.9526 | 508.0880 | 488.7259 | 489.7069 | 504.5284 | 521.6101 | 553.5186 | 574.5118 | (73) |

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## 6. Solar gains

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| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| North | 9.9100 | 10.6334 | 0.4500 | 0.7100 | 0.7700 | 23.3319 | (74) |
| South | 5.2600 | 46.7521 | 0.4500 | 0.7100 | 0.7700 | 54.4491 | (78) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 77.7810 | 133.7620 | 189.3579 | 250.0834 | 297.7247 | 304.2524 | 289.6504 | 252.1626 | 209.7555 | 149.2587 | 93.3236 | 66.4996 | (83) |
| Total gains | 664.4988 | 734.2003 | 764.6875 | 805.1893 | 824.6773 | 812.3404 | 778.3763 | 741.8696 | 714.2840 | 670.8688 | 646.8422 | 641.0114 | (84) |

## 7. Mean internal temperature (heating season)

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

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| tau | 48.8924 | 49.0589 | 49.2232 | 50.0099 | 50.1599 | 50.8702 | 50.8702 | 51.0039 | 50.5942 | 50.1599 | 49.8574 | 49.5450 | |
| alpha | 4.2595 | 4.2706 | 4.2815 | 4.3340 | 4.3440 | 4.3913 | 4.3913 | 4.4003 | 4.3729 | 4.3440 | 4.3238 | 4.3030 | |
| util living area | 0.9816 | 0.9704 | 0.9522 | 0.9024 | 0.8024 | 0.6281 | 0.4716 | 0.5118 | 0.7301 | 0.9101 | 0.9677 | 0.9840 | (86) |
| Living | 19.6438 | 19.8363 | 20.0998 | 20.4692 | 20.7657 | 20.9416 | 20.9867 | 20.9811 | 20.8846 | 20.5249 | 20.0415 | 19.6217 | |
| Non living | 18.5427 | 18.7876 | 19.1205 | 19.5831 | 19.9279 | 20.1153 | 20.1504 | 20.1491 | 20.0620 | 19.6585 | 19.0583 | 18.5222 | |
| 24 / 16 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 24 / 9 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 16 / 9 | 28 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 | |
| MIT | 20.3062 | 19.8363 | 20.0998 | 20.4692 | 20.7657 | 20.9416 | 20.9867 | 20.9811 | 20.8846 | 20.5249 | 20.0415 | 19.8145 | (87) |
| Th 2 | 20.1255 | 20.1282 | 20.1309 | 20.1434 | 20.1458 | 20.1567 | 20.1567 | 20.1587 | 20.1525 | 20.1458 | 20.1410 | 20.1361 | (88) |
| util rest of house | 0.9778 | 0.9644 | 0.9421 | 0.8812 | 0.7604 | 0.5591 | 0.3857 | 0.4247 | 0.6665 | 0.8864 | 0.9601 | 0.9806 | (89) |
| MIT 2 | 19.4945 | 18.7876 | 19.1205 | 19.5831 | 19.9279 | 20.1153 | 20.1504 | 20.1491 | 20.0620 | 19.6585 | 19.0583 | 18.8130 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.2848 | (91) |
| MIT | 19.7257 | 19.0863 | 19.3994 | 19.8354 | 20.1665 | 20.3506 | 20.3886 | 20.3861 | 20.2963 | 19.9052 | 19.3383 | 19.0982 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 19.7257 | 19.0863 | 19.3994 | 19.8354 | 20.1665 | 20.3506 | 20.3886 | 20.3861 | 20.2963 | 19.9052 | 19.3383 | 19.0982 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9757 | 0.9552 | 0.9316 | 0.8724 | 0.7615 | 0.5756 | 0.4098 | 0.4488 | 0.6780 | 0.8785 | 0.9510 | 0.9755 | (94) |
| Useful gains | 648.3715 | 701.3028 | 712.3651 | 702.4526 | 627.9619 | 467.5821 | 318.9654 | 332.9687 | 484.3042 | 589.3749 | 615.1614 | 625.3022 | (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 | 1368.2005 | 1254.0006 | 1136.4385 | 948.2580 | 731.9718 | 490.2272 | 322.9700 | 338.9151 | 531.1028 | 804.4843 | 1064.4848 | 1304.0102 | (97) |
| Space heating kWh | 535.5528 | 371.4129 | 315.5105 | 176.9799 | 77.3833 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 160.0414 | 323.5128 | 504.9588 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 2465.3525 | |
| Solar heating kWh | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | 535.5528 | 371.4129 | 315.5105 | 176.9799 | 77.3833 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 160.0414 | 323.5128 | 504.9588 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 2465.3525 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 26.3956 | (99) |

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

| | | |
|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | 0.0000 | (201) |
| Fraction of space heat from main system(s) | 1.0000 | (202) |
| Efficiency of main space heating system 1 (in %) | 294.2390 | (206) |
| Efficiency of main space heating system 2 (in %) | 0.0000 | (207) |
| Efficiency of secondary/supplementary heating system, % | 0.0000 | (208) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement | 535.5528 | 371.4129 | 315.5105 | 176.9799 | 77.3833 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 160.0414 | 323.5128 | 504.9588 | (98) |
| Space heating efficiency (main heating system 1) | 294.2390 | 294.2390 | 294.2390 | 294.2390 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 294.2390 | 294.2390 | 294.2390 | | (210) |
| Space heating fuel (main heating system) | 182.0128 | 126.2283 | 107.2293 | 60.1483 | 26.2995 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 54.3916 | 109.9490 | 171.6152 | (211) |
| Space heating efficiency (main heating system 2) | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (212) |
| Space heating fuel (main heating system 2) | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (213) |
| Space heating fuel (secondary) | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (215) |
| Water heating | | | | | | | | | | | | | |
| Water heating requirement | 269.9177 | 238.6024 | 253.0892 | 221.4291 | 213.9384 | 191.9939 | 188.8464 | 196.7346 | 199.3385 | 223.2315 | 238.5541 | 266.8135 | (64) |
| Efficiency of water heater | | | | | | | | | | | | 202.7251 | (216) |
| (217)m | 202.7251 | 202.7251 | 202.7251 | 202.7251 | 202.7251 | 202.7251 | 202.7251 | 202.7251 | 202.7251 | 202.7251 | 202.7251 | 202.7251 | (217) |
| Fuel for water heating, kWh/month | 133.1447 | 117.6975 | 124.8435 | 109.2262 | 105.5313 | 94.7065 | 93.1539 | 97.0450 | 98.3294 | 110.1154 | 117.6737 | 131.6134 | (219) |
| Space cooling fuel requirement | | | | | | | | | | | | | |
| (221)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (221) |
| Pumps and Fa | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (231) |
| Lighting | 24.7318 | 19.8408 | 17.8644 | 13.0883 | 10.1097 | 8.2597 | 9.2224 | 11.9877 | 15.5708 | 20.4298 | 23.0754 | 25.4192 | (232) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (233a)m | -28.6719 | -46.5828 | -77.7464 | -97.2495 | -110.0428 | -102.1238 | -100.1611 | -90.9131 | -74.4429 | -56.0788 | -32.9612 | -23.8260 | (233a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (234a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (234a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (235a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235a) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | | |
| (235c)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235c) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (233b)m | -7.7523 | -19.9300 | -49.4933 | -91.4559 | -137.3472 | -146.5715 | -142.9629 | -112.2833 | -71.7303 | -32.8657 | -11.4041 | -5.8549 | (233b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (234b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (234b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (235b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235b) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | | |
| (235d)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235d) |

Annual totals kWh/year

| | | |
|---|---|---|
| Space heating fuel - main system 1 | 837.8741 | (211) |
| Space heating fuel - main system 2 | 0.0000 | (213) |
| Space heating fuel - secondary | 0.0000 | (215) |
| Efficiency of water heater | 202.7251 | |
| Water heating fuel used | 1333.0805 | (219) |
| Space cooling fuel | 0.0000 | (221) |

Electricity for pumps and fans:

| | | |
|---|---|---|
| Total electricity for the above, kWh/year | 0.0000 | (231) |
| Electricity for lighting (calculated in Appendix L) | 199.6001 | (232) |
| Energy saving/generation technologies (Appendices M ,N and Q) | | |
| PV generation | -1670.4518 | (233) |
| Wind generation | 0.0000 | (234) |
| Hydro-electric generation (Appendix N) | 0.0000 | (235a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 | (235) |
| Appendix Q - special features | | |
| Energy saved or generated | -0.0000 | (236) |
| Energy used | 0.0000 | (237) |
| Total delivered energy for all uses | 700.1029 | (238) |

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

| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 837.8741 | 0.1555 | 130.3163 | (261) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 1333.0805 | 0.1410 | 187.9522 | (264) |
| Space and water heating | | | 318.2685 | (265) |
| Pumps, fans and electric keep-hot | 0.0000 | 0.0000 | 0.0000 | (267) |
| Energy for lighting | 199.6001 | 0.1443 | 28.8085 | (268) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -840.8003 | 0.1327 | -111.5788 | |
| PV Unit electricity exported | -829.6515 | 0.1209 | -100.3160 | |
| Total | | | -211.8949 | (269) |
| Total CO2, kg/year | | | 135.1821 | (272) |
| EPC Dwelling Carbon Dioxide Emission Rate (DER) | | | 1.4500 | (273) |

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

| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 837.8741 | 1.5758 | 1320.3124 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 1333.0805 | 1.5213 | 2028.0658 | (278) |
| Space and water heating | | | 3348.3781 | (279) |
| Pumps, fans and electric keep-hot | 0.0000 | 0.0000 | 0.0000 | (281) |
| Energy for lighting | 199.6001 | 1.5338 | 306.1533 | (282) |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -840.8003 | 1.4904 | -1253.0990 | |
| PV Unit electricity exported | -829.6515 | 0.4436 | -368.0055 | |
| Total | | | -1621.1045 | (283) |
| Total Primary energy kWh/year | | | 2033.4269 | (286) |
| Dwelling Primary energy Rate (DPER) | | | 21.7700 | (287) |

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF TARGET EMISSIONS

1. Overall dwelling characteristics

| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 46.7000 | (1b) x | 2.5200 | (2b) = | 117.6840 | (1b) - (3b) |
| First floor | 46.7000 | (1c) x | 2.7700 | (2c) = | 129.3590 | (1c) - (3c) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 93.4000 | | | | | (4) |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = | | 247.0430 | (5) |

2. Ventilation rate

| | m3 per hour | |
|---|---|---|
| Number of open chimneys | 0 * 80 = 0.0000 | (6a) |
| Number of open flues | 0 * 20 = 0.0000 | (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = 0.0000 | (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = 0.0000 | (6d) |
| Number of flues attached to other heater | 0 * 35 = 0.0000 | (6e) |
| Number of blocked chimneys | 0 * 20 = 0.0000 | (6f) |
| Number of intermittent extract fans | 3 * 10 = 30.0000 | (7a) |
| Number of passive vents | 0 * 10 = 0.0000 | (7b) |
| Number of flueless gas fires | 0 * 40 = 0.0000 | (7c) |
| | Air changes per hour | |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 30.0000 / (5) = 0.1214 | (8) |
| Pressure test | Yes | |
| Pressure Test Method | Blower Door | |
| Measured/design AP50 | 5.0000 | (17) |
| Infiltration rate | 0.3714 | (18) |
| Number of sides sheltered | 2 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = 0.8500 | (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = 0.3157 | (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Adj infilt rate | | | | | | | | | | | | | |
| | 0.4025 | 0.3947 | 0.3868 | 0.3473 | 0.3394 | 0.2999 | 0.2999 | 0.2920 | 0.3157 | 0.3394 | 0.3552 | 0.3710 | (22b) |
| Effective ac | 0.5810 | 0.5779 | 0.5748 | 0.5603 | 0.5576 | 0.5450 | 0.5450 | 0.5426 | 0.5498 | 0.5576 | 0.5631 | 0.5688 | (25) |

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3. Heat losses and heat loss parameter

---

| Element | Gross | Openings | NetArea | U-value | A x U | K-value | A x K | |
|---|---|---|---|---|---|---|---|---|
| | m2 | m2 | m2 | W/m2K | W/K | kJ/m2K | kJ/K | |
| Main dwelling | | | | | | | | |
| TER Opaque door | | | 2.1500 | 1.0000 | 2.1500 | | | (26) |
| TER Opening Type | | | 15.1700 | 1.1450 | 17.3702 | | | (27) |
| Heatloss Floor 1 | | | 46.7000 | 0.1300 | 6.0710 | | | (28a) |
| External Wall 1 | 55.0200 | 17.3200 | 37.7000 | 0.1800 | 6.7860 | | | (29a) |
| Main Roof | 46.7000 | | 46.7000 | 0.1100 | 5.1370 | | | (30) |
| Total net area of external elements Aum(A, m2) | | | 148.4200 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | | (26)...(30) + (32) = | 37.5142 | | | (33) |
| Main dwelling | | | | | | | | |
| Party Wall | | | 95.2200 | 0.0000 | 0.0000 | | | (32) |

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 167.1485 (35)

List of Thermal Bridges

| K1 Element | Length | Psi-value | Total |
|---|---|---|---|
| E5 Ground floor (normal) | 10.4000 | 0.1600 | 1.6640 |
| E6 Intermediate floor within a dwelling | 10.4000 | 0.0000 | 0.0000 |
| E2 Other lintels (including other steel lintels) | 12.2200 | 0.0500 | 0.6110 |
| E3 Sill | 11.2000 | 0.0500 | 0.5600 |
| E4 Jamb | 23.7600 | 0.0500 | 1.1880 |
| E12 Gable (insulation at ceiling level) | 10.4000 | 0.0600 | 0.6240 |
| E18 Party wall between dwellings | 21.1600 | 0.0600 | 1.2696 |
| P1 Party wall - Ground floor | 18.0000 | 0.0800 | 1.4400 |
| P2 Party wall - Intermediate floor within a dwelling | 18.0000 | 0.0000 | 0.0000 |
| P4 Party wall - Roof (insulation at ceiling level) | 18.0000 | 0.1200 | 2.1600 |

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 9.5166 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 47.0308 (37)

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 47.3673 | 47.1108 | 46.8594 | 45.6785 | 45.4576 | 44.4291 | 44.4291 | 44.2386 | 44.8252 | 45.4576 | 45.9045 | 46.3718 | (38) |
| Heat transfer coeff | | | | | | | | | | | | | |
| | 94.3981 | 94.1416 | 93.8902 | 92.7093 | 92.4884 | 91.4599 | 91.4599 | 91.2695 | 91.8561 | 92.4884 | 92.9354 | 93.4026 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 92.7083 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.0107 | 1.0079 | 1.0052 | 0.9926 | 0.9902 | 0.9792 | 0.9792 | 0.9772 | 0.9835 | 0.9902 | 0.9950 | 1.0000 | (40) |
| HLP (average) | | | | | | | | | | | | 0.9926 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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4. Water heating energy requirements (kWh/year)

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| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Assumed occupancy | | | | | | | | | | | | 2.6695 | (42) |
| Hot water usage for mixer showers | | | | | | | | | | | | | |
| | 68.9778 | 67.9412 | 66.4307 | 63.5405 | 61.4077 | 59.0292 | 57.6772 | 59.1763 | 60.8196 | 63.3734 | 66.3256 | 68.7135 | (42a) |
| Hot water usage for baths | | | | | | | | | | | | | |
| | 29.7859 | 29.3436 | 28.7206 | 27.5720 | 26.7120 | 25.7583 | 25.2432 | 25.8618 | 26.5353 | 27.5558 | 28.7280 | 29.6852 | (42b) |
| Hot water usage for other uses | | | | | | | | | | | | | |
| | 41.9679 | 40.4418 | 38.9157 | 37.3896 | 35.8635 | 34.3374 | 34.3374 | 35.8635 | 37.3896 | 38.9157 | 40.4418 | 41.9679 | (42c) |
| Average daily hot water use (litres/day) | | | | | | | | | | | | 129.3641 | (43) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | | | | | | | | | | | | | |
| | 140.7317 | 137.7266 | 134.0670 | 128.5022 | 123.9832 | 119.1249 | 117.2578 | 120.9016 | 124.7445 | 129.8449 | 135.4954 | 140.3667 | (44) |
| Energy conte | 222.8845 | 196.1208 | 206.0560 | 175.9131 | 166.9052 | 146.4779 | 141.8132 | 149.7014 | 153.8225 | 176.1983 | 193.0381 | 219.7803 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 2148.7113 | |
| Distribution loss (46)m = 0.15 x (45)m | | | | | | | | | | | | | |
| | 33.4327 | 29.4181 | 30.9084 | 26.3870 | 25.0358 | 21.9717 | 21.2720 | 22.4552 | 23.0734 | 26.4297 | 28.9557 | 32.9670 | (46) |
| Water storage loss (or HIU loss): | | | | | | | | | | | | | |
| Store volume | | | | | | | | | | | | 210.0000 | (47) |
| a) If manufacturer declared loss factor is known (kWh/day): | | | | | | | | | | | | 1.7016 | (48) |
| Temperature factor from Table 2b | | | | | | | | | | | | 0.5400 | (49) |
| Enter (49) or (54) in (55) | | | | | | | | | | | | 0.9188 | (55) |
| Total storage loss | | | | | | | | | | | | | |
| | 28.4842 | 25.7277 | 28.4842 | 27.5653 | 28.4842 | 27.5653 | 28.4842 | 28.4842 | 27.5653 | 28.4842 | 27.5653 | 28.4842 | (56) |
| If cylinder contains dedicated solar storage | | | | | | | | | | | | | |
| | 28.4842 | 25.7277 | 28.4842 | 27.5653 | 28.4842 | 27.5653 | 28.4842 | 28.4842 | 27.5653 | 28.4842 | 27.5653 | 28.4842 | (57) |
| Primary loss | 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |
| Total heat required for water heating calculated for each month | | | | | | | | | | | | | |
| | 274.6311 | 242.8597 | 257.8026 | 225.9904 | 218.6518 | 196.5553 | 193.5597 | 201.4480 | 203.8998 | 227.9449 | 243.1155 | 271.5269 | (62) |
| WWHRS | -31.5338 | -27.8887 | -29.2035 | -24.1816 | -22.5364 | -19.2846 | -18.0762 | -19.2222 | -19.9526 | -23.5219 | -26.6474 | -30.9498 | (63a) |
| PV diverter | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |
| Output from w/h | | | | | | | | | | | | | |
| | 243.0974 | 214.9709 | 228.5991 | 201.8088 | 196.1154 | 177.2707 | 175.4835 | 182.2258 | 183.9473 | 204.4230 | 216.4680 | 240.5771 | (64) |
| | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 2464.9870 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 2465 | (64) |
| Electric shower(s) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |
| | | | | | | | | | | Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | | 0.0000 | (64a) |
| Heat gains from water heating, kWh/month | | | | | | | | | | | | | |
| | 115.5064 | 102.6013 | 109.9109 | 98.5530 | 96.8932 | 88.7658 | 88.5501 | 91.1730 | 91.2078 | 99.9832 | 104.2470 | 114.4742 | (65) |

---

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

---

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Metabolic gains (Table 5), Watts | | | | | | | | | | | | | |
| (66)m | 133.4729 | 133.4729 | 133.4729 | 133.4729 | 133.4729 | 133.4729 | 133.4729 | 133.4729 | 133.4729 | 133.4729 | 133.4729 | 133.4729 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | | | | | | | | | | | | | |
| | 128.6475 | 142.4312 | 128.6475 | 132.9358 | 128.6475 | 132.9358 | 128.6475 | 128.6475 | 132.9358 | 128.6475 | 132.9358 | 128.6475 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | | | | | | | | | | | | | |
| | 245.1957 | 247.7401 | 241.3283 | 227.6786 | 210.4482 | 194.2540 | 183.4353 | 180.8910 | 187.3027 | 200.9525 | 218.1829 | 234.3770 | (68) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | | | | | | | | | | | | | |
| | 36.3473 | 36.3473 | 36.3473 | 36.3473 | 36.3473 | 36.3473 | 36.3473 | 36.3473 | 36.3473 | 36.3473 | 36.3473 | 36.3473 | (69) |
| Pumps, fans | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 3.0000 | 3.0000 | 3.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | | | | | | | | | | | | | |
| | -106.7783 | -106.7783 | -106.7783 | -106.7783 | -106.7783 | -106.7783 | -106.7783 | -106.7783 | -106.7783 | -106.7783 | -106.7783 | -106.7783 | (71) |
| Water heating gains (Table 5) | | | | | | | | | | | | | |
| | 155.2505 | 152.6804 | 147.7297 | 136.8791 | 130.2329 | 123.2858 | 119.0190 | 122.5444 | 126.6776 | 134.3860 | 144.7876 | 153.8632 | (72) |
| Total internal gains | | | | | | | | | | | | | |
| | 595.1356 | 608.8935 | 583.7474 | 563.5353 | 535.3704 | 513.5175 | 494.1437 | 495.1247 | 509.9579 | 530.0279 | 561.9481 | 582.9296 | (73) |

## 6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| North | 9.9100 | 10.6334 | 0.6300 | 0.7000 | 0.7700 | 32.2046 | (74) |
| South | 5.2600 | 46.7521 | 0.6300 | 0.7000 | 0.7700 | 75.1551 | (78) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 107.3596 | 184.6292 | 261.3673 | 345.1856 | 410.9439 | 419.9540 | 399.7991 | 348.0555 | 289.5217 | 206.0191 | 128.8129 | 91.7882 | (83) |
| Total gains | 702.4952 | 793.5228 | 845.1147 | 908.7209 | 946.3143 | 933.4715 | 893.9429 | 843.1802 | 799.4796 | 736.0470 | 690.7609 | 674.7178 | (84) |

## 7. Mean internal temperature (heating season)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature during heating periods in the living area from Table 9, Th1 (C) | | | | | | | | | | | | 21.0000 | (85) |
| Utilisation factor for gains for living area, ni1,m (see Table 9a) | | | | | | | | | | | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| tau | 45.9392 | 46.0644 | 46.1877 | 46.7760 | 46.8878 | 47.4150 | 47.4150 | 47.5140 | 47.2105 | 46.8878 | 46.6623 | 46.4288 | |
| alpha | 4.0626 | 4.0710 | 4.0792 | 4.1184 | 4.1259 | 4.1610 | 4.1610 | 4.1676 | 4.1474 | 4.1259 | 4.1108 | 4.0953 | |
| util living area | | | | | | | | | | | | | |
| | 0.9789 | 0.9645 | 0.9405 | 0.8791 | 0.7647 | 0.5902 | 0.4411 | 0.4839 | 0.7029 | 0.8957 | 0.9630 | 0.9818 | (86) |
| MIT | 19.5686 | 19.7907 | 20.0862 | 20.4775 | 20.7790 | 20.9441 | 20.9868 | 20.9807 | 20.8834 | 20.5101 | 19.9868 | 19.5357 | (87) |
| Th 2 | 20.0744 | 20.0767 | 20.0790 | 20.0895 | 20.0915 | 20.1007 | 20.1007 | 20.1024 | 20.0971 | 20.0915 | 20.0875 | 20.0833 | (88) |
| util rest of house | | | | | | | | | | | | | |
| | 0.9745 | 0.9573 | 0.9281 | 0.8540 | 0.7181 | 0.5192 | 0.3549 | 0.3954 | 0.6354 | 0.8687 | 0.9542 | 0.9780 | (89) |
| MIT 2 | 18.4118 | 18.6929 | 19.0637 | 19.5469 | 19.8909 | 20.0622 | 20.0947 | 20.0930 | 20.0080 | 19.5961 | 18.9507 | 18.3764 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.2848 | (91) |
| MIT | 18.7413 | 19.0055 | 19.3549 | 19.8119 | 20.1438 | 20.3134 | 20.3488 | 20.3458 | 20.2573 | 19.8564 | 19.2458 | 18.7066 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 18.7413 | 19.0055 | 19.3549 | 19.8119 | 20.1438 | 20.3134 | 20.3488 | 20.3458 | 20.2573 | 19.8564 | 19.2458 | 18.7066 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9660 | 0.9466 | 0.9162 | 0.8452 | 0.7210 | 0.5366 | 0.3791 | 0.4200 | 0.6482 | 0.8605 | 0.9439 | 0.9703 | (94) |
| Useful gains | 678.6290 | 751.1512 | 774.3214 | 768.0783 | 682.3147 | 500.8863 | 338.9130 | 354.1033 | 518.2255 | 633.3936 | 652.0110 | 654.6531 | (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 | | | | | | | | | | | | | |
| | 1363.2267 | 1327.9171 | 1206.9496 | 1011.6345 | 780.9581 | 522.5439 | 342.8608 | 360.1311 | 565.5838 | 856.1098 | 1128.7744 | 1354.9510 | (97) |
| Space heating kWh | | | | | | | | | | | | | |
| | 509.3407 | 387.5867 | 321.8754 | 175.3605 | 73.3907 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 165.7009 | 343.2696 | 521.0216 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 2497.5459 | |
| Solar heating kWh | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | | | | | | | | | | | | | |
| | 509.3407 | 387.5867 | 321.8754 | 175.3605 | 73.3907 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 165.7009 | 343.2696 | 521.0216 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 2497.5459 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 26.7403 | (99) |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | | | | | | | | | | | | 0.0000 | (201) |
| Fraction of space heat from main system(s) | | | | | | | | | | | | 1.0000 | (202) |
| Efficiency of main space heating system 1 (in %) | | | | | | | | | | | | 92.3000 | (206) |
| Efficiency of main space heating system 2 (in %) | | | | | | | | | | | | 0.0000 | (207) |
| Efficiency of secondary/supplementary heating system, % | | | | | | | | | | | | 0.0000 | (208) |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| Space heating requirement | | | | | | | | | | | | | |
| | 509.3407 | 387.5867 | 321.8754 | 175.3605 | 73.3907 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 165.7009 | 343.2696 | 521.0216 | (98) |
| Space heating efficiency (main heating system 1) | | | | | | | | | | | | | |
| | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 92.3000 | 92.3000 | 92.3000 | (210) |
| Space heating fuel (main heating system) | | | | | | | | | | | | | |
| | 551.8317 | 419.9206 | 348.7274 | 189.9897 | 79.5132 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 179.5242 | 371.9064 | 564.4871 | (211) |
| Space heating efficiency (main heating system 2) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (212) |
| Space heating fuel (main heating system 2) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (213) |
| Space heating fuel (secondary) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (215) |
| Water heating | | | | | | | | | | | | | |
| Water heating requirement | | | | | | | | | | | | | |
| | 243.0974 | 214.9709 | 228.5991 | 201.8088 | 196.1154 | 177.2707 | 175.4835 | 182.2258 | 183.9473 | 204.4230 | 216.4680 | 240.5771 | (64) |
| Efficiency of water heater | | | | | | | | | | | | 79.8000 | (216) |
| (217)m | 85.6781 | 85.3652 | 84.8271 | 83.7463 | 82.0650 | 79.8000 | 79.8000 | 79.8000 | 79.8000 | 83.5929 | 85.0887 | 85.7452 | (217) |
| Fuel for water heating, kWh/month | | | | | | | | | | | | | |
| | 283.7334 | 251.8250 | 269.4884 | 240.9763 | 238.9758 | 222.1438 | 219.9042 | 228.3531 | 230.5104 | 244.5458 | 254.4027 | 280.5719 | (219) |
| Space cooling fuel requirement | | | | | | | | | | | | | |
| (221)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (221) |
| Pumps and Fa | 7.3041 | 6.5973 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 | (231) |
| Lighting | 26.7304 | 21.4441 | 19.3081 | 14.1459 | 10.9267 | 8.9272 | 9.9677 | 12.9564 | 16.8291 | 22.0807 | 24.9401 | 27.4733 | (232) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (233a)m | -43.0109 | -60.2877 | -86.1555 | -96.2755 | -103.2944 | -96.1990 | -94.9780 | -89.9005 | -80.8866 | -68.6291 | -47.1488 | -37.2239 | (233a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (234a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (234a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (235a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235a) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | | |
| (235c)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235c) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (233b)m | -25.3671 | -53.2421 | -105.6129 | -158.3343 | -209.0980 | -210.0284 | -207.5861 | -175.9057 | -129.1039 | -76.0791 | -33.8456 | -20.0714 | (233b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (234b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (234b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (235b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235b) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | | |
| (235d)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235d) |

| | | |
|---|---|---|
| Annual totals kWh/year | | |
| Space heating fuel - main system 1 | 2705.9003 | (211) |
| Space heating fuel - main system 2 | 0.0000 | (213) |
| Space heating fuel - secondary | 0.0000 | (215) |
| Efficiency of water heater | 79.8000 | |
| Water heating fuel used | 2965.4308 | (219) |
| Space cooling fuel | 0.0000 | (221) |
| | | |
| Electricity for pumps and fans: | | |
| Total electricity for the above, kWh/year | 86.0000 | (231) |
| Electricity for lighting (calculated in Appendix L) | 215.7298 | (232) |
| | | |
| Energy saving/generation technologies (Appendices M ,N and Q) | | |
| PV generation | -2308.2645 | (233) |
| Wind generation | 0.0000 | (234) |
| Hydro-electric generation (Appendix N) | 0.0000 | (235a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 | (235) |
| Appendix Q - special features | | |
| Energy saved or generated | -0.0000 | (236) |
| Energy used | 0.0000 | (237) |
| Total delivered energy for all uses | 3664.7963 | (238) |

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

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| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 2705.9003 | 0.2100 | 568.2391 | (261) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 2965.4308 | 0.2100 | 622.7405 | (264) |
| Space and water heating | | | 1190.9795 | (265) |
| Pumps, fans and electric keep-hot | 86.0000 | 0.1387 | 11.9293 | (267) |
| Energy for lighting | 215.7298 | 0.1443 | 31.1365 | (268) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -903.9898 | 0.1347 | -121.7848 | |
| PV Unit electricity exported | -1404.2747 | 0.1259 | -176.8635 | |
| Total | | | -298.6483 | (269) |
| Total CO2, kg/year | | | 935.3969 | (272) |
| EPC Target Carbon Dioxide Emission Rate (TER) | | | 10.0100 | (273) |

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

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| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 2705.9003 | 1.1300 | 3057.6673 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 2965.4308 | 1.1300 | 3350.9368 | (278) |
| Space and water heating | | | 6408.6041 | (279) |
| Pumps, fans and electric keep-hot | 86.0000 | 1.5128 | 130.1008 | (281) |
| Energy for lighting | 215.7298 | 1.5338 | 330.8935 | (282) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -903.9898 | 1.4979 | -1354.0927 | |
| PV Unit electricity exported | -1404.2747 | 0.4623 | -649.2135 | |
| Total | | | -2003.3062 | (283) |
| Total Primary energy kWh/year | | | 4866.2921 | (286) |
| Target Primary Energy Rate (TPER) | | | 52.1000 | (287) |

# Full SAP Calculation Printout

| | | | |
|---|---|---|---|
| Plot Reference | 5.9 Detached | Issued on Date | 16/01/2026 |
| Assessment Reference | 5.9 Detached | Plot Type Ref | 5.9 Detached |
| Plot Address | | SAP Version | 10.2 |

| | | | | | |
|---|---|---|---|---|---|
| SAP Rating | 91 B | DER | 1.78 | TER | 8.58 |
| Environmental | 98 A | % DER < TER | | | 79.25 |
| $CO_2$ Emissions (t/year) | 0.34 | DFEE | 38.59 | TFEE | 38.93 |
| Compliance Check | See BREL | % DFEE < TFEE | | | 0.87 |
| % DPER < TPER | 60.79 | DPER | 17.69 | TPER | 45.11 |

| | | | |
|---|---|---|---|
| Assessor Details | Miss Eleanor Risby | Assessor ID | M976-0001 |
| Client | | | |

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE

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1. Overall dwelling characteristics

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| | Area (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Main dwelling | | | | | | |
| Ground floor | 87.6500 (1b) | x | 2.4000 (2b) | = | 210.3600 | (1b) - (3b) |
| First floor | 95.0000 (1c) | x | 2.7500 (2c) | = | 261.2500 | (1c) - (3c) |
| Second floor | 59.3000 (1d) | x | 2.0000 (2d) | = | 118.6000 | (1d) - (3d) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 241.9500 | | | | | (4) |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = | 590.2100 | (5) |

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2. Ventilation rate

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| | | m3 per hour | |
|---|---|---|---|
| Number of open chimneys | 0 * 80 = | 0.0000 | (6a) |
| Number of open flues | 0 * 20 = | 0.0000 | (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 | (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 | (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 | (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 | (6f) |
| Number of intermittent extract fans | 6 * 10 = | 60.0000 | (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 | (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 | (7c) |
| | Air changes per hour | | |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 60.0000 / (5) = | 0.1017 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 4.0000 | (17) |
| Infiltration rate | | 0.3017 | (18) |
| Number of sides sheltered | | 0 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 1.0000 | (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.3017 | (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.3846 | 0.3771 | 0.3695 | 0.3318 | 0.3243 | 0.2866 | 0.2866 | 0.2790 | 0.3017 | 0.3243 | 0.3394 | 0.3544 | (22b) |
| Effective ac | 0.5740 | 0.5711 | 0.5683 | 0.5551 | 0.5526 | 0.5411 | 0.5411 | 0.5389 | 0.5455 | 0.5526 | 0.5576 | 0.5628 | (25) |

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3. Heat losses and heat loss parameter

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| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | | |
| External Doors | | | 2.0600 | 1.2000 | 2.4720 | | | (26) |
| Glazing | | | 24.5600 | 1.1450 | 28.1221 | | | (27) |
| Ground Floor | | | 87.6500 | 0.1000 | 8.7650 | 110.0000 | 9641.5000 | (28a) |
| Exposed Floor (above garage) | | | 18.6000 | 0.1500 | 2.7900 | 100.0000 | 1860.0000 | (28b) |
| Exposed Floor (front) | | | 2.7000 | 0.1500 | 0.4050 | 100.0000 | 270.0000 | (28b) |
| External Wall 1 | 221.9400 | 21.8700 | 200.0700 | 0.1900 | 38.0133 | 60.0000 | 12004.2000 | (29a) |
| Dormer Walls | 8.3000 | 4.7500 | 3.5500 | 0.2000 | 0.7100 | 60.0000 | 213.0000 | (29a) |
| Main Roof | 56.9000 | | 56.9000 | 0.0800 | 4.5520 | 9.0000 | 512.1000 | (30) |
| Side Roof | 18.6000 | | 18.6000 | 0.0800 | 1.4880 | 9.0000 | 167.4000 | (30) |
| Dormer Roofs | 3.9000 | | 3.9000 | 0.1500 | 0.5850 | 9.0000 | 35.1000 | (30) |
| Insulated Ceiling 1F | 15.2000 | | 15.2000 | 0.1000 | 1.5200 | 9.0000 | 136.8000 | (30) |
| GF Roof (rear) | 13.8000 | | 13.8000 | 0.1500 | 2.0700 | 9.0000 | 124.2000 | (30) |
| GF Roof (Bay window) | 2.6900 | | 2.6900 | 0.2000 | 0.5380 | 9.0000 | 24.2100 | (30) |
| Total net area of external elements Aum(A, m2) | | | 450.2800 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 92.0304 | | | (33) |
| Main dwelling | | | | | | | | |
| Internal Wall 1 | | | 200.0000 | | | 9.0000 | 1800.0000 | (32c) |
| Internal Floor 1 | | | 74.5000 | | | 18.0000 | 1341.0000 | (32d) |

| | | | | | |
|---|---|---|---|---|---|
| Internal Ceiling 1 | 74.5000 | | 9.0000 | 670.5000 | (32e) |

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 28800.0100 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 119.0329 (35)
List of Thermal Bridges

| | Length | Psi-value | Total |
|---|---|---|---|
| K1 Element | | | |
| E2 Other lintels (including other steel lintels) | 19.5400 | 0.1500 | 2.9310 |
| E3 Sill | 18.5600 | 0.0500 | 0.9280 |
| E4 Jamb | 42.0400 | 0.0500 | 2.1020 |
| E5 Ground floor (normal) | 42.4000 | 0.1000 | 4.2400 |
| E6 Intermediate floor within a dwelling | 17.5000 | 0.0020 | 0.0350 |
| E6 Intermediate floor within a dwelling | 29.0000 | 0.0020 | 0.0580 |
| E16 Corner (normal) | 28.5000 | 0.0400 | 1.1400 |
| E17 Corner (inverted - internal area greater than external area) | 7.9000 | 0.0000 | 0.0000 |
| E24 Eaves (insulation at ceiling level - inverted) | 6.4000 | 0.1500 | 0.9600 |
| E24 Eaves (insulation at ceiling level - inverted) | 3.1500 | 0.1500 | 0.4725 |
| E10 Eaves (insulation at ceiling level) | 6.4000 | 0.0500 | 0.3200 |
| E10 Eaves (insulation at ceiling level) | 4.3500 | 0.0500 | 0.2175 |
| E12 Gable (insulation at ceiling level) | 4.3000 | 0.0500 | 0.2150 |
| E20 Exposed floor (normal) | 3.7500 | 0.1500 | 0.5625 |
| E20 Exposed floor (normal) | 12.8500 | 0.1500 | 1.9275 |
| E21 Exposed floor (inverted) | 3.7500 | 0.3200 | 1.2000 |
| E21 Exposed floor (inverted) | 6.1000 | 0.3200 | 1.9520 |
| E11 Eaves (insulation at rafter level) | 6.8000 | 0.0500 | 0.3400 |
| E13 Gable (insulation at rafter level) | 6.1000 | 0.0500 | 0.3050 |
| E14 Flat roof | 4.9000 | 0.1600 | 0.7840 |
| R7 Flat ceiling (inverted) | 2.5000 | 0.1200 | 0.3000 |
| R6 Flat ceiling | 23.1000 | 0.1200 | 2.7720 |
| E13 Gable (insulation at rafter level) | 3.0500 | 0.0500 | 0.1525 |
| E14 Flat roof | 4.5000 | 0.1600 | 0.7200 |
| R7 Flat ceiling (inverted) | 1.8000 | 0.1200 | 0.2160 |

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 24.8505 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 116.8809 (37)

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 111.7906 | 111.2312 | 110.6829 | 108.1074 | 107.6256 | 105.3824 | 105.3824 | 104.9670 | 106.2465 | 107.6256 | 108.6004 | 109.6195 | (38) |
| Heat transfer coeff | 228.6716 | 228.1122 | 227.5638 | 224.9884 | 224.5065 | 222.2634 | 222.2634 | 221.8480 | 223.1274 | 224.5065 | 225.4813 | 226.5004 | (39) |

Average = Sum(39)m / 12 = 224.9861

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 0.9451 | 0.9428 | 0.9405 | 0.9299 | 0.9279 | 0.9186 | 0.9186 | 0.9169 | 0.9222 | 0.9279 | 0.9319 | 0.9361 | (40) |
| HLP (average) | | | | | | | | | | | | 0.9299 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

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4. Water heating energy requirements (kWh/year)
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Assumed occupancy 3.0565 (42)
Hot water usage for mixer showers

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 75.4667 | 74.3326 | 72.6800 | 69.5180 | 67.1845 | 64.5822 | 63.1031 | 64.7432 | 66.5411 | 69.3351 | 72.5651 | 75.1776 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 32.5764 | 32.0926 | 31.4113 | 30.1551 | 29.2145 | 28.1715 | 27.6081 | 28.2846 | 29.0212 | 30.1373 | 31.4194 | 32.4663 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 45.9313 | 44.2610 | 42.5908 | 40.9206 | 39.2503 | 37.5801 | 37.5801 | 39.2503 | 40.9206 | 42.5908 | 44.2610 | 45.9313 | (42c) |

Average daily hot water use (litres/day) 141.5369 (43)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 153.9744 | 150.6862 | 146.6821 | 140.5937 | 135.6493 | 130.3338 | 128.2913 | 132.2782 | 136.4829 | 142.0632 | 148.2455 | 153.5751 | (44) |
| Energy conte | 243.8578 | 214.5752 | 225.4449 | 192.4657 | 182.6100 | 160.2606 | 155.1572 | 163.7880 | 168.2971 | 192.7785 | 211.2028 | 240.4615 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 2350.8994 | |
| Distribution loss (46)m = 0.15 x (45)m | 36.5787 | 32.1863 | 33.8167 | 28.8699 | 27.3915 | 24.0391 | 23.2736 | 24.5682 | 25.2446 | 28.9168 | 31.6804 | 36.0692 | (46) |
| Water storage loss (or HIU loss): | | | | | | | | | | | | | |
| Store volume | | | | | | | | | | | | 150.0000 | (47) |
| a) If manufacturer declared loss factor is known (kWh/day): | | | | | | | | | | | | 1.4000 | (48) |
| Temperature factor from Table 2b | | | | | | | | | | | | 0.7800 | (49) |
| Enter (49) or (54) in (55) | | | | | | | | | | | | 1.0920 | (55) |
| Total storage loss | 33.8520 | 30.5760 | 33.8520 | 32.7600 | 33.8520 | 32.7600 | 33.8520 | 33.8520 | 32.7600 | 33.8520 | 32.7600 | 33.8520 | (56) |
| If cylinder contains dedicated solar storage | 33.8520 | 30.5760 | 33.8520 | 32.7600 | 33.8520 | 32.7600 | 33.8520 | 33.8520 | 32.7600 | 33.8520 | 32.7600 | 33.8520 | (57) |
| Primary loss | 54.8576 | 49.5488 | 54.8576 | 53.0880 | 54.8576 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 54.8576 | 53.0880 | 54.8576 | (59) |
| Combi loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |
| Total heat required for water heating calculated for each month | 332.5674 | 294.7000 | 314.1545 | 278.3137 | 271.3196 | 215.5326 | 212.2716 | 220.9024 | 223.5691 | 281.4881 | 297.0508 | 329.1711 | (62) |
| WWHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63a) |
| PV diverter | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |
| Output from w/h | 332.5674 | 294.7000 | 314.1545 | 278.3137 | 271.3196 | 215.5326 | 212.2716 | 220.9024 | 223.5691 | 281.4881 | 297.0508 | 329.1711 | (64) |
| | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 3271.0410 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 3271 | (64) |
| Electric shower(s) | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |
| Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | | | | | | | | | | | | 0.0000 | (64a) |

Heat gains from water heating, kWh/month

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 124.9688 | 110.9853 | 118.8465 | 106.4652 | 104.6039 | 71.2963 | 70.1997 | 73.0694 | 73.9684 | 107.9849 | 112.6953 | 123.8395 | (65) |

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5. Internal gains (see Table 5 and 5a)
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Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 152.8232 | 152.8232 | 152.8232 | 152.8232 | 152.8232 | 152.8232 | 152.8232 | 152.8232 | 152.8232 | 152.8232 | 152.8232 | 152.8232 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 244.2678 | 270.4393 | 244.2678 | 252.4100 | 244.2678 | 252.4100 | 244.2678 | 244.2678 | 252.4100 | 244.2678 | 252.4100 | 244.2678 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 409.3513 | 413.5991 | 402.8948 | 380.1066 | 351.3407 | 324.3048 | 306.2431 | 301.9953 | 312.6996 | 335.4877 | 364.2537 | 391.2896 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 38.2823 | 38.2823 | 38.2823 | 38.2823 | 38.2823 | 38.2823 | 38.2823 | 38.2823 | 38.2823 | 38.2823 | 38.2823 | 38.2823 | (69) |
| Pumps, fans | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | | | | | | | | | | | | | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | -122.2586 | -122.2586 | -122.2586 | -122.2586 | -122.2586 | -122.2586 | -122.2586 | -122.2586 | -122.2586 | -122.2586 | -122.2586 | (71) |
| Water heating gains (Table 5) | | | | | | | | | | | | |
| | 167.9688 | 165.1567 | 159.7399 | 147.8684 | 140.5967 | 99.0226 | 94.3544 | 98.2116 | 102.7339 | 145.1410 | 156.5213 | 166.4510 (72) |
| Total internal gains | | | | | | | | | | | | |
| | 890.4348 | 918.0420 | 875.7495 | 849.2320 | 805.0521 | 744.5843 | 713.7123 | 713.3217 | 736.6904 | 793.7435 | 842.0320 | 870.8554 (73) |

## 6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| North | 15.0300 | 10.6334 | 0.4500 | 0.7000 | 0.7700 | 34.8879 | (74) |
| Southeast | 1.0100 | 36.7938 | 0.4500 | 0.7000 | 0.7700 | 8.1122 | (77) |
| South | 7.5100 | 46.7521 | 0.4500 | 0.7000 | 0.7700 | 76.6451 | (78) |
| Southwest | 1.0100 | 36.7938 | 0.4500 | 0.7000 | 0.7700 | 8.1122 | (79) |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 127.7575 | 219.8337 | 311.0026 | 409.5476 | 485.9379 | 495.7605 | 472.3151 | 412.3809 | 344.1892 | 245.2993 | 153.3225 | 109.1975 (83) |
| Total gains | 1018.1923 | 1137.8758 | 1186.7520 | 1258.7796 | 1290.9900 | 1240.3448 | 1186.0274 | 1125.7026 | 1080.8797 | 1039.0428 | 995.3545 | 980.0528 (84) |

## 7. Mean internal temperature (heating season)

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

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| tau | 34.9847 | 35.0705 | 35.1550 | 35.5574 | 35.6337 | 35.9933 | 35.9933 | 36.0607 | 35.8540 | 35.6337 | 35.4797 | 35.3200 | |
| alpha | 3.3323 | 3.3380 | 3.3437 | 3.3705 | 3.3756 | 3.3996 | 3.3996 | 3.4040 | 3.3903 | 3.3756 | 3.3653 | 3.3547 | |
| util living area | | | | | | | | | | | | | |
| | 0.9910 | 0.9861 | 0.9788 | 0.9586 | 0.9142 | 0.8225 | 0.6933 | 0.7336 | 0.8861 | 0.9628 | 0.9855 | 0.9921 | (86) |
| Living | 19.2056 | 19.3616 | 19.6108 | 19.9859 | 20.3558 | 20.6636 | 20.8143 | 20.7905 | 20.5540 | 20.0958 | 19.5984 | 19.1871 | |
| Non living | 17.9803 | 18.1809 | 18.5004 | 18.9830 | 19.4459 | 19.8175 | 19.9732 | 19.9542 | 19.6941 | 19.1261 | 18.4910 | 17.9619 | |
| 24 / 16 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 24 / 9 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 16 / 9 | 26 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 31 | |
| MIT | 20.1476 | 19.4377 | 19.6108 | 19.9859 | 20.3558 | 20.6636 | 20.8143 | 20.7905 | 20.5540 | 20.0958 | 19.5984 | 19.9732 | (87) |
| Th 2 | 20.1293 | 20.1313 | 20.1332 | 20.1422 | 20.1438 | 20.1517 | 20.1517 | 20.1531 | 20.1487 | 20.1438 | 20.1404 | 20.1369 | (88) |
| util rest of house | | | | | | | | | | | | | |
| | 0.9895 | 0.9837 | 0.9748 | 0.9498 | 0.8928 | 0.7707 | 0.5986 | 0.6458 | 0.8494 | 0.9533 | 0.9826 | 0.9908 | (89) |
| MIT 2 | 19.3338 | 18.2976 | 18.5004 | 18.9830 | 19.4459 | 19.8175 | 19.9732 | 19.9542 | 19.6941 | 19.1261 | 18.4910 | 19.1769 | (90) |
| Living area fraction | | | | | | | | | | fLA = Living area / (4) = | | 0.1742 | (91) |
| MIT | 19.4755 | 18.4962 | 18.6938 | 19.1576 | 19.6044 | 19.9648 | 20.1197 | 20.0999 | 19.8439 | 19.2950 | 18.6839 | 19.3156 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 19.4755 | 18.4962 | 18.6938 | 19.1576 | 19.6044 | 19.9648 | 20.1197 | 20.0999 | 19.8439 | 19.2950 | 18.6839 | 19.3156 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9881 | 0.9774 | 0.9657 | 0.9366 | 0.8761 | 0.7572 | 0.5946 | 0.6394 | 0.8331 | 0.9406 | 0.9756 | 0.9892 | (94) |
| Useful gains | 1006.0416 | 1112.1951 | 1146.0545 | 1178.9650 | 1131.0392 | 939.2424 | 705.2358 | 719.8272 | 900.4427 | 977.2994 | 971.0280 | 969.4783 | (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 | | | | | | | | | | | | | |
| | 3470.2084 | 3101.4542 | 2774.8713 | 2307.8510 | 1774.5895 | 1192.4071 | 782.3033 | 820.8066 | 1281.6235 | 1952.0816 | 2611.9483 | 3423.6898 | (97) |
| Space heating kWh | | | | | | | | | | | | | |
| | 1833.3401 | 1336.7821 | 1211.8397 | 812.7979 | 478.8014 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 725.2380 | 1181.4626 | 1825.9334 | (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 9406.1953 | |
| Solar heating kWh | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 | |
| Space heating kWh | | | | | | | | | | | | | |
| | 1833.3401 | 1336.7821 | 1211.8397 | 812.7979 | 478.8014 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 725.2380 | 1181.4626 | 1825.9334 | (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 9406.1953 | |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 38.8766 | (99) |

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

| | | |
|---|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | 0.0000 | (201) |
| Fraction of space heat from main system(s) | 1.0000 | (202) |
| Efficiency of main space heating system 1 (in %) | 318.2543 | (206) |
| Efficiency of main space heating system 2 (in %) | 0.0000 | (207) |
| Efficiency of secondary/supplementary heating system, % | 0.0000 | (208) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement | | | | | | | | | | | | | |
| | 1833.3401 | 1336.7821 | 1211.8397 | 812.7979 | 478.8014 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 725.2380 | 1181.4626 | 1825.9334 | (98) |
| Space heating efficiency (main heating system 1) | | | | | | | | | | | | | |
| | 318.2543 | 318.2543 | 318.2543 | 318.2543 | 318.2543 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 318.2543 | 318.2543 | 318.2543 | (210) |
| Space heating fuel (main heating system) | | | | | | | | | | | | | |
| | 576.0614 | 420.0359 | 380.7772 | 255.3926 | 150.4462 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 227.8801 | 371.2323 | 573.7341 | (211) |
| Space heating efficiency (main heating system 2) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (212) |
| Space heating fuel (main heating system 2) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (213) |
| Space heating fuel (secondary) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (215) |
| Water heating | | | | | | | | | | | | | |
| Water heating requirement | | | | | | | | | | | | | |
| | 332.5674 | 294.7000 | 314.1545 | 278.3137 | 271.3196 | 215.5326 | 212.2716 | 220.9024 | 223.5691 | 281.4881 | 297.0508 | 329.1711 | (64) |
| Efficiency of water heater | | | | | | | | | | | | 312.1577 | (216) |
| (217)m | 312.1577 | 312.1577 | 312.1577 | 312.1577 | 312.1577 | 312.1577 | 312.1577 | 312.1577 | 312.1577 | 312.1577 | 312.1577 | 312.1577 | (217) |
| Fuel for water heating, kWh/month | | | | | | | | | | | | | |
| | 106.5383 | 94.4074 | 100.6397 | 89.1580 | 86.9175 | 69.0461 | 68.0014 | 70.7663 | 71.6206 | 90.1750 | 95.1605 | 105.4503 | (219) |
| Space cooling fuel requirement | | | | | | | | | | | | | |
| (221)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (221) |
| Pumps and Fa | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (231) |
| Lighting | 59.3671 | 47.6265 | 42.8824 | 31.4175 | 24.2678 | 19.8270 | 22.1379 | 28.7756 | 37.3767 | 49.0403 | 55.3909 | 61.0171 | (232) |

Electricity generated by PVs (Appendix M) (negative quantity)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (233a)m | -71.8680 | -113.8929 | -184.4650 | -221.1863 | -235.7322 | -189.5720 | -186.2759 | -174.3500 | -150.4849 | -132.4417 | -81.2449 | -60.0693 (233a) |

Electricity generated by wind turbines (Appendix M) (negative quantity)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (234a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (234a) |

Electricity generated by hydro-electric generators (Appendix M) (negative quantity)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (235a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (235a) |

Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (235c)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (235c) |

Electricity generated by PVs (Appendix M) (negative quantity)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (233b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (233b) |

Electricity generated by wind turbines (Appendix M) (negative quantity)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (234b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (234b) |

Electricity generated by hydro-electric generators (Appendix M) (negative quantity)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (235b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (235b) |

Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (235d)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (235d) |

Annual totals kWh/year

| | |
|---|---|
| Space heating fuel - main system 1 | 2955.5598 (211) |
| Space heating fuel - main system 2 | 0.0000 (213) |
| Space heating fuel - secondary | 0.0000 (215) |
| Efficiency of water heater | 312.1577 |
| Water heating fuel used | 1047.8809 (219) |
| Space cooling fuel | 0.0000 (221) |
| | |
| Electricity for pumps and fans: | |
| Total electricity for the above, kWh/year | 0.0000 (231) |
| Electricity for lighting (calculated in Appendix L) | 479.1268 (232) |
| | |
| Energy saving/generation technologies (Appendices M ,N and Q) | |
| PV generation | -1801.5832 (233) |
| Wind generation | 0.0000 (234) |
| Hydro-electric generation (Appendix N) | 0.0000 (235a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 (235) |
| Appendix Q - special features | |
| Energy saved or generated | -0.0000 (236) |
| Energy used | 0.0000 (237) |
| Total delivered energy for all uses | 2680.9843 (238) |

---

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

---

| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 2955.5598 | 0.1544 | 456.3091 | (261) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 1047.8809 | 0.1416 | 148.4101 | (264) |
| Space and water heating | | | 604.7193 | (265) |
| Pumps, fans and electric keep-hot | 0.0000 | 0.0000 | 0.0000 | (267) |
| Energy for lighting | 479.1268 | 0.1443 | 69.1528 | (268) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -1801.5832 | 0.1345 | -242.2898 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -242.2898 | (269) |
| Total CO2, kg/year | | | 431.5823 | (272) |
| EPC Dwelling Carbon Dioxide Emission Rate (DER) | | | 1.7800 | (273) |

---

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

---

| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 2955.5598 | 1.5716 | 4644.8714 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 1047.8809 | 1.5237 | 1596.7001 | (278) |
| Space and water heating | | | 6241.5716 | (279) |
| Pumps, fans and electric keep-hot | 0.0000 | 0.0000 | 0.0000 | (281) |
| Energy for lighting | 479.1268 | 1.5338 | 734.9007 | (282) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -1801.5832 | 1.4971 | -2697.1084 | |
| PV Unit electricity exported | 0.0000 | 0.0000 | 0.0000 | |
| Total | | | -2697.1084 | (283) |
| Total Primary energy kWh/year | | | 4279.3638 | (286) |
| Dwelling Primary energy Rate (DPER) | | | 17.6900 | (287) |

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SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)
CALCULATION OF TARGET EMISSIONS

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1. Overall dwelling characteristics

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| | Area (m2) | | Storey height (m) | | | Volume (m3) | |
|---|---|---|---|---|---|---|---|
| Main dwelling | | | | | | | |
| Ground floor | 87.6500 | (1b) | x 2.4000 | (2b) | = | 210.3600 | (1b) - (3b) |
| First floor | 95.0000 | (1c) | x 2.7500 | (2c) | = | 261.2500 | (1c) - (3c) |
| Second floor | 59.3000 | (1d) | x 2.0000 | (2d) | = | 118.6000 | (1d) - (3d) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 241.9500 | | | | | | (4) |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | | = | 590.2100 | (5) |

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2. Ventilation rate

---

m3 per hour

| | | | |
|---|---|---|---|
| Number of open chimneys | 0 * 80 = | 0.0000 | (6a) |
| Number of open flues | 0 * 20 = | 0.0000 | (6b) |
| Number of chimneys / flues attached to closed fire | 0 * 10 = | 0.0000 | (6c) |
| Number of flues attached to solid fuel boiler | 0 * 20 = | 0.0000 | (6d) |
| Number of flues attached to other heater | 0 * 35 = | 0.0000 | (6e) |
| Number of blocked chimneys | 0 * 20 = | 0.0000 | (6f) |
| Number of intermittent extract fans | 4 * 10 = | 40.0000 | (7a) |
| Number of passive vents | 0 * 10 = | 0.0000 | (7b) |
| Number of flueless gas fires | 0 * 40 = | 0.0000 | (7c) |

| | | Air changes per hour | |
|---|---|---|---|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 40.0000 / (5) = | 0.0678 | (8) |
| Pressure test | | Yes | |
| Pressure Test Method | | Blower Door | |
| Measured/design AP50 | | 5.0000 | (17) |
| Infiltration rate | | 0.3178 | (18) |
| Number of sides sheltered | | 0 | (19) |
| Shelter factor | (20) = 1 - [0.075 x (19)] = | 1.0000 | (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = | 0.3178 | (21) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wind speed | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 | (22) |
| Wind factor | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 | (22a) |
| Adj infilt rate | 0.4052 | 0.3972 | 0.3893 | 0.3495 | 0.3416 | 0.3019 | 0.3019 | 0.2939 | 0.3178 | 0.3416 | 0.3575 | 0.3734 | (22b) |
| Effective ac | 0.5821 | 0.5789 | 0.5758 | 0.5611 | 0.5583 | 0.5456 | 0.5456 | 0.5432 | 0.5505 | 0.5583 | 0.5639 | 0.5697 | (25) |

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## 3. Heat losses and heat loss parameter

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| Element | Gross | Openings | NetArea | U-value | A x U | K-value | A x K | |
|---|---|---|---|---|---|---|---|---|
| Main dwelling | m2 | m2 | m2 | W/m2K | W/K | kJ/m2K | kJ/K | |
| TER Opaque door | | | 2.0600 | 1.0000 | 2.0600 | | | (26) |
| TER Opening Type | | | 24.5600 | 1.1450 | 28.1221 | | | (27) |
| Ground Floor | | | 87.6500 | 0.1300 | 11.3945 | | | (28a) |
| Exposed Floor (above garage) | | | 18.6000 | 0.1300 | 2.4180 | | | (28b) |
| Exposed Floor (front) | | | 2.7000 | 0.1300 | 0.3510 | | | (28b) |
| External Wall 1 | 221.9400 | 21.8700 | 200.0700 | 0.1800 | 36.0126 | | | (29a) |
| Dormer Walls | 8.3000 | 4.7500 | 3.5500 | 0.1800 | 0.6390 | | | (29a) |
| Main Roof | 56.9000 | | 56.9000 | 0.1100 | 6.2590 | | | (30) |
| Side Roof | 18.6000 | | 18.6000 | 0.1100 | 2.0460 | | | (30) |
| Dormer Roofs | 3.9000 | | 3.9000 | 0.1100 | 0.4290 | | | (30) |
| Insulated Ceiling 1F | 15.2000 | | 15.2000 | 0.1100 | 1.6720 | | | (30) |
| GF Roof (rear) | 13.8000 | | 13.8000 | 0.1100 | 1.5180 | | | (30) |
| GF Roof (Bay window) | 2.6900 | | 2.6900 | 0.1100 | 0.2959 | | | (30) |
| Total net area of external elements Aum(A, m2) | | | 450.2800 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 93.2171 | | | (33) |

| | | |
|---|---|---|
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | 119.0329 | (35) |

List of Thermal Bridges

| | Length | Psi-value | Total |
|---|---|---|---|
| K1 Element | | | |
| E2 Other lintels (including other steel lintels) | 19.5400 | 0.0500 | 0.9770 |
| E3 Sill | 18.5600 | 0.0500 | 0.9280 |
| E4 Jamb | 42.0400 | 0.0500 | 2.1020 |
| E5 Ground floor (normal) | 42.4000 | 0.1600 | 6.7840 |
| E6 Intermediate floor within a dwelling | 17.5000 | 0.0000 | 0.0000 |
| E6 Intermediate floor within a dwelling | 29.0000 | 0.0000 | 0.0000 |
| E16 Corner (normal) | 28.5000 | 0.0900 | 2.5650 |
| E17 Corner (inverted - internal area greater than external area) | 7.9000 | -0.0900 | -0.7110 |
| E24 Eaves (insulation at ceiling level - inverted) | 6.4000 | 0.2400 | 1.5360 |
| E24 Eaves (insulation at ceiling level - inverted) | 3.1500 | 0.2400 | 0.7560 |
| E10 Eaves (insulation at ceiling level) | 6.4000 | 0.0600 | 0.3840 |
| E10 Eaves (insulation at ceiling level) | 4.3500 | 0.0600 | 0.2610 |
| E12 Gable (insulation at ceiling level) | 4.3000 | 0.0600 | 0.2580 |
| E20 Exposed floor (normal) | 3.7500 | 0.3200 | 1.2000 |
| E20 Exposed floor (normal) | 12.8500 | 0.3200 | 4.1120 |
| E21 Exposed floor (inverted) | 3.7500 | 0.3200 | 1.2000 |
| E21 Exposed floor (inverted) | 6.1000 | 0.3200 | 1.9520 |
| E11 Eaves (insulation at rafter level) | 6.8000 | 0.0400 | 0.2720 |
| E13 Gable (insulation at rafter level) | 6.1000 | 0.0800 | 0.4880 |
| E14 Flat roof | 4.9000 | 0.0800 | 0.3920 |
| R7 Flat ceiling (inverted) | 2.5000 | 0.0400 | 0.1000 |
| R6 Flat ceiling | 23.1000 | 0.0600 | 1.3860 |
| E13 Gable (insulation at rafter level) | 3.0500 | 0.0800 | 0.2440 |
| E14 Flat roof | 4.5000 | 0.0800 | 0.3600 |
| R7 Flat ceiling (inverted) | 1.8000 | 0.0400 | 0.0720 |

| | | |
|---|---|---|
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) | 27.6180 | (36) |
| Point Thermal bridges | (36a) = 0.0000 | |
| Total fabric heat loss | (33) + (36) + (36a) = 120.8351 | (37) |

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (38)m | 113.3708 | 112.7500 | 112.1416 | 109.2836 | 108.7489 | 106.2597 | 106.2597 | 105.7987 | 107.2185 | 108.7489 | 109.8306 | 110.9615 | (38) |
| Heat transfer coeff | 234.2059 | 233.5852 | 232.9767 | 230.1187 | 229.5840 | 227.0948 | 227.0948 | 226.6339 | 228.0536 | 229.5840 | 230.6657 | 231.7966 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 230.1162 | |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 0.9680 | 0.9654 | 0.9629 | 0.9511 | 0.9489 | 0.9386 | 0.9386 | 0.9367 | 0.9426 | 0.9489 | 0.9534 | 0.9580 | (40) |
| HLP (average) | | | | | | | | | | | | 0.9511 | |
| Days in mont | 31 | 28 | 31 | 30 | 31 | 30 | 31 | 31 | 30 | 31 | 30 | 31 | |

---

## 4. Water heating energy requirements (kWh/year)

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| | | |
|---|---|---|
| Assumed occupancy | 3.0565 | (42) |

Hot water usage for mixer showers

| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 75.4667 | 74.3326 | 72.6800 | 69.5180 | 67.1845 | 64.5822 | 63.1031 | 64.7432 | 66.5411 | 69.3351 | 72.5651 | 75.1776 | (42a) |

Hot water usage for baths

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 32.5764 | 32.0926 | 31.4113 | 30.1551 | 29.2145 | 28.1715 | 27.6081 | 28.2846 | 29.0212 | 30.1373 | 31.4194 | 32.4663 | (42b) |

Hot water usage for other uses

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 45.9313 | 44.2610 | 42.5908 | 40.9206 | 39.2503 | 37.5801 | 37.5801 | 39.2503 | 40.9206 | 42.5908 | 44.2610 | 45.9313 | (42c) |

| | | |
|---|---|---|
| Average daily hot water use (litres/day) | 141.5369 | (43) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | | | | | | | | | | | | | |
| | 153.9744 | 150.6862 | 146.6821 | 140.5937 | 135.6493 | 130.3338 | 128.2913 | 132.2782 | 136.4829 | 142.0632 | 148.2455 | 153.5751 | (44) |
| Energy conte | 243.8578 | 214.5752 | 225.4449 | 192.4657 | 182.6100 | 160.2606 | 155.1572 | 163.7880 | 168.2971 | 192.7785 | 211.2028 | 240.4615 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 2350.8994 | |
| Distribution loss (46)m = 0.15 x (45)m | | | | | | | | | | | | | |
| | 36.5787 | 32.1863 | 33.8167 | 28.8699 | 27.3915 | 24.0391 | 23.2736 | 24.5682 | 25.2446 | 28.9168 | 31.6804 | 36.0692 | (46) |
| Water storage loss (or HIU loss): | | | | | | | | | | | | | |
| Store volume | | | | | | | | | | | | 150.0000 | (47) |
| a) If manufacturer declared loss factor is known (kWh/day): | | | | | | | | | | | | 1.3938 | (48) |
| Temperature factor from Table 2b | | | | | | | | | | | | 0.5400 | (49) |
| Enter (49) or (54) in (55) | | | | | | | | | | | | 0.7527 | (55) |
| Total storage loss | | | | | | | | | | | | | |
| | 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (56) |
| If cylinder contains dedicated solar storage | | | | | | | | | | | | | |
| | 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (57) |
| Primary loss | 23.2624 | 21.0112 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | 23.2624 | 22.5120 | 23.2624 | 22.5120 | 23.2624 | (59) |
| Combi loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (61) |
| Total heat required for water heating calculated for each month | | | | | | | | | | | | | |
| | 290.4527 | 256.6609 | 272.0398 | 237.5575 | 229.2050 | 205.3525 | 201.7521 | 210.3829 | 213.3889 | 239.3734 | 256.2947 | 287.0564 | (62) |
| WWHRS | -34.5002 | -30.5123 | -31.9507 | -26.4565 | -24.6565 | -21.0987 | -19.7767 | -21.0305 | -21.8295 | -25.7346 | -29.1542 | -33.8614 | (63a) |
| PV diverter | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | -0.0000 | (63b) |
| Solar input | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63c) |
| FGHRS | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (63d) |
| Output from w/h | | | | | | | | | | | | | |
| | 255.9525 | 226.1486 | 240.0891 | 211.1011 | 204.5485 | 184.2537 | 181.9754 | 189.3524 | 191.5594 | 213.6387 | 227.1405 | 253.1951 | (64) |
| | | | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | 2578.9549 | (64) |
| 12Total per year (kWh/year) | | | | | | | | | | | | 2579 | (64) |
| Electric shower(s) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (64a) |
| | | | | | | Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | | | | | | 0.0000 | (64a) |
| Heat gains from water heating, kWh/month | | | | | | | | | | | | | |
| | 118.3586 | 105.0148 | 112.2364 | 100.0683 | 97.9938 | 89.3601 | 88.8657 | 91.7354 | 92.0322 | 101.3748 | 106.2984 | 117.2294 | (65) |

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

| Metabolic gains (Table 5), Watts | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 152.8232 | 152.8232 | 152.8232 | 152.8232 | 152.8232 | 152.8232 | 152.8232 | 152.8232 | 152.8232 | 152.8232 | 152.8232 | 152.8232 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | | | | | | | | | | | | | |
| | 237.6649 | 263.1290 | 237.6649 | 245.5871 | 237.6649 | 245.5871 | 237.6649 | 237.6649 | 245.5871 | 237.6649 | 245.5871 | 237.6649 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | | | | | | | | | | | | | |
| | 409.3513 | 413.5991 | 402.8948 | 380.1066 | 351.3407 | 324.3048 | 306.2431 | 301.9953 | 312.6996 | 335.4877 | 364.2537 | 391.2896 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | | | | | | | | | | | | | |
| | 38.2823 | 38.2823 | 38.2823 | 38.2823 | 38.2823 | 38.2823 | 38.2823 | 38.2823 | 38.2823 | 38.2823 | 38.2823 | 38.2823 | (69) |
| Pumps, fans | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 3.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 3.0000 | 3.0000 | 3.0000 | (70) |
| Losses e.g. evaporation (negative values) (Table 5) | | | | | | | | | | | | | |
| | -122.2586 | -122.2586 | -122.2586 | -122.2586 | -122.2586 | -122.2586 | -122.2586 | -122.2586 | -122.2586 | -122.2586 | -122.2586 | -122.2586 | (71) |
| Water heating gains (Table 5) | | | | | | | | | | | | | |
| | 159.0842 | 156.2721 | 150.8553 | 138.9838 | 131.7120 | 124.1113 | 119.4431 | 123.3003 | 127.8226 | 136.2564 | 147.6367 | 157.5664 | (72) |
| Total internal gains | | | | | | | | | | | | | |
| | 877.9474 | 904.8471 | 863.2620 | 836.5245 | 792.5646 | 762.8501 | 732.1981 | 731.8075 | 754.9562 | 781.2560 | 829.3244 | 858.3679 | (73) |

## 6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| North | 15.0300 | 10.6334 | 0.6300 | 0.7000 | 0.7700 | 48.8430 | (74) |
| Southeast | 1.0100 | 36.7938 | 0.6300 | 0.7000 | 0.7700 | 11.3571 | (77) |
| South | 7.5100 | 46.7521 | 0.6300 | 0.7000 | 0.7700 | 107.3032 | (78) |
| Southwest | 1.0100 | 36.7938 | 0.6300 | 0.7000 | 0.7700 | 11.3571 | (79) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 178.8604 | 307.7672 | 435.4036 | 573.3666 | 680.3131 | 694.0647 | 661.2412 | 577.3333 | 481.8649 | 343.4191 | 214.6514 | 152.8764 | (83) |
| Total gains | 1056.8078 | 1212.6144 | 1298.6656 | 1409.8911 | 1472.8777 | 1456.9148 | 1393.4393 | 1309.1408 | 1236.8211 | 1124.6751 | 1043.9759 | 1011.2443 | (84) |

## 7. Mean internal temperature (heating season)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Temperature during heating periods in the living area from Table 9, Th1 (C) | | | | | | | | | | | | 21.0000 | (85) |
| Utilisation factor for gains for living area, ni1,m (see Table 9a) | | | | | | | | | | | | | |
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
| tau | 34.1580 | 34.2488 | 34.3382 | 34.7647 | 34.8456 | 35.2276 | 35.2276 | 35.2992 | 35.0795 | 34.8456 | 34.6822 | 34.5130 | |
| alpha | 3.2772 | 3.2833 | 3.2892 | 3.3176 | 3.3230 | 3.3485 | 3.3485 | 3.3533 | 3.3386 | 3.3230 | 3.3121 | 3.3009 | |
| util living area | | | | | | | | | | | | | |
| | 0.9899 | 0.9834 | 0.9730 | 0.9455 | 0.8870 | 0.7691 | 0.6299 | 0.6762 | 0.8522 | 0.9549 | 0.9835 | 0.9913 | (86) |
| MIT | 18.7034 | 18.9395 | 19.3021 | 19.8300 | 20.3315 | 20.7305 | 20.9017 | 20.8726 | 20.5801 | 19.9403 | 19.2444 | 18.6744 | (87) |
| Th 2 | 20.1101 | 20.1122 | 20.1144 | 20.1243 | 20.1261 | 20.1348 | 20.1348 | 20.1364 | 20.1315 | 20.1261 | 20.1224 | 20.1185 | (88) |
| util rest of house | | | | | | | | | | | | | |
| | 0.9882 | 0.9805 | 0.9680 | 0.9342 | 0.8607 | 0.7103 | 0.5337 | 0.5845 | 0.8086 | 0.9435 | 0.9801 | 0.9898 | (89) |
| MIT 2 | 17.3756 | 17.6782 | 18.1416 | 18.8151 | 19.4359 | 19.9041 | 20.0735 | 20.0516 | 19.7420 | 18.9607 | 18.0752 | 17.3436 | (90) |
| Living area fraction | | | | | | | | | fLA = Living area / (4) = | | | 0.1742 | (91) |
| MIT | 17.6068 | 17.8979 | 18.3437 | 18.9918 | 19.5919 | 20.0481 | 20.2177 | 20.1946 | 19.8880 | 19.1313 | 18.2789 | 17.5753 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 17.6068 | 17.8979 | 18.3437 | 18.9918 | 19.5919 | 20.0481 | 20.2177 | 20.1946 | 19.8880 | 19.1313 | 18.2789 | 17.5753 | (93) |

## 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9807 | 0.9699 | 0.9538 | 0.9151 | 0.8411 | 0.7036 | 0.5437 | 0.5913 | 0.7939 | 0.9259 | 0.9696 | 0.9832 | (94) |
| Useful gains | 1036.4287 | 1176.1196 | 1238.6649 | 1290.2381 | 1238.8456 | 1025.0758 | 757.6584 | 774.0906 | 981.8937 | 1041.3112 | 1012.2403 | 994.2277 | (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 | | | | | | | | | | | | | |
| | 3116.5392 | 3036.1059 | 2759.3048 | 2322.3189 | 1811.8530 | 1237.2244 | 821.5681 | 859.9764 | 1319.9750 | 1958.6540 | 2578.5818 | 3100.3587 | (97) |
| Space heating kWh | | | | | | | | | | | | | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1547.6022 | 1249.9108 | 1131.3561 | 743.0981 | 426.3175 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 682.5031 | 1127.7659 | 1566.9614 (98a) |
| Space heating requirement - total per year (kWh/year) | | | | | | | | | | | | 8475.5152 |
| Solar heating kWh | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 (98b) |
| Solar heating contribution - total per year (kWh/year) | | | | | | | | | | | | 0.0000 |
| Space heating kWh | | | | | | | | | | | | |
| | 1547.6022 | 1249.9108 | 1131.3561 | 743.0981 | 426.3175 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 682.5031 | 1127.7659 | 1566.9614 (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) | | | | | | | | | | | | 8475.5152 |
| Space heating per m2 | | | | | | | | | | | (98c) / (4) = | 35.0300 (99) |

---

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

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| | |
|---|---|
| Fraction of space heat from secondary/supplementary system (Table 11) | 0.0000 (201) |
| Fraction of space heat from main system(s) | 1.0000 (202) |
| Efficiency of main space heating system 1 (in %) | 92.3000 (206) |
| Efficiency of main space heating system 2 (in %) | 0.0000 (207) |
| Efficiency of secondary/supplementary heating system, % | 0.0000 (208) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement | | | | | | | | | | | | | |
| | 1547.6022 | 1249.9108 | 1131.3561 | 743.0981 | 426.3175 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 682.5031 | 1127.7659 | 1566.9614 | (98) |
| Space heating efficiency (main heating system 1) | | | | | | | | | | | | | |
| | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 92.3000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 92.3000 | 92.3000 | 92.3000 | (210) |
| Space heating fuel (main heating system) | | | | | | | | | | | | | |
| | 1676.7088 | 1354.1829 | 1225.7379 | 805.0901 | 461.8824 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 739.4400 | 1221.8482 | 1697.6830 | (211) |
| Space heating efficiency (main heating system 2) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (212) |
| Space heating fuel (main heating system 2) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (213) |
| Space heating fuel (secondary) | | | | | | | | | | | | | |
| | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (215) |
| Water heating | | | | | | | | | | | | | |
| Water heating requirement | | | | | | | | | | | | | |
| | 255.9525 | 226.1486 | 240.0891 | 211.1011 | 204.5485 | 184.2537 | 181.9754 | 189.3524 | 191.5594 | 213.6387 | 227.1405 | 253.1951 | (64) |
| Efficiency of water heater | | | | | | | | | | | | 79.8000 | (216) |
| (217)m | 87.4011 | 87.2916 | 87.0807 | 86.6383 | 85.6673 | 79.8000 | 79.8000 | 79.8000 | 79.8000 | 86.4749 | 87.1522 | 87.4284 | (217) |
| Fuel for water heating, kWh/month | | | | | | | | | | | | | |
| | 292.8481 | 259.0725 | 275.7088 | 243.6580 | 238.7707 | 230.8944 | 228.0394 | 237.2837 | 240.0493 | 247.0528 | 260.6250 | 289.6029 | (219) |
| Space cooling fuel requirement | | | | | | | | | | | | | |
| (221)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (221) |
| Pumps and Fa | 7.3041 | 6.5973 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 | 7.3041 | 7.0685 | 7.3041 | 7.0685 | 7.3041 | (231) |
| Lighting | 49.3821 | 39.6161 | 35.6699 | 26.1333 | 20.1861 | 16.4922 | 18.4145 | 23.9358 | 31.0903 | 40.7921 | 46.0746 | 50.7546 | (232) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (233a)m | -78.0335 | -107.9934 | -152.2807 | -167.6726 | -177.6271 | -164.4100 | -162.1740 | -154.5717 | -140.8095 | -121.6596 | -84.9914 | -67.6862 | (233a) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (234a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (234a) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (235a)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235a) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | | |
| (235c)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235c) |
| Electricity generated by PVs (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (233b)m | -50.3034 | -105.0877 | -207.6444 | -310.1978 | -408.6940 | -410.3401 | -405.7005 | -344.3128 | -253.3161 | -149.9394 | -67.0249 | -39.8499 | (233b) |
| Electricity generated by wind turbines (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (234b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (234b) |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity) | | | | | | | | | | | | | |
| (235b)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235b) |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | | | | | | | | | | | | | |
| (235d)m | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (235d) |

| | |
|---|---|
| Annual totals kWh/year | |
| Space heating fuel - main system 1 | 9182.5733 (211) |
| Space heating fuel - main system 2 | 0.0000 (213) |
| Space heating fuel - secondary | 0.0000 (215) |
| Efficiency of water heater | 79.8000 |
| Water heating fuel used | 3043.6055 (219) |
| Space cooling fuel | 0.0000 (221) |
| | |
| Electricity for pumps and fans: | |
| Total electricity for the above, kWh/year | 86.0000 (231) |
| Electricity for lighting (calculated in Appendix L) | 398.5416 (232) |
| | |
| Energy saving/generation technologies (Appendices M ,N and Q) | |
| PV generation | -4332.3209 (233) |
| Wind generation | 0.0000 (234) |
| Hydro-electric generation (Appendix N) | 0.0000 (235a) |
| Electricity generated - Micro CHP (Appendix N) | 0.0000 (235) |
| Appendix Q - special features | |
| Energy saved or generated | -0.0000 (236) |
| Energy used | 0.0000 (237) |
| Total delivered energy for all uses | 8378.3996 (238) |

---

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

---

| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 9182.5733 | 0.2100 | 1928.3404 | (261) |
| Total CO2 associated with community systems | | | 0.0000 | (373) |
| Water heating (other fuel) | 3043.6055 | 0.2100 | 639.1571 | (264) |
| Space and water heating | | | 2567.4975 | (265) |
| Pumps, fans and electric keep-hot | 86.0000 | 0.1387 | 11.9293 | (267) |
| Energy for lighting | 398.5416 | 0.1443 | 57.5219 | (268) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -1579.9096 | 0.1350 | -213.3549 | |
| PV Unit electricity exported | -2752.4112 | 0.1260 | -346.9213 | |
| Total | | | -560.2762 | (269) |
| Total CO2, kg/year | | | 2076.6725 | (272) |
| EPC Target Carbon Dioxide Emission Rate (TER) | | | 8.5800 | (273) |

---

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

---

| | Energy kWh/year | Primary energy factor kg CO2/kWh | Primary energy kWh/year | |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| Space heating - main system 1 | 9182.5733 | 1.1300 | 10376.3078 | (275) |
| Total CO2 associated with community systems | | | 0.0000 | (473) |
| Water heating (other fuel) | 3043.6055 | 1.1300 | 3439.2742 | (278) |
| Space and water heating | | | 13815.5820 | (279) |
| Pumps, fans and electric keep-hot | 86.0000 | 1.5128 | 130.1008 | (281) |
| Energy for lighting | 398.5416 | 1.5338 | 611.2964 | (282) |
| | | | | |
| Energy saving/generation technologies | | | | |
| PV Unit electricity used in dwelling | -1579.9096 | 1.4991 | -2368.4740 | |
| PV Unit electricity exported | -2752.4112 | 0.4627 | -1273.4549 | |
| Total | | | -3641.9289 | (283) |
| Total Primary energy kWh/year | | | 10915.0504 | (286) |
| Target Primary Energy Rate (TPER) | | | 45.1100 | (287) |

HODKINSON

# Appendix D

BRUKL Worksheets

# BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2021

**Project name**

## Land West of Worthing - Care Home

As designed

**Date:** Fri Jan 16 14:17:50 2026

## Administrative information

### Building Details

**Address:**

### Certification tool

**Calculation engine:** SBEM

**Calculation engine version:** v6.1.e.2

**Interface to calculation engine:** DesignBuilder SBEM

**Interface to calculation engine version:** v7.3.1

**BRUKL compliance module version:** v6.1.e.1

### Certifier details

**Name:**

**Telephone number:**

**Address:** , ,

**Foundation area [m²]:** 1162.42

## The $CO_2$ emission and primary energy rates of the building must not exceed the targets

| | | |
|---|---|---|
| Target $CO_2$ emission rate (TER), $kgCO_2/m^2$.annum | 16.22 | |
| Building $CO_2$ emission rate (BER), $kgCO_2/m^2$.annum | 10.46 | |
| Target primary energy rate (TPER), $kWh_{PE}/m^2$.annum | 175.77 | |
| Building primary energy rate (BPER), $kWh_{PE}/m^2$.annum | 112.94 | |
| Do the building's emission and primary energy rates exceed the targets? | BER =< TER | BPER =< TPER |

## The performance of the building fabric and fixed building services should achieve reasonable overall standards of energy efficiency

| Fabric element | $U_{a\text{-}Limit}$ | $U_{a\text{-}Calc}$ | $U_{i\text{-}Calc}$ | First surface with maximum value |
|---|---|---|---|---|
| Walls* | 0.26 | 0.21 | 0.21 | 00 Ground Floor - Kitchen_W_6 |
| Floors | 0.18 | 0.1 | 0.13 | 00 Ground Floor - Hydro Pool_S_3 |
| Pitched roofs | 0.16 | - | - | No heat loss pitched roofs |
| Flat roofs | 0.18 | 0.12 | 0.12 | 00 Ground Floor - Kitchen_R_4 |
| Windows** and roof windows | 1.6 | 1.3 | 1.3 | 00 Ground Floor - Kitchen_G_7 |
| Rooflights*** | 2.2 | - | - | No external rooflights |
| Personnel doors^ | 1.6 | - | - | No external personnel doors |
| Vehicle access & similar large doors | 1.3 | - | - | No external vehicle access doors |
| High usage entrance doors | 3 | - | - | No external high usage entrance doors |

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [W/(m²K)] $U_{i\text{-}Calc}$ = Calculated maximum individual element U-values [W/(m²K)]

$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [W/(m²K)]

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

** Display windows and similar glazing are excluded from the U-value check. *** Values for rooflights refer to the horizontal position.

^ For fire doors, limiting U-value is 1.8 W/m²K

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

| Air permeability | Limiting standard | This building |
|---|---|---|
| $m^3/(h.m^2)$ at 50 Pa | 8 | 5 |

## Building services

**For details on the standard values listed below, system-specific guidance, and additional regulatory requirements, refer to the Approved Documents.**

| | |
|---|---|
| **Whole building lighting automatic monitoring & targeting with alarms for out-of-range values** | YES |
| **Whole building electric power factor achieved by power factor correction** | >0.95 |

1- VRF

| | Heating efficiency | Cooling efficiency | Radiant efficiency | SFP [W/(l/s)] | HR efficiency |
|---|---|---|---|---|---|
| **This system** | 5 | 6.5 | - | - | - |
| **Standard value** | 2.5* | 5 | N/A | N/A | N/A |
| **Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system** | | | | | YES |
| * Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps. | | | | | |

2- Communal ASHP

| | Heating efficiency | Cooling efficiency | Radiant efficiency | SFP [W/(l/s)] | HR efficiency |
|---|---|---|---|---|---|
| **This system** | 3.6 | - | - | - | - |
| **Standard value** | 2.5* | N/A | N/A | N/A | N/A |
| **Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system** | | | | | YES |
| * Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps. | | | | | |

1- Communal ASHP

| | Water heating efficiency | Storage loss factor [kWh/litre per day] |
|---|---|---|
| **This building** | 3.6 | 0 |
| **Standard value** | 2* | N/A |
| * Standard shown is for all types except absorption and gas engine heat pumps. | | |

### Zone-level mechanical ventilation, exhaust, and terminal units

| ID | System type in the Approved Documents |
|---|---|
| A | Local supply or extract ventilation units |
| B | Zonal supply system where the fan is remote from the zone |
| C | Zonal extract system where the fan is remote from the zone |
| D | Zonal balanced supply and extract ventilation system |
| E | Local balanced supply and extract ventilation units |
| F | Other local ventilation units |
| G | Fan assisted terminal variable air volume units |
| H | Fan coil units |
| I | Kitchen extract with the fan remote from the zone and a grease filter |
| NB: Limiting SFP may be increased by the amounts specified in the Approved Documents if the installation includes particular components. | |

| Zone name | SFP [W/(l/s)] | | | | | | | | | HR efficiency | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **ID of system type** | **A** | **B** | **C** | **D** | **E** | **F** | **G** | **H** | **I** | | |
| **Standard value** | 0.3 | 1.1 | 0.5 | 2.3 | 2 | 0.5 | 0.5 | 0.4 | 1 | **Zone** | **Standard** |
| 00 Ground Floor - Nurse Station | - | - | - | - | 1 | - | - | - | - | 0.85 | N/A |
| 00 Ground Floor - Kitchen | - | - | - | - | 1 | - | - | - | 1 | - | N/A |
| 00 Ground Floor - Chefs Office | - | - | - | - | 1 | - | - | - | - | 0.85 | N/A |
| 00 Ground Floor - Foyer & Central Hub | - | - | - | - | 1 | - | - | - | - | 0.85 | N/A |
| 00 Ground Floor - Restaurant | - | - | - | - | 1 | - | - | - | - | 0.85 | N/A |
| 00 Ground Floor - Salon | - | - | - | - | 1 | - | - | - | - | 0.85 | N/A |

| Zone name | SFP [W/(l/s)] | | | | | | | | | HR efficiency | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ID of system type | A | B | C | D | E | F | G | H | I | | |
| Standard value | 0.3 | 1.1 | 0.5 | 2.3 | 2 | 0.5 | 0.5 | 0.4 | 1 | Zone | Standard |
| 00 Ground Floor - Photocopy | - | - | - | - | 1 | - | - | - | - | 0.85 | N/A |
| 00 Ground Floor - Admin | - | - | - | - | 1 | - | - | - | - | 0.85 | N/A |
| 00 Ground Floor - Manager | - | - | - | - | 1 | - | - | - | - | 0.85 | N/A |
| 00 Ground Floor - Private Dining | - | - | - | - | 1 | - | - | - | - | 0.85 | N/A |
| 01 1st Floor - Dining | - | - | - | - | 1 | - | - | - | - | 0.85 | N/A |
| 01 1st Floor - Nurse Station | - | - | - | - | 1 | - | - | - | - | 0.85 | N/A |
| 01 1st Floor - Laundry | - | - | 0.5 | - | - | - | - | - | - | - | N/A |
| 01 1st Floor - Green Room | - | - | - | - | 1 | - | - | - | - | 0.85 | N/A |
| 01 1st Floor - Gym & Physio Room | - | - | - | - | 1 | - | - | - | - | 0.85 | N/A |
| 02 2nd Floor - Nurse Station | - | - | - | - | 1 | - | - | - | - | 0.85 | N/A |
| 02 2nd Floor - Lounge | - | - | - | - | 1 | - | - | - | - | 0.85 | N/A |
| 02 2nd Floor - Dining | - | - | - | - | 1 | - | - | - | - | 0.85 | N/A |
| 02 2nd Floor - Staff Room | - | - | - | - | 1 | - | - | - | - | 0.85 | N/A |
| 02 2nd Floor - Consult Room 2 | - | - | - | - | 1 | - | - | - | - | 0.85 | N/A |
| 02 2nd Floor - Consult Room 1 | - | - | - | - | 1 | - | - | - | - | 0.85 | N/A |
| 00 Ground Floor - Ensuite 5 | 0.2 | - | - | - | - | - | - | - | - | - | N/A |
| 00 Ground Floor - Ensuite 6 | 0.2 | - | - | - | - | - | - | - | - | - | N/A |
| 00 Ground Floor - Ensuite 8 | 0.2 | - | - | - | - | - | - | - | - | - | N/A |
| 00 Ground Floor - Ensuite 7 | 0.2 | - | - | - | - | - | - | - | - | - | N/A |
| 00 Ground Floor - Kitchen Staff Change | | - | 0.5 | - | - | - | - | - | - | - | N/A |
| 00 Ground Floor - Reception | - | - | - | - | 1 | - | - | - | - | 0.85 | N/A |
| 00 Ground Floor - WCs | - | - | 0.5 | - | - | - | - | - | - | - | N/A |
| 00 Ground Floor - Vistor WC | - | - | 0.5 | - | - | - | - | - | - | - | N/A |
| 00 Ground Floor - Corridor | - | - | - | - | 1 | - | - | - | - | 0.85 | N/A |
| 00 Ground Floor - Female & Male Changing Room | | | 0.5 | - | - | - | - | - | - | - | N/A |
| 00 Ground Floor - Hydro Pool Room | - | - | - | - | 1 | - | - | - | - | 0.85 | N/A |
| 00 Ground Floor - Ensuite 1 | 0.2 | - | - | - | - | - | - | - | - | - | N/A |
| 00 Ground Floor - Ensuite 2 | 0.2 | - | - | - | - | - | - | - | - | - | N/A |
| 00 Ground Floor - Ensuite 4 | 0.2 | - | - | - | - | - | - | - | - | - | N/A |
| 00 Ground Floor - Ensuite 3 | 0.2 | - | - | - | - | - | - | - | - | - | N/A |
| 01 1st Floor - AWC | - | - | 0.5 | - | - | - | - | - | - | - | N/A |
| 01 1st Floor - Corridor | - | - | - | - | 1 | - | - | - | - | 0.85 | N/A |
| 01 1st Floor - Ensuite 9 | 0.2 | - | - | - | - | - | - | - | - | - | N/A |
| 01 1st Floor - Ensuite 8 | 0.2 | - | - | - | - | - | - | - | - | - | N/A |
| 01 1st Floor - Ensuite 7 | 0.2 | - | - | - | - | - | - | - | - | - | N/A |
| 01 1st Floor - Ensuite 6 | 0.2 | - | - | - | - | - | - | - | - | - | N/A |
| 01 1st Floor - Ensuite 5 | 0.2 | - | - | - | - | - | - | - | - | - | N/A |
| 01 1st Floor - Ensuite 10 | 0.2 | - | - | - | - | - | - | - | - | - | N/A |
| 01 1st Floor - Ensuite 11 | 0.2 | - | - | - | - | - | - | - | - | - | N/A |
| 01 1st Floor - Ensuite 2 | 0.3 | - | - | - | - | - | - | - | - | - | N/A |
| 01 1st Floor - Ensuite 1 | 0.2 | - | - | - | - | - | - | - | - | - | N/A |
| 01 1st Floor - Ensuite 3 | 0.2 | - | - | - | - | - | - | - | - | - | N/A |
| 01 1st Floor - Ensuite 4 | 0.2 | - | - | - | - | - | - | - | - | - | N/A |

| Zone name | SFP [W/(l/s)] | | | | | | | | | HR efficiency | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ID of system type | A | B | C | D | E | F | G | H | I | | |
| Standard value | 0.3 | 1.1 | 0.5 | 2.3 | 2 | 0.5 | 0.5 | 0.4 | 1 | Zone | Standard |
| 02 2nd Floor - Corridor | - | - | - | - | 1 | - | - | - | - | 0.85 | N/A |
| 02 2nd Floor - Ensuite 6 | 0.2 | - | - | - | - | - | - | - | - | - | N/A |
| 02 2nd Floor - Ensuite 5 | 0.2 | - | - | - | - | - | - | - | - | - | N/A |
| 02 2nd Floor - Ensuite 8 | 0.2 | - | - | - | - | - | - | - | - | - | N/A |
| 02 2nd Floor - AWC | - | - | 0.5 | - | - | - | - | - | - | - | N/A |
| 02 2nd Floor - Ensuite 9 | 0.2 | - | - | - | - | - | - | - | - | - | N/A |
| 02 2nd Floor - Female Staff Change | - | - | 0.5 | - | - | - | - | - | - | - | N/A |
| 02 2nd Floor - WC | - | - | 0.5 | - | - | - | - | - | - | - | N/A |
| 02 2nd Floor - Ensuite 11 | 0.2 | - | - | - | - | - | - | - | - | - | N/A |
| 02 2nd Floor - Ensuite 10 | 0.2 | - | - | - | - | - | - | - | - | - | N/A |
| 02 2nd Floor - Ensuite 7 | 0.2 | - | - | - | - | - | - | - | - | - | N/A |
| 02 2nd Floor - Ensuite 12 | 0.2 | - | - | - | - | - | - | - | - | - | N/A |
| 02 2nd Floor - Ensuite 13 | 0.2 | - | - | - | - | - | - | - | - | - | N/A |
| 02 2nd Floor - Male Staff Change | - | - | 0.5 | - | - | - | - | - | - | - | N/A |
| 02 2nd Floor - Ensuite 1 | 0.2 | - | - | - | - | - | - | - | - | - | N/A |
| 02 2nd Floor - Ensuite 2 | 0.2 | - | - | - | - | - | - | - | - | - | N/A |
| 02 2nd Floor - Ensuite 3 | 0.2 | - | - | - | - | - | - | - | - | - | N/A |
| 02 2nd Floor - Ensuite 4 | 0.2 | - | - | - | - | - | - | - | - | - | N/A |

| General lighting and display lighting | General luminaire | Display light source | |
|---|---|---|---|
| Zone name | Efficacy [lm/W] | Efficacy [lm/W] | Power density [W/m²] |
| Standard value | 95 | 80 | 0.3 |
| 00 Ground Floor - Nurse Station | 110 | - | - |
| 00 Ground Floor - Kitchen | 110 | - | - |
| 00 Ground Floor - Chefs Office | 110 | - | - |
| 00 Ground Floor - Foyer & Central Hub | 110 | 110 | 1.227 |
| 00 Ground Floor - Restaurant | 110 | - | - |
| 00 Ground Floor - Salon | 110 | 110 | 1.364 |
| 00 Ground Floor - Photocopy | 110 | - | - |
| 00 Ground Floor - Admin | 110 | - | - |
| 00 Ground Floor - Manager | 110 | - | - |
| 00 Ground Floor - Private Dining | 110 | - | - |
| 01 1st Floor - Dining | 110 | - | - |
| 01 1st Floor - Media | 110 | - | - |
| 01 1st Floor - Nurse Station | 110 | - | - |
| 01 1st Floor - Laundry | 110 | - | - |
| 01 1st Floor - Green Room | 110 | - | - |
| 01 1st Floor - Gym & Physio Room | 110 | - | - |
| 02 2nd Floor - Nurse Station | 110 | - | - |
| 02 2nd Floor - Lounge | 110 | - | - |
| 02 2nd Floor - Dining | 110 | - | - |
| 02 2nd Floor - Staff Room | 110 | - | - |
| 02 2nd Floor - Consult Room 2 | 110 | - | - |

| General lighting and display lighting | General luminaire | Display light source | |
|---|---|---|---|
| Zone name | Efficacy [lm/W] | Efficacy [lm/W] | Power density [W/m²] |
| Standard value | 95 | 80 | 0.3 |
| 02 2nd Floor - Comms | 110 | - | - |
| 02 2nd Floor - Consult Room 1 | 110 | - | - |
| 00 Ground Floor - Corridor | 110 | - | - |
| 00 Ground Floor - Stairs 2 | 110 | - | - |
| 00 Ground Floor - Ensuite 5 | 110 | - | - |
| 00 Ground Floor - Bedrooms 3 | 110 | - | - |
| 00 Ground Floor - Ensuite 6 | 110 | - | - |
| 00 Ground Floor - Ensuite 8 | 110 | - | - |
| 00 Ground Floor - Sluice | 110 | - | - |
| 00 Ground Floor - Med Store | 110 | - | - |
| 00 Ground Floor - Ensuite 7 | 110 | - | - |
| 00 Ground Floor - Hoist | 110 | - | - |
| 00 Ground Floor - Staff Entrance | 110 | - | - |
| 00 Ground Floor - Kitchen Store | 110 | - | - |
| 00 Ground Floor - Kitchen Staff Change | 110 | - | - |
| 00 Ground Floor - Reception | 110 | 110 | 1.227 |
| 00 Ground Floor - Store | 110 | - | - |
| 00 Ground Floor - WCs | 110 | - | - |
| 00 Ground Floor - Bedrooms 1 | 110 | - | - |
| 00 Ground Floor - Bedroom 2 | 110 | - | - |
| 00 Ground Floor - Vistor WC | 110 | - | - |
| 00 Ground Floor - Lobby | 110 | - | - |
| 00 Ground Floor - Stairs 1 | 110 | - | - |
| 00 Ground Floor - Corridor | 110 | - | - |
| 00 Ground Floor - Female & Male Changing Room | 110 | - | - |
| 00 Ground Floor - Hydro Pool Room | 110 | - | - |
| 00 Ground Floor - Ensuite 1 | 110 | - | - |
| 00 Ground Floor - Ensuite 2 | 110 | - | - |
| 00 Ground Floor - Ensuite 4 | 110 | - | - |
| 00 Ground Floor - Ensuite 3 | 110 | - | - |
| 00 Ground Floor - Hydro Pool | 110 | - | - |
| 01 1st Floor - AWC | 110 | - | - |
| 01 1st Floor - Corridor | 110 | - | - |
| 01 1st Floor - Bedrooms 2 | 110 | - | - |
| 01 1st Floor - Ensuite 9 | 110 | - | - |
| 01 1st Floor - Ensuite 8 | 110 | - | - |
| 01 1st Floor - Store | 110 | - | - |
| 01 1st Floor - Ensuite 7 | 110 | - | - |
| 01 1st Floor - Ensuite 6 | 110 | - | - |
| 01 1st Floor - Ensuite 5 | 110 | - | - |
| 01 1st Floor - Stairs 2 | 110 | - | - |
| 01 1st Floor - Bedrooms 1 | 110 | - | - |
| 01 1st Floor - COSHH | 110 | - | - |

| General lighting and display lighting | General luminaire | Display light source | |
|---|---|---|---|
| Zone name | Efficacy [lm/W] | Efficacy [lm/W] | Power density [W/m²] |
| Standard value | 95 | 80 | 0.3 |
| 01 1st Floor - Sluice | 110 | - | - |
| 01 1st Floor - Med Store | 110 | - | - |
| 01 1st Floor - Linen & Store | 110 | - | - |
| 01 1st Floor - Female & Male Changing | 110 | - | - |
| 01 1st Floor - Stairs 1 | 110 | - | - |
| 01 1st Floor - Ensuite 10 | 110 | - | - |
| 01 1st Floor - Ensuite 11 | 110 | - | - |
| 01 1st Floor - Hoist Store | 110 | - | - |
| 01 1st Floor - Ensuite 2 | 110 | - | - |
| 01 1st Floor - Ensuite 1 | 110 | - | - |
| 01 1st Floor - Ensuite 3 | 110 | - | - |
| 01 1st Floor - Ensuite 4 | 110 | - | - |
| 01 1st Floor - Bedroom 3 | 110 | - | - |
| 02 2nd Floor - Bedrooms 1 | 110 | - | - |
| 02 2nd Floor - Corridor | 110 | - | - |
| 02 2nd Floor - Store 1 | 110 | - | - |
| 02 2nd Floor - Store 3 | 110 | - | - |
| 02 2nd Floor - Bedrooms 2 | 110 | - | - |
| 02 2nd Floor - Ensuite 6 | 110 | - | - |
| 02 2nd Floor - Ensuite 5 | 110 | - | - |
| 02 2nd Floor - Stairs 2 | 110 | - | - |
| 02 2nd Floor - Bedrooms 3 | 110 | - | - |
| 02 2nd Floor - Ensuite 8 | 110 | - | - |
| 02 2nd Floor - AWC | 110 | - | - |
| 02 2nd Floor - Ensuite 9 | 110 | - | - |
| 02 2nd Floor - Linen & Store | 110 | - | - |
| 02 2nd Floor - Hoist | 110 | - | - |
| 02 2nd Floor - Female Staff Change | 110 | - | - |
| 02 2nd Floor - Lobby & Roof Hatch | 110 | - | - |
| 02 2nd Floor - WC | 110 | - | - |
| 02 2nd Floor - Ensuite 11 | 110 | - | - |
| 02 2nd Floor - Ensuite 10 | 110 | - | - |
| 02 2nd Floor - Ensuite 7 | 110 | - | - |
| 02 2nd Floor - Sluice | 110 | - | - |
| 02 2nd Floor - Med Store | 110 | - | - |
| 02 2nd Floor - Store 2 | 110 | - | - |
| 02 2nd Floor - Ensuite 12 | 110 | - | - |
| 02 2nd Floor - Ensuite 13 | 110 | - | - |
| 02 2nd Floor - Stairs 1 | 110 | - | - |
| 02 2nd Floor - Male Staff Change | 110 | - | - |
| 02 2nd Floor - Bedrooms 4 | 110 | - | - |
| 02 2nd Floor - Ensuite 1 | 110 | - | - |
| 02 2nd Floor - Ensuite 2 | 110 | - | - |

| General lighting and display lighting | General luminaire | Display light source | |
|---|---|---|---|
| Zone name | Efficacy [lm/W] | Efficacy [lm/W] | Power density [W/m²] |
| Standard value | 95 | 80 | 0.3 |
| 02 2nd Floor - Ensuite 3 | 110 | - | - |
| 02 2nd Floor - Ensuite 4 | 110 | - | - |
| 02 2nd Floor - Bedroom 4 | 110 | - | - |

## The spaces in the building should have appropriate passive control measures to limit solar gains in summer

| Zone | Solar gain limit exceeded? (%) | Internal blinds used? |
|---|---|---|
| 00 Ground Floor - Nurse Station | N/A | N/A |
| 00 Ground Floor - Kitchen | NO (-70.2%) | NO |
| 00 Ground Floor - Chefs Office | N/A | N/A |
| 00 Ground Floor - Foyer & Central Hub | NO (-34.8%) | NO |
| 00 Ground Floor - Restaurant | NO (-42.3%) | NO |
| 00 Ground Floor - Salon | NO (-68.5%) | NO |
| 00 Ground Floor - Photocopy | N/A | N/A |
| 00 Ground Floor - Admin | NO (-34.6%) | NO |
| 00 Ground Floor - Manager | NO (-32.5%) | NO |
| 00 Ground Floor - Private Dining | NO (-46.7%) | NO |
| 01 1st Floor - Dining | NO (-42.9%) | NO |
| 01 1st Floor - Media | NO (-57.8%) | NO |
| 01 1st Floor - Nurse Station | N/A | N/A |
| 01 1st Floor - Laundry | N/A | N/A |
| 01 1st Floor - Green Room | NO (-68.7%) | NO |
| 01 1st Floor - Gym & Physio Room | NO (-64.9%) | NO |
| 02 2nd Floor - Nurse Station | N/A | N/A |
| 02 2nd Floor - Lounge | NO (-73.7%) | NO |
| 02 2nd Floor - Dining | NO (-63%) | NO |
| 02 2nd Floor - Staff Room | NO (-77.3%) | NO |
| 02 2nd Floor - Consult Room 2 | NO (-82.4%) | NO |
| 02 2nd Floor - Comms | N/A | N/A |
| 02 2nd Floor - Consult Room 1 | NO (-75.8%) | NO |
| 00 Ground Floor - Ensuite 5 | N/A | N/A |
| 00 Ground Floor - Bedrooms 3 | NO (-28.4%) | NO |
| 00 Ground Floor - Ensuite 6 | N/A | N/A |
| 00 Ground Floor - Ensuite 8 | N/A | N/A |
| 00 Ground Floor - Ensuite 7 | N/A | N/A |
| 00 Ground Floor - Reception | N/A | N/A |
| 00 Ground Floor - Bedrooms 1 | NO (-57.5%) | NO |
| 00 Ground Floor - Bedroom 2 | NO (-70.9%) | NO |
| 00 Ground Floor - Hydro Pool Room | NO (-65.5%) | NO |
| 00 Ground Floor - Ensuite 1 | NO (-76.5%) | NO |
| 00 Ground Floor - Ensuite 2 | N/A | N/A |
| 00 Ground Floor - Ensuite 4 | N/A | N/A |
| 00 Ground Floor - Ensuite 3 | NO (-86.2%) | NO |
| 00 Ground Floor - Hydro Pool | N/A | N/A |

| Zone | Solar gain limit exceeded? (%) | Internal blinds used? |
|---|---|---|
| 01 1st Floor - Bedrooms 2 | NO (-50.1%) | NO |
| 01 1st Floor - Ensuite 9 | N/A | N/A |
| 01 1st Floor - Ensuite 8 | N/A | N/A |
| 01 1st Floor - Ensuite 7 | N/A | N/A |
| 01 1st Floor - Ensuite 6 | N/A | N/A |
| 01 1st Floor - Ensuite 5 | N/A | N/A |
| 01 1st Floor - Bedrooms 1 | NO (-71.7%) | NO |
| 01 1st Floor - Ensuite 10 | N/A | N/A |
| 01 1st Floor - Ensuite 11 | N/A | N/A |
| 01 1st Floor - Ensuite 2 | N/A | N/A |
| 01 1st Floor - Ensuite 1 | NO (-75.4%) | NO |
| 01 1st Floor - Ensuite 3 | N/A | N/A |
| 01 1st Floor - Ensuite 4 | N/A | N/A |
| 01 1st Floor - Bedroom 3 | NO (-39.2%) | NO |
| 02 2nd Floor - Bedrooms 1 | NO (-78.4%) | NO |
| 02 2nd Floor - Bedrooms 2 | NO (-68.8%) | NO |
| 02 2nd Floor - Ensuite 6 | N/A | N/A |
| 02 2nd Floor - Ensuite 5 | N/A | N/A |
| 02 2nd Floor - Bedrooms 3 | NO (-68.9%) | NO |
| 02 2nd Floor - Ensuite 8 | N/A | N/A |
| 02 2nd Floor - Ensuite 9 | N/A | N/A |
| 02 2nd Floor - Ensuite 11 | N/A | N/A |
| 02 2nd Floor - Ensuite 10 | N/A | N/A |
| 02 2nd Floor - Ensuite 7 | N/A | N/A |
| 02 2nd Floor - Ensuite 12 | N/A | N/A |
| 02 2nd Floor - Ensuite 13 | N/A | N/A |
| 02 2nd Floor - Bedrooms 4 | NO (-53.7%) | NO |
| 02 2nd Floor - Ensuite 1 | NO (-75.4%) | NO |
| 02 2nd Floor - Ensuite 2 | N/A | N/A |
| 02 2nd Floor - Ensuite 3 | N/A | N/A |
| 02 2nd Floor - Ensuite 4 | N/A | N/A |
| 02 2nd Floor - Bedroom 4 | NO (-87.4%) | NO |

## Regulation 25A: Consideration of high efficiency alternative energy systems

| | |
|---|---|
| **Were alternative energy systems considered and analysed as part of the design process?** | NO |
| Is evidence of such assessment available as a separate submission? | NO |
| Are any such measures included in the proposed design? | NO |

# Technical Data Sheet (Actual vs. Notional Building)

## Building Global Parameters

| | Actual | Notional |
|---|---|---|
| Floor area [$m^2$] | 3487.3 | 3487.3 |
| External area [$m^2$] | 4331.3 | 4331.3 |
| Weather | LON | LON |
| Infiltration [$m^3/hm^2$@ 50Pa] | 5 | 3 |
| Average conductance [W/K] | 1078.67 | 1563.83 |
| Average U-value [$W/m^2K$] | 0.25 | 0.36 |
| Alpha value* [%] | 30.41 | 23.46 |

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

## Building Use

| % Area | Building Type |
|---|---|
| 1 | **Retail/Financial and Professional Services** |
| | Restaurants and Cafes/Drinking Establishments/Takeaways |
| | Offices and Workshop Businesses |
| | General Industrial and Special Industrial Groups |
| | Storage or Distribution |
| | Hotels |
| 93 | **Residential Institutions: Hospitals and Care Homes** |
| 4 | **Residential Institutions: Residential Schools** |
| | Residential Institutions: Universities and Colleges |
| | Secure Residential Institutions |
| | Residential Spaces |
| | Non-residential Institutions: Community/Day Centre |
| | Non-residential Institutions: Libraries, Museums, and Galleries |
| | Non-residential Institutions: Education |
| | Non-residential Institutions: Primary Health Care Building |
| | Non-residential Institutions: Crown and County Courts |
| 2 | **General Assembly and Leisure, Night Clubs, and Theatres** |
| | Others: Passenger Terminals |
| | Others: Emergency Services |
| | Others: Miscellaneous 24hr Activities |
| | Others: Car Parks 24 hrs |
| | Others: Stand Alone Utility Block |

## Energy Consumption by End Use [$kWh/m^2$]

| | Actual | Notional |
|---|---|---|
| Heating | 7.09 | 11.07 |
| Cooling | 7.02 | 8.43 |
| Auxiliary | 12.47 | 11.17 |
| Lighting | 11.41 | 11 |
| Hot water | 44.02 | 77.08 |
| Equipment* | 52.97 | 52.97 |
| **TOTAL**** | **82** | **118.76** |

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

## Energy Production by Technology [$kWh/m^2$]

| | Actual | Notional |
|---|---|---|
| Photovoltaic systems | 5.7 | 0 |
| Wind turbines | 0 | 0 |
| CHP generators | 0 | 0 |
| Solar thermal systems | 0 | 0 |
| *Displaced electricity* | *5.7* | *0* |

## Energy & $CO_2$ Emissions Summary

| | Actual | Notional |
|---|---|---|
| Heating + cooling demand [$MJ/m^2$] | 277.39 | 331.1 |
| Primary energy [$kWh_{PE}/m^2$] | 112.94 | 175.77 |
| Total emissions [$kg/m^2$] | 10.46 | 16.22 |

## HVAC Systems Performance

| System Type | | Heat dem MJ/m2 | Cool dem MJ/m2 | Heat con kWh/m2 | Cool con kWh/m2 | Aux con kWh/m2 | Heat SSEEF | Cool SSEER | Heat gen SEFF | Cool gen SEER |
|---|---|---|---|---|---|---|---|---|---|---|
| [ST] Split or multi-split system, [HS] ASHP, [HFT] Electricity, [CFT] Electricity | | | | | | | | | | |
| | Actual | 19.4 | 490.4 | 1.1 | 28 | 24.6 | 4.9 | 4.86 | 5 | 6.5 |
| | Notional | 24.6 | 533.4 | 2.6 | 33.7 | 18.1 | 2.64 | 4.4 | ---- | ---- |
| [ST] Central heating using water: radiators, [HS] ASHP, [HFT] Electricity, [CFT] Electricity | | | | | | | | | | |
| | Actual | 110.6 | 89.2 | 9.1 | 0 | 8.4 | 3.38 | 0 | 3.6 | 0 |
| | Notional | 132.2 | 123.2 | 13.9 | 0 | 8.3 | 2.64 | 0 | ---- | ---- |

### Key to terms

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

# BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2021

**Project name**

## Land West of Worthing - Community Hub

As designed

**Date:** Fri Jan 16 14:37:59 2026

## Administrative information

### Building Details

**Address:** London,

### Certification tool

**Calculation engine:** EnergyPlus

**Calculation engine version:** "v9.4.0.002"

**Interface to calculation engine:** DesignBuilder DSM

**Interface to calculation engine version:** v7.3.1

**BRUKL compliance module version:** v6.1.e.1

### Certifier details

**Name:**

**Telephone number:**

**Address:** , ,

**Foundation area [m²]:** 684.49

## The $CO_2$ emission and primary energy rates of the building must not exceed the targets

| | | |
|---|---|---|
| Target $CO_2$ emission rate (TER), $kgCO_2/m^2.annum$ | 2.9 | |
| Building $CO_2$ emission rate (BER), $kgCO_2/m^2.annum$ | 1.7 | |
| Target primary energy rate (TPER), $kWh_{PE}/m^2.annum$ | 31.22 | |
| Building primary energy rate (BPER), $kWh_{PE}/m^2.annum$ | 18.48 | |
| Do the building's emission and primary energy rates exceed the targets? | BER =< TER | BPER =< TPER |

## The performance of the building fabric and fixed building services should achieve reasonable overall standards of energy efficiency

| Fabric element | $U_{a\text{-}Limit}$ | $U_{a\text{-}Calc}$ | $U_{i\text{-}Calc}$ | First surface with maximum value |
|---|---|---|---|---|
| Walls* | 0.26 | 0.18 | 0.18 | 00_Level - Circulation 2_W_8 |
| Floors | 0.18 | 0.1 | 0.1 | 00_Level - Circulation 2_E_0 |
| Pitched roofs | 0.16 | - | - | No Exposed Roof in project |
| Flat roofs | 0.18 | 0.12 | 0.15 | 02_Level - Youth Space 1_R_1 |
| Windows** and roof windows | 1.6 | 0.85 | 0.85 | 00_Level - Circulation 2_G_8_0 |
| Rooflights*** | 2.2 | - | - | No Rooflights in project |
| Personnel doors^ | 1.6 | - | - | No external personnel doors |
| Vehicle access & similar large doors | 1.3 | - | - | No external vehicle access doors |
| High usage entrance doors | 3 | - | - | No external high usage entrance doors |

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [W/(m²K)] $U_{i\text{-}Calc}$ = Calculated maximum individual element U-values [W/(m²K)]

$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [W/(m²K)]

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

** Display windows and similar glazing are excluded from the U-value check. *** Values for rooflights refer to the horizontal position.

^ For fire doors, limiting U-value is 1.8 W/m²K

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

| Air permeability | Limiting standard | This building |
|---|---|---|
| $m^3/(h.m^2)$ at 50 Pa | 8 | 3 |

## Building services

**For details on the standard values listed below, system-specific guidance, and additional regulatory requirements, refer to the Approved Documents.**

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

1- ASHP - Be Green

| | **Heating efficiency** | **Cooling efficiency** | **Radiant efficiency** | **SFP [W/(l/s)]** | **HR efficiency** |
|---|---|---|---|---|---|
| **This system** | 4.6 | 9.5 | - | - | - |
| **Standard value** | 2.5* | 5 | N/A | N/A | N/A |
| **Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system** | | | | | YES |
| * Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps. | | | | | |

1- ASHP DHW - Be Green

| | **Water heating efficiency** | **Storage loss factor [kWh/litre per day]** |
|---|---|---|
| **This building** | 3.8 | - |
| **Standard value** | 2* | N/A |
| * Standard shown is for all types except absorption and gas engine heat pumps. | | |

### Zone-level mechanical ventilation, exhaust, and terminal units

| **ID** | **System type in the Approved Documents** |
|---|---|
| A | Local supply or extract ventilation units |
| B | Zonal supply system where the fan is remote from the zone |
| C | Zonal extract system where the fan is remote from the zone |
| D | Zonal balanced supply and extract ventilation system |
| E | Local balanced supply and extract ventilation units |
| F | Other local ventilation units |
| G | Fan assisted terminal variable air volume units |
| H | Fan coil units |
| I | Kitchen extract with the fan remote from the zone and a grease filter |
| NB: Limiting SFP may be increased by the amounts specified in the Approved Documents if the installation includes particular components. | |

| **Zone name** | **SFP [W/(l/s)]** | | | | | | | | | **HR efficiency** | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **ID of system type** | **A** | **B** | **C** | **D** | **E** | **F** | **G** | **H** | **I** | | |
| **Standard value** | 0.3 | 1.1 | 0.5 | 2.3 | 2 | 0.5 | 0.5 | 0.4 | 1 | **Zone** | **Standard** |
| 00_Level - Male WC 1 | - | - | 0.3 | - | - | - | - | - | - | - | N/A |
| 00_Level - Accessible WC 1 | - | - | 0.3 | - | - | - | - | - | - | - | N/A |
| 00_Level - Adult's & Children's Library 2 | - | - | - | - | 1 | - | - | - | - | 0.85 | N/A |
| 00_Level - Adult's & Children's Library 1 | - | - | - | - | 1 | - | - | - | - | 0.85 | N/A |
| 00_Level - Children's WC 1 | - | - | 0.3 | - | - | - | - | - | - | - | N/A |
| 00_Level - Toilet Lobby 1 | - | - | 0.3 | - | - | - | - | - | - | - | N/A |
| 00_Level - Management Office 1 | - | - | - | - | 1 | - | - | - | - | 0.85 | N/A |
| 00_Level - Changing Places & WC 1 | - | - | 0.3 | - | - | - | - | - | - | - | N/A |
| 00_Level - Baby Change 1 | - | - | 0.3 | - | - | - | - | - | - | - | N/A |
| 00_Level - Children's WC 2 | - | - | 0.3 | - | - | - | - | - | - | - | N/A |
| 00_Level - Female WC 1 | - | - | 0.3 | - | - | - | - | - | - | - | N/A |
| 00_Level - Entrance Lobby 1 | - | - | - | - | 1 | - | - | - | - | 0.85 | N/A |
| 01_Level - Adult Library 3 | - | - | - | - | 1 | - | - | - | - | 0.85 | N/A |

| Zone name | SFP [W/(l/s)] | | | | | | | | | HR efficiency | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ID of system type | A | B | C | D | E | F | G | H | I | | |
| Standard value | 0.3 | 1.1 | 0.5 | 2.3 | 2 | 0.5 | 0.5 | 0.4 | 1 | Zone | Standard |
| 01_Level - Adult Library 4 | - | - | - | - | 1 | - | - | - | - | 0.85 | N/A |
| 01_Level - Toilet Lobby 1 | - | - | 0.3 | - | - | - | - | - | - | - | N/A |
| 01_Level - Female WC 1 | - | - | 0.3 | - | - | - | - | - | - | - | N/A |
| 01_Level - Male WC 1 | - | - | 0.3 | - | - | - | - | - | - | - | N/A |
| 01_Level - Unisex Accessible WC 1 | - | - | 0.3 | - | - | - | - | - | - | - | N/A |
| 01_Level - Adult Library 1 | - | - | - | - | 1 | - | - | - | - | 0.85 | N/A |
| 01_Level - Adult Library 2 | - | - | - | - | 1 | - | - | - | - | 0.85 | N/A |
| 02_Level - Toilet Lobby 1 | - | - | 0.3 | - | - | - | - | - | - | - | N/A |
| 02_Level - Meeting Room | - | - | - | - | 1 | - | - | - | - | 0.85 | N/A |
| 02_Level - Female WC 1 | - | - | 0.3 | - | - | - | - | - | - | - | N/A |
| 02_Level - Male WC 1 | - | - | 0.3 | - | - | - | - | - | - | - | N/A |
| 02_Level - Unisex Accessible WC 1 | - | - | 0.3 | - | - | - | - | - | - | - | N/A |
| 02_Level - Youth Space_Toilet Lobby | - | - | 0.3 | - | - | - | - | - | - | - | N/A |
| 02_Level - Staff Area_Toilet Lobby | - | - | 0.3 | - | - | - | - | - | - | - | N/A |
| 02_Level - Staff Area_Accessible WC | - | - | 0.3 | - | - | - | - | - | - | - | N/A |
| 02_Level - Staff Area 1 | - | - | - | - | 1 | - | - | - | - | 0.85 | N/A |
| 02_Level - Youth Space 2 | - | - | - | - | 1 | - | - | - | - | 0.85 | N/A |
| 02_Level - Staff Area_Female WC | - | - | 0.3 | - | - | - | - | - | - | - | N/A |
| 02_Level - Council Office 2 | - | - | - | - | 1 | - | - | - | - | 0.85 | N/A |
| 02_Level - Council Office 1 | - | - | - | - | 1 | - | - | - | - | 0.85 | N/A |
| 02_Level - Youth Space 1 | - | - | - | - | 1 | - | - | - | - | 0.85 | N/A |
| 02_Level - Youth Space_Male WC | - | - | 0.3 | - | - | - | - | - | - | - | N/A |
| 02_Level - Staff Area_Male WC | - | - | 0.3 | - | - | - | - | - | - | - | N/A |
| 02_Level - Youth Space_Female WC | - | - | 0.3 | - | - | - | - | - | - | - | N/A |
| 02_Level - Youth Space_Accessible WC | - | 0.3 | - | - | - | - | - | - | - | - | N/A |
| 03_Level - Communal Circulation | - | - | - | - | 1 | - | - | - | - | 0.85 | N/A |
| 03_Level - Male WC 1 | - | - | 0.3 | - | - | - | - | - | - | - | N/A |
| 03_Level - Toilet Lobby 1 | - | - | 0.3 | - | - | - | - | - | - | - | N/A |
| 03_Level - Meeting Room 1 | - | - | - | - | 1 | - | - | - | - | 0.85 | N/A |
| 03_Level - Toilet Lobby 2 | - | - | 0.3 | - | - | - | - | - | - | - | N/A |
| 03_Level - Unisex Accessible WC 2 | - | - | 0.3 | - | - | - | - | - | - | - | N/A |
| 03_Level - Meeting Room 5 | - | - | - | - | 1 | - | - | - | - | 0.85 | N/A |
| 03_Level - Female WC 2 | - | - | 0.3 | - | - | - | - | - | - | - | N/A |
| 03_Level - Kitchen | - | - | - | - | 1 | - | - | - | - | 0.85 | N/A |
| 03_Level - Female WC 1 | - | - | 0.3 | - | - | - | - | - | - | - | N/A |
| 03_Level - Unisex Accessible WC 1 | - | - | 0.3 | - | - | - | - | - | - | - | N/A |
| 03_Level - Meeting Room 4 | - | - | - | - | 1 | - | - | - | - | 0.85 | N/A |
| 03_Level - Meeting Room 3 | - | - | - | - | 1 | - | - | - | - | 0.85 | N/A |
| 03_Level - Meeting Room 2 | - | - | - | - | 1 | - | - | - | - | 0.85 | N/A |
| 03_Level - Community Hall 1 | - | - | - | - | 1 | - | - | - | - | 0.85 | N/A |
| 03_Level - Community Hall | - | - | - | - | 1 | - | - | - | - | 0.85 | N/A |
| 03_Level - Male WC 2 | - | - | 0.3 | - | - | - | - | - | - | - | N/A |

| General lighting and display lighting | General luminaire | Display light source | |
|---|---|---|---|
| **Zone name** | **Efficacy [lm/W]** | **Efficacy [lm/W]** | **Power density [W/m²]** |
| **Standard value** | 95 | 80 | 0.3 |
| 00_Level - Circulation 2 | 150 | - | - |
| 00_Level - Lift 1 | 150 | - | - |
| 00_Level - Male WC 1 | 150 | - | - |
| 00_Level - Circulation 1 | 150 | - | - |
| 00_Level - Accessible WC 1 | 150 | - | - |
| 00_Level - Adult's & Children's Library 2 | 150 | - | - |
| 00_Level - Staircase 1 | 150 | - | - |
| 00_Level - Adult's & Children's Library 1 | 150 | - | - |
| 00_Level - Staircase 2 | 150 | - | - |
| 00_Level - Lift Lobby 1 | 150 | - | - |
| 00_Level - Lift 2 | 150 | - | - |
| 00_Level - Staircase_Library 1 | 150 | - | - |
| 00_Level - Children's WC 1 | 150 | - | - |
| 00_Level - Toilet Lobby 1 | 150 | - | - |
| 00_Level - Management Office 1 | 150 | - | - |
| 00_Level - Changing Places & WC 1 | 150 | - | - |
| 00_Level - Baby Change 1 | 150 | - | - |
| 00_Level - Cleaners Store 1 | 150 | - | - |
| 00_Level - Children's WC 2 | 150 | - | - |
| 00_Level - Female WC 1 | 150 | - | - |
| 00_Level - Entrance Lobby 1 | 150 | 150 | 0.9 |
| 01_Level - Adult Library 3 | 150 | - | - |
| 01_Level - Adult Library 4 | 150 | - | - |
| 01_Level - Toilet Lobby 1 | 150 | - | - |
| 01_Level - Lift 1 | 150 | - | - |
| 01_Level - Female WC 1 | 150 | - | - |
| 01_Level - Male WC 1 | 150 | - | - |
| 01_Level - Unisex Accessible WC 1 | 150 | - | - |
| 01_Level - Cleaners Store 1 | 150 | - | - |
| 01_Level - Staircase 1 | 150 | - | - |
| 01_Level - Circulation 1 | 150 | - | - |
| 01_Level - Adult Library 1 | 150 | - | - |
| 01_Level - Staircase 2 | 150 | - | - |
| 01_Level - Lift Lobby 2 | 150 | - | - |
| 01_Level - Circulation 2 | 150 | - | - |
| 01_Level - Lift 2 | 150 | - | - |
| 01_Level - Store Room 1 | 150 | - | - |
| 01_Level - Adult Library 2 | 150 | - | - |
| 02_Level - Toilet Lobby 1 | 150 | - | - |
| 02_Level - Meeting Room | 150 | - | - |
| 02_Level - Lift 1 | 150 | - | - |
| 02_Level - Female WC 1 | 150 | - | - |

| General lighting and display lighting | General luminaire | Display light source | |
|---|---|---|---|
| Zone name | Efficacy [lm/W] | Efficacy [lm/W] | Power density [W/m²] |
| Standard value | 95 | 80 | 0.3 |
| 02_Level - Male WC 1 | 150 | - | - |
| 02_Level - Unisex Accessible WC 1 | 150 | - | - |
| 02_Level - Staircase 1 | 150 | - | - |
| 02_Level - Circulation 1 | 150 | - | - |
| 02_Level - Youth Space_Toilet Lobby | 150 | - | - |
| 02_Level - Staircase 2 | 150 | - | - |
| 02_Level - Circulation 2 | 150 | - | - |
| 02_Level - Staff Area_Toilet Lobby | 150 | - | - |
| 02_Level - Staff Area_Accessible WC | 150 | - | - |
| 02_Level - Staff Area 1 | 150 | - | - |
| 02_Level - Youth Space 2 | 150 | - | - |
| 02_Level - Staff Area_Female WC | 150 | - | - |
| 02_Level - Lift 2 | 150 | - | - |
| 02_Level - Council Office 2 | 150 | - | - |
| 02_Level - Council Office 1 | 150 | - | - |
| 02_Level - Youth Space 1 | 150 | - | - |
| 02_Level - Youth Space_Male WC | 150 | - | - |
| 02_Level - Staff Area_Male WC | 150 | - | - |
| 02_Level - Youth Space_Female WC | 150 | - | - |
| 02_Level - Youth Space_Accessible WC | 150 | - | - |
| 03_Level - Communal Circulation | 150 | - | - |
| 03_Level - Lift 1 | 150 | - | - |
| 03_Level - Male WC 1 | 150 | - | - |
| 03_Level - Toilet Lobby 1 | 150 | - | - |
| 03_Level - Meeting Room 1 | 150 | - | - |
| 03_Level - Lift 2 | 150 | - | - |
| 03_Level - Toilet Lobby 2 | 150 | - | - |
| 03_Level - Unisex Accessible WC 2 | 150 | - | - |
| 03_Level - Meeting Room 5 | 150 | - | - |
| 03_Level - Lift Lobby 1 | 150 | - | - |
| 03_Level - Staircase 2 | 150 | - | - |
| 03_Level - Female WC 2 | 150 | - | - |
| 03_Level - Kitchen | 150 | - | - |
| 03_Level - Staircase 1 | 150 | - | - |
| 03_Level - Female WC 1 | 150 | - | - |
| 03_Level - Unisex Accessible WC 1 | 150 | - | - |
| 03_Level - Meeting Room 4 | 150 | - | - |
| 03_Level - Meeting Room 3 | 150 | - | - |
| 03_Level - Meeting Room 2 | 150 | - | - |
| 03_Level - Community Hall 1 | 150 | - | - |
| 03_Level - Community Hall | 150 | - | - |
| 03_Level - Store Room 1 | 150 | - | - |
| 03_Level - Male WC 2 | 150 | - | - |

## The spaces in the building should have appropriate passive control measures to limit solar gains in summer

| Zone | Solar gain limit exceeded? (%) | Internal blinds used? |
|---|---|---|
| 00_Level - Circulation 2 | NO (-95.8%) | NO |
| 00_Level - Lift 1 | N/A | N/A |
| 00_Level - Male WC 1 | N/A | N/A |
| 00_Level - Circulation 1 | NO (-70.1%) | NO |
| 00_Level - Accessible WC 1 | N/A | N/A |
| 00_Level - Adult's & Children's Library 2 | N/A | N/A |
| 00_Level - Staircase 1 | N/A | N/A |
| 00_Level - Adult's & Children's Library 1 | NO (-35.1%) | NO |
| 00_Level - Staircase 2 | NO (-95.4%) | NO |
| 00_Level - Lift Lobby 1 | NO (-88%) | NO |
| 00_Level - Lift 2 | N/A | N/A |
| 00_Level - Staircase_Library 1 | N/A | N/A |
| 00_Level - Children's WC 1 | N/A | N/A |
| 00_Level - Toilet Lobby 1 | N/A | N/A |
| 00_Level - Management Office 1 | N/A | N/A |
| 00_Level - Changing Places & WC 1 | N/A | N/A |
| 00_Level - Baby Change 1 | N/A | N/A |
| 00_Level - Cleaners Store 1 | N/A | N/A |
| 00_Level - Children's WC 2 | N/A | N/A |
| 00_Level - Female WC 1 | N/A | N/A |
| 00_Level - Entrance Lobby 1 | NO (-33.1%) | NO |
| 01_Level - Adult Library 3 | N/A | N/A |
| 01_Level - Adult Library 4 | NO (-57.4%) | NO |
| 01_Level - Toilet Lobby 1 | NO (-85.8%) | NO |
| 01_Level - Lift 1 | N/A | N/A |
| 01_Level - Female WC 1 | N/A | N/A |
| 01_Level - Male WC 1 | N/A | N/A |
| 01_Level - Unisex Accessible WC 1 | N/A | N/A |
| 01_Level - Cleaners Store 1 | N/A | N/A |
| 01_Level - Staircase 1 | N/A | N/A |
| 01_Level - Circulation 1 | NO (-77.3%) | NO |
| 01_Level - Adult Library 1 | NO (-57.7%) | NO |
| 01_Level - Staircase 2 | NO (-96.4%) | NO |
| 01_Level - Lift Lobby 2 | NO (-90.9%) | NO |
| 01_Level - Circulation 2 | N/A | N/A |
| 01_Level - Lift 2 | N/A | N/A |
| 01_Level - Store Room 1 | N/A | N/A |
| 01_Level - Adult Library 2 | NO (-58.9%) | NO |
| 02_Level - Toilet Lobby 1 | NO (-84.6%) | NO |
| 02_Level - Meeting Room | NO (-54.6%) | NO |
| 02_Level - Lift 1 | N/A | N/A |
| 02_Level - Female WC 1 | N/A | N/A |
| 02_Level - Male WC 1 | N/A | N/A |
| 02_Level - Unisex Accessible WC 1 | N/A | N/A |

| Zone | Solar gain limit exceeded? (%) | Internal blinds used? |
|---|---|---|
| 02_Level - Staircase 1 | N/A | N/A |
| 02_Level - Circulation 1 | NO (-75.4%) | NO |
| 02_Level - Youth Space_Toilet Lobby | NO (-86.4%) | NO |
| 02_Level - Staircase 2 | NO (-95.5%) | NO |
| 02_Level - Circulation 2 | NO (-88.9%) | NO |
| 02_Level - Staff Area_Toilet Lobby | NO (-88.1%) | NO |
| 02_Level - Staff Area_Accessible WC | N/A | N/A |
| 02_Level - Staff Area 1 | NO (-58.4%) | NO |
| 02_Level - Youth Space 2 | N/A | N/A |
| 02_Level - Staff Area_Female WC | N/A | N/A |
| 02_Level - Lift 2 | N/A | N/A |
| 02_Level - Council Office 2 | N/A | N/A |
| 02_Level - Council Office 1 | NO (-46.8%) | NO |
| 02_Level - Youth Space 1 | NO (-55.4%) | NO |
| 02_Level - Youth Space_Male WC | N/A | N/A |
| 02_Level - Staff Area_Male WC | N/A | N/A |
| 02_Level - Youth Space_Female WC | N/A | N/A |
| 02_Level - Youth Space_Accessible WC | N/A | N/A |
| 03_Level - Communal Circulation | NO (-82.8%) | NO |
| 03_Level - Lift 1 | N/A | N/A |
| 03_Level - Male WC 1 | N/A | N/A |
| 03_Level - Toilet Lobby 1 | NO (-84.9%) | NO |
| 03_Level - Meeting Room 1 | NO (-58.4%) | NO |
| 03_Level - Lift 2 | N/A | N/A |
| 03_Level - Toilet Lobby 2 | NO (-86.2%) | NO |
| 03_Level - Unisex Accessible WC 2 | N/A | N/A |
| 03_Level - Meeting Room 5 | NO (-64.2%) | NO |
| 03_Level - Lift Lobby 1 | NO (-87.1%) | NO |
| 03_Level - Staircase 2 | NO (-94.7%) | NO |
| 03_Level - Female WC 2 | N/A | N/A |
| 03_Level - Kitchen | NO (-93.3%) | NO |
| 03_Level - Staircase 1 | N/A | N/A |
| 03_Level - Female WC 1 | N/A | N/A |
| 03_Level - Unisex Accessible WC 1 | N/A | N/A |
| 03_Level - Meeting Room 4 | NO (-53.6%) | NO |
| 03_Level - Meeting Room 3 | NO (-55.7%) | NO |
| 03_Level - Meeting Room 2 | NO (-54.3%) | NO |
| 03_Level - Community Hall 1 | NO (-86.7%) | NO |
| 03_Level - Community Hall | NO (-72.1%) | NO |
| 03_Level - Store Room 1 | NO (-93.2%) | NO |
| 03_Level - Male WC 2 | N/A | N/A |

## Regulation 25A: Consideration of high efficiency alternative energy systems

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

# Technical Data Sheet (Actual vs. Notional Building)

## Building Global Parameters

| | Actual | Notional |
|---|---|---|
| Floor area [$m^2$] | 2738 | 2738 |
| External area [$m^2$] | 3117.7 | 3117.7 |
| Weather | LON | LON |
| Infiltration [$m^3/hm^2$@ 50Pa] | 3 | 3 |
| Average conductance [W/K] | 871.76 | 1272.26 |
| Average U-value [$W/m^2K$] | 0.28 | 0.41 |
| Alpha value* [%] | 25 | 10 |

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

## Building Use

| % Area | Building Type |
|---|---|
| | Retail/Financial and Professional Services |
| | Restaurants and Cafes/Drinking Establishments/Takeaways |
| **43** | **Offices and Workshop Businesses** |
| | General Industrial and Special Industrial Groups |
| | Storage or Distribution |
| | Hotels |
| | Residential Institutions: Hospitals and Care Homes |
| | Residential Institutions: Residential Schools |
| | Residential Institutions: Universities and Colleges |
| | Secure Residential Institutions |
| | Residential Spaces |
| **26** | **Non-residential Institutions: Community/Day Centre** |
| **34** | **Non-residential Institutions: Libraries, Museums, and Galleries** |
| | Non-residential Institutions: Education |
| **9** | **Non-residential Institutions: Primary Health Care Building** |
| | Non-residential Institutions: Crown and County Courts |
| | General Assembly and Leisure, Night Clubs, and Theatres |
| | Others: Passenger Terminals |
| | Others: Emergency Services |
| | Others: Miscellaneous 24hr Activities |
| | Others: Car Parks 24 hrs |
| | Others: Stand Alone Utility Block |

## Energy Consumption by End Use [$kWh/m^2$]

| | Actual | Notional |
|---|---|---|
| Heating | 1.58 | 4.35 |
| Cooling | 3.1 | 4.42 |
| Auxiliary | 3.04 | 3.73 |
| Lighting | 6.09 | 7.32 |
| Hot water | 0.99 | 1.35 |
| Equipment* | 29.69 | 29.69 |
| **TOTAL**** | **14.81** | **21.16** |

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

## Energy Production by Technology [$kWh/m^2$]

| | Actual | Notional |
|---|---|---|
| Photovoltaic systems | 2.74 | 0 |
| Wind turbines | 0 | 0 |
| CHP generators | 0 | 0 |
| Solar thermal systems | 0 | 0 |
| *Displaced electricity* | *2.74* | *0* |

## Energy & $CO_2$ Emissions Summary

| | Actual | Notional |
|---|---|---|
| Heating + cooling demand [$MJ/m^2$] | 104.91 | 111.29 |
| Primary energy [$kWh_{PE}/m^2$] | 18.48 | 31.22 |
| Total emissions [$kg/m^2$] | 1.74 | 2.87 |

## HVAC Systems Performance

| System Type | | Heat dem MJ/m2 | Cool dem MJ/m2 | Heat con kWh/m2 | Cool con kWh/m2 | Aux con kWh/m2 | Heat SSEEF | Cool SSEER | Heat gen SEFF | Cool gen SEER |
|---|---|---|---|---|---|---|---|---|---|---|
| [ST] Split or multi-split system, [HS] ASHP, [HFT] Electricity, [CFT] Electricity | | | | | | | | | | |
| | Actual | 25.7 | 79.2 | 1.6 | 3.1 | 3 | 4.51 | 7.1 | 4.6 | 9.5 |
| | Notional | 41.4 | 69.9 | 4.4 | 4.4 | 3.7 | 2.64 | 4.4 | ---- | ---- |

## Key to terms

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

# BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2021

**Project name**

## Land West of Worthing - School

As designed

**Date:** Fri Jan 16 14:58:39 2026

## Administrative information

### Building Details

**Address:**

### Certification tool

**Calculation engine:** SBEM

**Calculation engine version:** v6.1.e.2

**Interface to calculation engine:** DesignBuilder SBEM

**Interface to calculation engine version:** v7.3.1

**BRUKL compliance module version:** v6.1.e.1

### Certifier details

**Name:**

**Telephone number:**

**Address:** , ,

**Foundation area [m²]:** 272.05

## The $CO_2$ emission and primary energy rates of the building must not exceed the targets

| | | |
|---|---|---|
| Target $CO_2$ emission rate (TER), $kgCO_2/m^2.annum$ | 5.05 | |
| Building $CO_2$ emission rate (BER), $kgCO_2/m^2.annum$ | 3.81 | |
| Target primary energy rate (TPER), $kWh_{PE}/m^2.annum$ | 54.2 | |
| Building primary energy rate (BPER), $kWh_{PE}/m^2.annum$ | 40.82 | |
| Do the building's emission and primary energy rates exceed the targets? | BER =< TER | BPER =< TPER |

## The performance of the building fabric and fixed building services should achieve reasonable overall standards of energy efficiency

| Fabric element | $U_{a\text{-}Limit}$ | $U_{a\text{-}Calc}$ | $U_{i\text{-}Calc}$ | First surface with maximum value |
|---|---|---|---|---|
| Walls* | 0.26 | 0.18 | 0.18 | Ground - Entrance Lobby_W_6 |
| Floors | 0.18 | 0.1 | 0.1 | Ground - Entrance Lobby_S_3 |
| Pitched roofs | 0.16 | 0.14 | 0.14 | Ground - Entrance Lobby_R_4 |
| Flat roofs | 0.18 | - | - | No heat loss flat roofs |
| Windows** and roof windows | 1.6 | 1.4 | 1.4 | Ground - Entrance Lobby_G_7 |
| Rooflights*** | 2.2 | - | - | No external rooflights |
| Personnel doors^ | 1.6 | - | - | No external personnel doors |
| Vehicle access & similar large doors | 1.3 | - | - | No external vehicle access doors |
| High usage entrance doors | 3 | - | - | No external high usage entrance doors |

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [W/(m²K)] $U_{i\text{-}Calc}$ = Calculated maximum individual element U-values [W/(m²K)]

$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [W/(m²K)]

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

** Display windows and similar glazing are excluded from the U-value check. *** Values for rooflights refer to the horizontal position.

^ For fire doors, limiting U-value is 1.8 W/m²K

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

| Air permeability | Limiting standard | This building |
|---|---|---|
| $m^3/(h.m^2)$ at 50 Pa | 8 | 7 |

## Building services

**For details on the standard values listed below, system-specific guidance, and additional regulatory requirements, refer to the Approved Documents.**

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

1- Indirectly Heated by VRF

| | Heating efficiency | Cooling efficiency | Radiant efficiency | SFP [W/(l/s)] | HR efficiency |
|---|---|---|---|---|---|
| **This system** | 4.7 | - | - | - | - |
| **Standard value** | 2.5* | N/A | N/A | N/A | N/A |
| **Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system** | | | | | NO |
| * Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps. | | | | | |

2- VRF

| | Heating efficiency | Cooling efficiency | Radiant efficiency | SFP [W/(l/s)] | HR efficiency |
|---|---|---|---|---|---|
| **This system** | 4.5 | 6.5 | - | - | - |
| **Standard value** | 2.5* | 5 | N/A | N/A | N/A |
| **Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system** | | | | | YES |
| * Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps. | | | | | |

1- Project DHW

| | Water heating efficiency | Storage loss factor [kWh/litre per day] |
|---|---|---|
| **This building** | 2.5 | 0.006 |
| **Standard value** | 2* | N/A |
| * Standard shown is for all types except absorption and gas engine heat pumps. | | |

### Zone-level mechanical ventilation, exhaust, and terminal units

| ID | System type in the Approved Documents |
|---|---|
| A | Local supply or extract ventilation units |
| B | Zonal supply system where the fan is remote from the zone |
| C | Zonal extract system where the fan is remote from the zone |
| D | Zonal balanced supply and extract ventilation system |
| E | Local balanced supply and extract ventilation units |
| F | Other local ventilation units |
| G | Fan assisted terminal variable air volume units |
| H | Fan coil units |
| I | Kitchen extract with the fan remote from the zone and a grease filter |
| NB: Limiting SFP may be increased by the amounts specified in the Approved Documents if the installation includes particular components. | |

| Zone name | SFP [W/(l/s)] | | | | | | | | | HR efficiency | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **ID of system type** | **A** | **B** | **C** | **D** | **E** | **F** | **G** | **H** | **I** | | |
| **Standard value** | 0.3 | 1.1 | 0.5 | 2.3 | 2 | 0.5 | 0.5 | 0.4 | 1 | **Zone** | **Standard** |
| Ground - WC 1 | 0.3 | - | - | - | - | - | - | - | - | - | N/A |
| Ground - WC 2 | 0.3 | - | - | - | - | - | - | - | - | - | N/A |
| Ground - Shower | 0.3 | - | - | - | - | - | - | - | - | - | N/A |
| Ground - Disabled Toilet | 0.3 | - | - | - | - | - | - | - | - | - | N/A |
| Ground - Cleaners | 0.3 | - | - | - | - | - | - | - | - | - | N/A |
| Ground - Reception & Admin | - | - | - | - | 1.4 | - | - | - | - | 0.85 | N/A |

| Zone name | SFP [W/(l/s)] | | | | | | | | | HR efficiency | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ID of system type | A | B | C | D | E | F | G | H | I | | |
| Standard value | 0.3 | 1.1 | 0.5 | 2.3 | 2 | 0.5 | 0.5 | 0.4 | 1 | Zone | Standard |
| Ground - Food Technology | - | - | - | - | 1.4 | - | - | - | - | 0.85 | N/A |
| Ground - Time Out & Medical Store | - | - | - | - | 1.4 | - | - | - | - | 0.85 | N/A |
| Ground - Art Classroom | - | - | - | - | 1.4 | - | - | - | - | 0.85 | N/A |
| Ground - Dining & Drama | - | - | - | - | 1.4 | - | - | - | - | 0.85 | N/A |
| Ground - Heads Office | - | - | - | - | 1.4 | - | - | - | - | 0.85 | N/A |
| Ground - Staff Room | - | - | - | - | 1.4 | - | - | - | - | 0.85 | N/A |
| Ground - Science | - | - | - | - | 1.4 | - | - | - | - | 0.85 | N/A |
| Ground - General Classroom | - | - | - | - | 1.4 | - | - | - | - | 0.85 | N/A |
| Ground - ICT | - | - | - | - | 1.4 | - | - | - | - | 0.85 | N/A |

| General lighting and display lighting | General luminaire | Display light source | |
|---|---|---|---|
| Zone name | Efficacy [lm/W] | Efficacy [lm/W] | Power density [W/m²] |
| Standard value | 95 | 80 | 0.3 |
| Ground - Entrance Lobby | 110 | - | - |
| Ground - WC 1 | 110 | - | - |
| Ground - Corridor | 110 | - | - |
| Ground - WC 2 | 110 | - | - |
| Ground - Shower | 110 | - | - |
| Ground - Disabled Toilet | 110 | - | - |
| Ground - Store | 110 | - | - |
| Ground - Exam Store | 110 | - | - |
| Ground - Cleaners | 110 | - | - |
| Ground - Reception & Admin | 110 | 80 | 1.688 |
| Ground - Food Technology | 110 | - | - |
| Ground - Time Out & Medical Store | 110 | - | - |
| Ground - Art Classroom | 110 | - | - |
| Ground - Dining & Drama | 110 | - | - |
| Ground - Heads Office | 110 | - | - |
| Ground - Staff Room | 110 | - | - |
| Ground - Science | 110 | - | - |
| Ground - General Classroom | 110 | - | - |
| Ground - ICT | 110 | - | - |
| Ground - Comms | 110 | - | - |
| Ground - Plant Room | 110 | - | - |

## The spaces in the building should have appropriate passive control measures to limit solar gains in summer

| Zone | Solar gain limit exceeded? (%) | Internal blinds used? |
|---|---|---|
| Ground - Corridor | NO (-22.6%) | NO |
| Ground - Reception & Admin | NO (-74.7%) | NO |
| Ground - Food Technology | NO (-87.8%) | NO |
| Ground - Time Out & Medical Store | N/A | N/A |
| Ground - Art Classroom | NO (-33.9%) | NO |

| Zone | Solar gain limit exceeded? (%) | Internal blinds used? |
|---|---|---|
| Ground - Dining & Drama | NO (-63.7%) | NO |
| Ground - Heads Office | NO (-61%) | NO |
| Ground - Staff Room | NO (-57.9%) | NO |
| Ground - Science | NO (-48.1%) | NO |
| Ground - General Classroom | NO (-67.5%) | NO |
| Ground - ICT | NO (-88.5%) | NO |
| Ground - Comms | N/A | N/A |

## Regulation 25A: Consideration of high efficiency alternative energy systems

| | |
|---|---|
| **Were alternative energy systems considered and analysed as part of the design process?** | NO |
| Is evidence of such assessment available as a separate submission? | NO |
| Are any such measures included in the proposed design? | NO |

# Technical Data Sheet (Actual vs. Notional Building)

## Building Global Parameters

| | Actual | Notional |
|---|---|---|
| Floor area [$m^2$] | 276 | 276 |
| External area [$m^2$] | 774.7 | 774.7 |
| Weather | SWI | SWI |
| Infiltration [$m^3/hm^2$@ 50Pa] | 7 | 3 |
| Average conductance [W/K] | 157.31 | 214.71 |
| Average U-value [$W/m^2K$] | 0.2 | 0.28 |
| Alpha value* [%] | 31.94 | 23.44 |

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

## Building Use

| % Area | Building Type |
|---|---|
| | Retail/Financial and Professional Services |
| | Restaurants and Cafes/Drinking Establishments/Takeaways |
| | Offices and Workshop Businesses |
| | General Industrial and Special Industrial Groups |
| | Storage or Distribution |
| | Hotels |
| | Residential Institutions: Hospitals and Care Homes |
| | Residential Institutions: Residential Schools |
| | Residential Institutions: Universities and Colleges |
| | Secure Residential Institutions |
| | Residential Spaces |
| | Non-residential Institutions: Community/Day Centre |
| | Non-residential Institutions: Libraries, Museums, and Galleries |
| **96** | **Non-residential Institutions: Education** |
| **3** | **Non-residential Institutions: Primary Health Care Building** |
| | Non-residential Institutions: Crown and County Courts |
| | General Assembly and Leisure, Night Clubs, and Theatres |
| | Others: Passenger Terminals |
| | Others: Emergency Services |
| **1** | **Others: Miscellaneous 24hr Activities** |
| | Others: Car Parks 24 hrs |
| | Others: Stand Alone Utility Block |

## Energy Consumption by End Use [$kWh/m^2$]

| | Actual | Notional |
|---|---|---|
| Heating | 5.59 | 8.46 |
| Cooling | 2.63 | 3.93 |
| Auxiliary | 5.41 | 7.23 |
| Lighting | 7.56 | 7.07 |
| Hot water | 5.53 | 9.74 |
| Equipment* | 29.49 | 29.49 |
| **TOTAL**** | **26.72** | **36.44** |

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

## Energy Production by Technology [$kWh/m^2$]

| | Actual | Notional |
|---|---|---|
| Photovoltaic systems | 0 | 0 |
| Wind turbines | 0 | 0 |
| CHP generators | 0 | 0 |
| Solar thermal systems | 0 | 0 |
| *Displaced electricity* | *0* | *0* |

## Energy & $CO_2$ Emissions Summary

| | Actual | Notional |
|---|---|---|
| Heating + cooling demand [$MJ/m^2$] | 160.85 | 170.47 |
| Primary energy [$kWh_{PE}/m^2$] | 40.82 | 54.2 |
| Total emissions [$kg/m^2$] | 3.81 | 5.05 |

## HVAC Systems Performance

| System Type | | Heat dem MJ/m2 | Cool dem MJ/m2 | Heat con kWh/m2 | Cool con kWh/m2 | Aux con kWh/m2 | Heat SSEEF | Cool SSEER | Heat gen SEFF | Cool gen SEER |
|---|---|---|---|---|---|---|---|---|---|---|
| [ST] Central heating using water: radiators, [HS] ASHP, [HFT] Electricity, [CFT] Natural Gas | | | | | | | | | | |
| | Actual | 142.4 | 36.2 | 9.4 | 0 | 3.1 | 4.19 | 0 | 4.7 | 0 |
| | Notional | 128.2 | 44.5 | 13.5 | 0 | 2.6 | 2.64 | 0 | ---- | ---- |
| [ST] Split or multi-split system, [HS] ASHP, [HFT] Electricity, [CFT] Electricity | | | | | | | | | | |
| | Actual | 65.1 | 66.2 | 4.1 | 3.8 | 6.5 | 4.41 | 4.86 | 4.5 | 6.5 |
| | Notional | 62.1 | 89.6 | 6.5 | 5.7 | 4.2 | 2.64 | 4.4 | ---- | ---- |
| [ST] No Heating or Cooling | | | | | | | | | | |
| | Actual | 0 | 1224.2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Notional | 0 | 1032.9 | 0 | 0 | 0 | 0 | 0 | ---- | ---- |

### Key to terms

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

# BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2021

**Project name** **Shell and Core**

## Land West of Worthing - Warehouse

As designed

**Date:** Fri Jan 16 14:45:18 2026

## Administrative information

### Building Details

**Address:** SEGRO V Park Grand Union, London, HA0

### Certifier details

**Name:** Nimco Ali

**Telephone number:** 02036031613

**Address:** Trinity Court Batchworth Island Church Street, Rickmansworth, WD3 1RT

### Certification tool

**Calculation engine:** SBEM

**Calculation engine version:** v6.1.e.2

**Interface to calculation engine:** DesignBuilder SBEM

**Interface to calculation engine version:** v7.3.1

**BRUKL compliance module version:** v6.1.e.1

**Foundation area [m²]:** 12947.3

## The $CO_2$ emission and primary energy rates of the building must not exceed the targets

| | | |
|---|---|---|
| Target $CO_2$ emission rate (TER), $kgCO_2/m^2.annum$ | 2.62 | |
| Building $CO_2$ emission rate (BER), $kgCO_2/m^2.annum$ | 1.6 | |
| Target primary energy rate (TPER), $kWh_{PE}/m^2.annum$ | 27.97 | |
| Building primary energy rate (BPER), $kWh_{PE}/m^2.annum$ | 16.43 | |
| Do the building's emission and primary energy rates exceed the targets? | BER =< TER | BPER =< TPER |

## The performance of the building fabric and fixed building services should achieve reasonable overall standards of energy efficiency

| Fabric element | $U_{a\text{-}Limit}$ | $U_{a\text{-}Calc}$ | $U_{i\text{-}Calc}$ | First surface with maximum value |
|---|---|---|---|---|
| Walls* | 0.26 | 0.25 | 0.25 | 01 Ground Floor - WC_W_5 |
| Floors | 0.18 | 0.12 | 0.2 | 03 1st Floor - Meeting Room 3_F_3 |
| Pitched roofs | 0.16 | - | - | No heat loss pitched roofs |
| Flat roofs | 0.18 | 0.18 | 0.2 | 01 Ground Floor - WC_R_4 |
| Windows** and roof windows | 1.6 | 1.2 | 1.2 | 00 Ground Floor - Management Office_G_7 |
| Rooflights*** | 2.2 | - | - | No external rooflights |
| Personnel doors^ | 1.6 | 1.6 | 1.6 | 00 Ground Floor - Stairs_D_9 |
| Vehicle access & similar large doors | 1.3 | - | - | No external vehicle access doors |
| High usage entrance doors | 3 | - | - | No external high usage entrance doors |

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [W/(m²K)] $U_{i\text{-}Calc}$ = Calculated maximum individual element U-values [W/(m²K)]

$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [W/(m²K)]

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

** Display windows and similar glazing are excluded from the U-value check. *** Values for rooflights refer to the horizontal position.

^ For fire doors, limiting U-value is 1.8 W/m²K

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

| Air permeability | Limiting standard | This building |
|---|---|---|
| $m^3/(h.m^2)$ at 50 Pa | 8 | 5 |

## Building services

**For details on the standard values listed below, system-specific guidance, and additional regulatory requirements, refer to the Approved Documents.**

| | |
|---|---|
| **Whole building lighting automatic monitoring & targeting with alarms for out-of-range values** | YES |
| **Whole building electric power factor achieved by power factor correction** | >0.95 |

1- Electric Panel Heater

| | Heating efficiency | Cooling efficiency | Radiant efficiency | SFP [W/(l/s)] | HR efficiency |
|---|---|---|---|---|---|
| **This system** | 1 | - | - | - | - |
| **Standard value** | N/A | N/A | N/A | N/A | N/A |
| **Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system** | | | | | NO |

2- Heat Pump

| | Heating efficiency | Cooling efficiency | Radiant efficiency | SFP [W/(l/s)] | HR efficiency |
|---|---|---|---|---|---|
| **This system** | 4.5 | 7 | - | - | - |
| **Standard value** | 2.5* | 5 | N/A | N/A | N/A |
| **Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system** | | | | | YES |
| * Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps. | | | | | |

3- Indirectly Heated Heat Pump

| | Heating efficiency | Cooling efficiency | Radiant efficiency | SFP [W/(l/s)] | HR efficiency |
|---|---|---|---|---|---|
| **This system** | 4.5 | - | - | - | - |
| **Standard value** | 2.5* | N/A | N/A | N/A | N/A |
| **Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system** | | | | | NO |
| * Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps. | | | | | |

1- Project DHW

| | Water heating efficiency | Storage loss factor [kWh/litre per day] |
|---|---|---|
| **This building** | 3.25 | 0 |
| **Standard value** | 2* | N/A |
| * Standard shown is for all types except absorption and gas engine heat pumps. | | |

### Zone-level mechanical ventilation, exhaust, and terminal units

| ID | System type in the Approved Documents |
|---|---|
| A | Local supply or extract ventilation units |
| B | Zonal supply system where the fan is remote from the zone |
| C | Zonal extract system where the fan is remote from the zone |
| D | Zonal balanced supply and extract ventilation system |
| E | Local balanced supply and extract ventilation units |
| F | Other local ventilation units |
| G | Fan assisted terminal variable air volume units |
| H | Fan coil units |
| I | Kitchen extract with the fan remote from the zone and a grease filter |
| NB: Limiting SFP may be increased by the amounts specified in the Approved Documents if the installation includes particular components. | |

| Zone name | SFP [W/(l/s)] | | | | | | | | | HR efficiency | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **ID of system type** | **A** | **B** | **C** | **D** | **E** | **F** | **G** | **H** | **I** | | |
| **Standard value** | 0.3 | 1.1 | 0.5 | 2.3 | 2 | 0.5 | 0.5 | 0.4 | 1 | **Zone** | **Standard** |
| 01 Ground Floor - WC | - | - | 0.3 | - | - | - | - | - | - | - | N/A |

| Zone name | SFP [W/(l/s)] | | | | | | | | | HR efficiency | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ID of system type | A | B | C | D | E | F | G | H | I | | |
| Standard value | 0.3 | 1.1 | 0.5 | 2.3 | 2 | 0.5 | 0.5 | 0.4 | 1 | Zone | Standard |
| 00 Ground Floor - Management Office | - | - | - | - | 1 | - | - | - | - | 0.85 | N/A |
| 03 1st Floor - Meeting Room 2 | - | - | - | - | 1 | - | - | - | - | 0.85 | N/A |
| 03 1st Floor - Meeting Room 1 | - | - | - | - | 1 | - | - | - | - | 0.85 | N/A |
| 03 1st Floor - Meeting Room 3 | - | - | - | - | 1 | - | - | - | - | 0.85 | N/A |
| 04 1st Floor - Breakout Area | - | - | - | - | 1 | - | - | - | - | 0.85 | N/A |
| 04 1st Floor - Meeting Room 1 | - | - | - | - | 1 | - | - | - | - | 0.85 | N/A |
| 06 3rd Floor - Workshop 03 | - | - | - | - | 1 | - | - | - | - | 0.85 | N/A |
| 06 3rd Floor - Workshop 04 | - | - | - | - | 1 | - | - | - | - | 0.85 | N/A |
| 06 3rd Floor - Workshop 06 | - | - | - | - | 1 | - | - | - | - | 0.85 | N/A |
| 06 3rd Floor - Workshop 05 | - | - | - | - | 1 | - | - | - | - | 0.85 | N/A |
| 06 3rd Floor - Workshop 01 | - | - | - | - | 1 | - | - | - | - | 0.85 | N/A |
| 06 3rd Floor - Workshop 02 | - | - | - | - | 1 | - | - | - | - | 0.85 | N/A |
| 08 5th Floor - Workshop 06 | - | - | - | - | 1 | - | - | - | - | 0.85 | N/A |
| 08 5th Floor - Workshop 03 | - | - | - | - | 1 | - | - | - | - | 0.85 | N/A |
| 08 5th Floor - Workshop 11 | - | - | - | - | 1 | - | - | - | - | 0.85 | N/A |
| 08 5th Floor - Workshop 10 | - | - | - | - | 1 | - | - | - | - | 0.85 | N/A |
| 08 5th Floor - Workshop 09 | - | - | - | - | 1 | - | - | - | - | 0.85 | N/A |
| 08 5th Floor - Workshop 05 | - | - | - | - | 1 | - | - | - | - | 0.85 | N/A |
| 08 5th Floor - Workshop 02 | - | - | - | - | 1 | - | - | - | - | 0.85 | N/A |
| 08 5th Floor - Workshop 08 | - | - | - | - | 1 | - | - | - | - | 0.85 | N/A |
| 08 5th Floor - Workshop 01 | - | - | - | - | 1 | - | - | - | - | 0.85 | N/A |
| 08 5th Floor - Workshop 04 | - | - | - | - | 1 | - | - | - | - | 0.85 | N/A |
| 08 5th Floor - Workshop 07 | - | - | - | - | 1 | - | - | - | - | 0.85 | N/A |
| 08 5th Floor - Workshop 12 | - | - | - | - | 1 | - | - | - | - | 0.85 | N/A |
| 02 Ground Floor - WC | - | - | 0.3 | - | - | - | - | - | - | - | N/A |
| 00 Ground Floor - Showers | - | - | 0.3 | - | - | - | - | - | - | - | N/A |
| 00 Ground Floor - WC | - | - | 0.3 | - | - | - | - | - | - | - | N/A |
| 04 1st Floor - Meeting Room 2 | - | - | - | - | 1 | - | - | - | - | 0.85 | N/A |
| 05 2nd Floor - Workshop | - | - | - | - | 1 | - | - | - | - | 0.85 | N/A |
| 06 3rd Floor - WC 3 | - | - | 0.3 | - | - | - | - | - | - | - | N/A |
| 06 3rd Floor - Shower 2 | - | - | 0.3 | - | - | - | - | - | - | - | N/A |
| 06 3rd Floor - WC 2 | - | - | 0.3 | - | - | - | - | - | - | - | N/A |
| 06 3rd Floor - Shower 3 | - | - | 0.3 | - | - | - | - | - | - | - | N/A |
| 06 3rd Floor - WC 1 | - | - | 0.3 | - | - | - | - | - | - | - | N/A |
| 06 3rd Floor - Shower 1 | - | - | 0.3 | - | - | - | - | - | - | - | N/A |
| 07 4th Floor - Workshop | - | - | - | - | 1 | - | - | - | - | 0.85 | N/A |
| 08 5th Floor - WCs 3 | - | - | 0.3 | - | - | - | - | - | - | - | N/A |
| 08 5th Floor - WC 1 | - | - | 0.3 | - | - | - | - | - | - | - | N/A |
| 08 5th Floor - WCs 2 | - | - | 0.3 | - | - | - | - | - | - | - | N/A |

**Shell and core configuration**

| Zone | Assumed shell? |
|---|---|
| 01 Ground Floor - WC | NO |
| 00 Ground Floor - Management Office | NO |
| 00 Ground Floor - IT | NO |

**Shell and core configuration**

| Zone | Assumed shell? |
|---|---|
| 03 1st Floor - Meeting Room 2 | NO |
| 03 1st Floor - Meeting Room 1 | NO |
| 03 1st Floor - Meeting Room 3 | NO |
| 04 1st Floor - Breakout Area | NO |
| 04 1st Floor - Meeting Room 1 | NO |
| 06 3rd Floor - Workshop 03 | NO |
| 06 3rd Floor - Workshop 04 | NO |
| 06 3rd Floor - Workshop 06 | NO |
| 06 3rd Floor - Workshop 05 | NO |
| 06 3rd Floor - Workshop 01 | NO |
| 06 3rd Floor - Workshop 02 | NO |
| 08 5th Floor - Workshop 06 | NO |
| 08 5th Floor - Workshop 03 | NO |
| 08 5th Floor - Workshop 11 | NO |
| 08 5th Floor - Workshop 10 | NO |
| 08 5th Floor - Workshop 09 | NO |
| 08 5th Floor - Workshop 05 | NO |
| 08 5th Floor - Workshop 02 | NO |
| 08 5th Floor - Workshop 08 | NO |
| 08 5th Floor - Workshop 01 | NO |
| 08 5th Floor - Workshop 04 | NO |
| 08 5th Floor - Workshop 07 | NO |
| 08 5th Floor - Workshop 12 | NO |
| 02 Ground Floor - Entrance Lobby | NO |
| 02 Ground Floor - Cupboard | NO |
| 02 Ground Floor - WC | NO |
| 02 Ground Floor - Stairs | NO |
| 02 Ground Floor - Lobby | NO |
| 02 Ground Floor - Riser | NO |
| 01 Ground Floor - Lobby | NO |
| 00 Ground Floor - Stairs | NO |
| 00 Ground Floor - Lobby | NO |
| 00 Ground Floor - Showers | NO |
| 00 Ground Floor - WC | NO |
| 00 Ground Floor - Lockers | NO |
| 03 1st Floor - Lobby | NO |
| 04 1st Floor - Riser 2 | NO |
| 04 1st Floor - Riser 1 | NO |
| 04 1st Floor - Stairs 1 | NO |
| 04 1st Floor - Lobby 1 | NO |
| 04 1st Floor - Lobby 2 | NO |
| 04 1st Floor - Lobby 4 | NO |
| 04 1st Floor - Lobby 3 | NO |
| 04 1st Floor - Lobby 5 | NO |
| 04 1st Floor - Meeting Room 2 | NO |
| 04 1st Floor - Stairs 2 | NO |
| 05 2nd Floor - Workshop | NO |

**Shell and core configuration**

| Zone | Assumed shell? |
|---|---|
| 05 2nd Floor - Stairs 1 | NO |
| 05 2nd Floor - Lobby | NO |
| 05 2nd Floor - Riser 1 | NO |
| 05 2nd Floor - Riser 2 | NO |
| 05 2nd Floor - Stairs 2 | NO |
| 05 2nd Floor - Lobby | NO |
| 05 2nd Floor - Riser 3 | NO |
| 05 2nd Floor - Riser 5 | NO |
| 05 2nd Floor - Riser 6 | NO |
| 06 3rd Floor - Loading Bay | NO |
| 06 3rd Floor - Lobby 2 | NO |
| 06 3rd Floor - Riser 4 | NO |
| 06 3rd Floor - Corridor | NO |
| 06 3rd Floor - Stairs 2 | NO |
| 06 3rd Floor - Riser 3 | NO |
| 06 3rd Floor - Stairs 1 | NO |
| 06 3rd Floor - Lobby 1 | NO |
| 06 3rd Floor - WC 3 | NO |
| 06 3rd Floor - Shower 2 | NO |
| 06 3rd Floor - WC 2 | NO |
| 06 3rd Floor - Riser 2 | NO |
| 06 3rd Floor - Riser 5 | NO |
| 06 3rd Floor - Shower 3 | NO |
| 06 3rd Floor - Riser 1 | NO |
| 06 3rd Floor - WC 1 | NO |
| 06 3rd Floor - Shower 1 | NO |
| 07 4th Floor - Workshop | NO |
| 07 4th Floor - Stairs 1 | NO |
| 07 4th Floor - Lobby | NO |
| 07 4th Floor - Riser 2 | NO |
| 07 4th Floor - Riser 3 | NO |
| 07 4th Floor - Stairs 2 | NO |
| 07 4th Floor - Lobby | NO |
| 07 4th Floor - Riser 4 | NO |
| 07 4th Floor - Riser 6 | NO |
| 07 4th Floor - Riser 1 | NO |
| 08 5th Floor - Loading Area | NO |
| 08 5th Floor - Lobby | NO |
| 08 5th Floor - Stairs 2 | NO |
| 08 5th Floor - Riser 6 | NO |
| 08 5th Floor - Riser 5 | NO |
| 08 5th Floor - Corridor | NO |
| 08 5th Floor - WCs 3 | NO |
| 08 5th Floor - Riser 4 | NO |
| 08 5th Floor - WC 1 | NO |
| 08 5th Floor - Riser 3 | NO |
| 08 5th Floor - Riser 2 | NO |

**Shell and core configuration**

| Zone | Assumed shell? |
|---|---|
| 08 5th Floor - WCs 2 | NO |
| 08 5th Floor - Riser 1 | NO |
| 08 5th Floor - Stairs 1 | NO |
| 08 5th Floor - Lobby | NO |

| General lighting and display lighting | General luminaire | Display light source | |
|---|---|---|---|
| Zone name | Efficacy [lm/W] | Efficacy [lm/W] | Power density [W/m²] |
| Standard value | 95 | 80 | 0.3 |
| 01 Ground Floor - WC | 130 | - | - |
| 00 Ground Floor - Management Office | 130 | - | - |
| 00 Ground Floor - IT | 130 | - | - |
| 03 1st Floor - Meeting Room 2 | 130 | - | - |
| 03 1st Floor - Meeting Room 1 | 130 | - | - |
| 03 1st Floor - Meeting Room 3 | 130 | - | - |
| 04 1st Floor - Breakout Area | 130 | - | - |
| 04 1st Floor - Meeting Room 1 | 130 | - | - |
| 06 3rd Floor - Workshop 03 | 130 | - | - |
| 06 3rd Floor - Workshop 04 | 130 | - | - |
| 06 3rd Floor - Workshop 06 | 130 | - | - |
| 06 3rd Floor - Workshop 05 | 130 | - | - |
| 06 3rd Floor - Workshop 01 | 130 | - | - |
| 06 3rd Floor - Workshop 02 | 130 | - | - |
| 08 5th Floor - Workshop 06 | 130 | - | - |
| 08 5th Floor - Workshop 03 | 130 | - | - |
| 08 5th Floor - Workshop 11 | 130 | - | - |
| 08 5th Floor - Workshop 10 | 130 | - | - |
| 08 5th Floor - Workshop 09 | 130 | - | - |
| 08 5th Floor - Workshop 05 | 130 | - | - |
| 08 5th Floor - Workshop 02 | 130 | - | - |
| 08 5th Floor - Workshop 08 | 130 | - | - |
| 08 5th Floor - Workshop 01 | 130 | - | - |
| 08 5th Floor - Workshop 04 | 130 | - | - |
| 08 5th Floor - Workshop 07 | 130 | - | - |
| 08 5th Floor - Workshop 12 | 130 | - | - |
| 02 Ground Floor - Entrance Lobby | 130 | - | - |
| 02 Ground Floor - Cupboard | 130 | - | - |
| 02 Ground Floor - WC | 130 | - | - |
| 02 Ground Floor - Stairs | 130 | - | - |
| 02 Ground Floor - Lobby | 130 | - | - |
| 02 Ground Floor - Riser | 130 | - | - |
| 01 Ground Floor - Lobby | 130 | - | - |
| 00 Ground Floor - Stairs | 130 | - | - |
| 00 Ground Floor - Lobby | 130 | - | - |
| 00 Ground Floor - Showers | 130 | - | - |
| 00 Ground Floor - WC | 130 | - | - |

| General lighting and display lighting | General luminaire | Display light source | |
|---|---|---|---|
| Zone name | Efficacy [lm/W] | Efficacy [lm/W] | Power density [W/m²] |
| Standard value | 95 | 80 | 0.3 |
| 00 Ground Floor - Lockers | 130 | - | - |
| 03 1st Floor - Lobby | 130 | - | - |
| 04 1st Floor - Riser 2 | 130 | - | - |
| 04 1st Floor - Riser 1 | 130 | - | - |
| 04 1st Floor - Stairs 1 | 130 | - | - |
| 04 1st Floor - Lobby 1 | 130 | - | - |
| 04 1st Floor - Lobby 2 | 130 | - | - |
| 04 1st Floor - Lobby 4 | 130 | - | - |
| 04 1st Floor - Lobby 3 | 130 | - | - |
| 04 1st Floor - Lobby 5 | 130 | - | - |
| 04 1st Floor - Meeting Room 2 | 130 | - | - |
| 04 1st Floor - Stairs 2 | 130 | - | - |
| 05 2nd Floor - Workshop | 130 | - | - |
| 05 2nd Floor - Stairs 1 | 130 | - | - |
| 05 2nd Floor - Lobby | 130 | - | - |
| 05 2nd Floor - Riser 1 | 130 | - | - |
| 05 2nd Floor - Riser 2 | 130 | - | - |
| 05 2nd Floor - Stairs 2 | 130 | - | - |
| 05 2nd Floor - Lobby | 130 | - | - |
| 05 2nd Floor - Riser 3 | 130 | - | - |
| 05 2nd Floor - Riser 5 | 130 | - | - |
| 05 2nd Floor - Riser 6 | 130 | - | - |
| 06 3rd Floor - Loading Bay | 130 | - | - |
| 06 3rd Floor - Lobby 2 | 130 | - | - |
| 06 3rd Floor - Riser 4 | 130 | - | - |
| 06 3rd Floor - Corridor | 130 | - | - |
| 06 3rd Floor - Stairs 2 | 130 | - | - |
| 06 3rd Floor - Riser 3 | 130 | - | - |
| 06 3rd Floor - Stairs 1 | 130 | - | - |
| 06 3rd Floor - Lobby 1 | 130 | - | - |
| 06 3rd Floor - WC 3 | 130 | - | - |
| 06 3rd Floor - Shower 2 | 130 | - | - |
| 06 3rd Floor - WC 2 | 130 | - | - |
| 06 3rd Floor - Riser 2 | 130 | - | - |
| 06 3rd Floor - Riser 5 | 130 | - | - |
| 06 3rd Floor - Shower 3 | 130 | - | - |
| 06 3rd Floor - Riser 1 | 130 | - | - |
| 06 3rd Floor - WC 1 | 130 | - | - |
| 06 3rd Floor - Shower 1 | 130 | - | - |
| 07 4th Floor - Workshop | 130 | - | - |
| 07 4th Floor - Stairs 1 | 130 | - | - |
| 07 4th Floor - Lobby | 130 | - | - |
| 07 4th Floor - Riser 2 | 130 | - | - |

| General lighting and display lighting | General luminaire | Display light source | |
|---|---|---|---|
| Zone name | Efficacy [lm/W] | Efficacy [lm/W] | Power density [W/m²] |
| Standard value | 95 | 80 | 0.3 |
| 07 4th Floor - Riser 3 | 130 | - | - |
| 07 4th Floor - Stairs 2 | 130 | - | - |
| 07 4th Floor - Lobby | 130 | - | - |
| 07 4th Floor - Riser 4 | 130 | - | - |
| 07 4th Floor - Riser 6 | 130 | - | - |
| 07 4th Floor - Riser 1 | 130 | - | - |
| 08 5th Floor - Loading Area | 130 | - | - |
| 08 5th Floor - Lobby | 130 | - | - |
| 08 5th Floor - Stairs 2 | 130 | - | - |
| 08 5th Floor - Riser 6 | 130 | - | - |
| 08 5th Floor - Riser 5 | 130 | - | - |
| 08 5th Floor - Corridor | 130 | - | - |
| 08 5th Floor - WCs 3 | 130 | - | - |
| 08 5th Floor - Riser 4 | 130 | - | - |
| 08 5th Floor - WC 1 | 130 | - | - |
| 08 5th Floor - Riser 3 | 130 | - | - |
| 08 5th Floor - Riser 2 | 130 | - | - |
| 08 5th Floor - WCs 2 | 130 | - | - |
| 08 5th Floor - Riser 1 | 130 | - | - |
| 08 5th Floor - Stairs 1 | 130 | - | - |
| 08 5th Floor - Lobby | 130 | - | - |

## The spaces in the building should have appropriate passive control measures to limit solar gains in summer

| Zone | Solar gain limit exceeded? (%) | Internal blinds used? |
|---|---|---|
| 00 Ground Floor - Management Office | NO (-46.4%) | NO |
| 00 Ground Floor - IT | N/A | N/A |
| 03 1st Floor - Meeting Room 2 | NO (-36.8%) | NO |
| 03 1st Floor - Meeting Room 1 | NO (-63.8%) | NO |
| 03 1st Floor - Meeting Room 3 | NO (-89.5%) | NO |
| 04 1st Floor - Breakout Area | NO (-36.7%) | NO |
| 04 1st Floor - Meeting Room 1 | N/A | N/A |
| 06 3rd Floor - Workshop 03 | NO (-72.4%) | NO |
| 06 3rd Floor - Workshop 04 | NO (-32.9%) | NO |
| 06 3rd Floor - Workshop 06 | NO (-45.2%) | NO |
| 06 3rd Floor - Workshop 05 | NO (-59.4%) | NO |
| 06 3rd Floor - Workshop 01 | NO (-85.9%) | NO |
| 06 3rd Floor - Workshop 02 | NO (-74.1%) | NO |
| 08 5th Floor - Workshop 06 | NO (-44.4%) | NO |
| 08 5th Floor - Workshop 03 | YES (+1.6%) | NO |
| 08 5th Floor - Workshop 11 | NO (-37%) | NO |
| 08 5th Floor - Workshop 10 | YES (+1%) | NO |
| 08 5th Floor - Workshop 09 | NO (-5.4%) | NO |
| 08 5th Floor - Workshop 05 | NO (-35.7%) | NO |

| Zone | Solar gain limit exceeded? (%) | Internal blinds used? |
|---|---|---|
| 08 5th Floor - Workshop 02 | NO (-69.7%) | NO |
| 08 5th Floor - Workshop 08 | NO (-60.1%) | NO |
| 08 5th Floor - Workshop 01 | NO (-43.3%) | NO |
| 08 5th Floor - Workshop 04 | NO (-45.9%) | NO |
| 08 5th Floor - Workshop 07 | NO (-22.8%) | NO |
| 08 5th Floor - Workshop 12 | NO (-78.7%) | NO |
| 00 Ground Floor - Lockers | N/A | N/A |
| 04 1st Floor - Riser 2 | N/A | N/A |
| 04 1st Floor - Lobby 5 | N/A | N/A |
| 04 1st Floor - Meeting Room 2 | N/A | N/A |
| 05 2nd Floor - Workshop | NO (-67.4%) | NO |
| 05 2nd Floor - Riser 6 | N/A | N/A |
| 07 4th Floor - Workshop | NO (-73.6%) | NO |

## Regulation 25A: Consideration of high efficiency alternative energy systems

| | |
|---|---|
| **Were alternative energy systems considered and analysed as part of the design process?** | NO |
| Is evidence of such assessment available as a separate submission? | NO |
| Are any such measures included in the proposed design? | NO |

# Technical Data Sheet (Actual vs. Notional Building)

## Building Global Parameters

| | Actual | Notional |
|---|---|---|
| Floor area [$m^2$] | 12947.3 | 12947.3 |
| External area [$m^2$] | 15447.3 | 15447.3 |
| Weather | LON | LON |
| Infiltration [$m^3/hm^2$@ 50Pa] | 5 | 5 |
| Average conductance [W/K] | 5464.32 | 4738.65 |
| Average U-value [$W/m^2K$] | 0.35 | 0.31 |
| Alpha value* [%] | 10.31 | 18.11 |

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

## Building Use

| % Area | Building Type |
|---|---|
| | Retail/Financial and Professional Services |
| | Restaurants and Cafes/Drinking Establishments/Takeaways |
| 100 | **Offices and Workshop Businesses** |
| | General Industrial and Special Industrial Groups |
| | Storage or Distribution |
| | Hotels |
| | Residential Institutions: Hospitals and Care Homes |
| | Residential Institutions: Residential Schools |
| | Residential Institutions: Universities and Colleges |
| | Secure Residential Institutions |
| | Residential Spaces |
| | Non-residential Institutions: Community/Day Centre |
| | Non-residential Institutions: Libraries, Museums, and Galleries |
| | Non-residential Institutions: Education |
| | Non-residential Institutions: Primary Health Care Building |
| | Non-residential Institutions: Crown and County Courts |
| | General Assembly and Leisure, Night Clubs, and Theatres |
| | Others: Passenger Terminals |
| | Others: Emergency Services |
| | Others: Miscellaneous 24hr Activities |
| | Others: Car Parks 24 hrs |
| | Others: Stand Alone Utility Block |

## Energy Consumption by End Use [$kWh/m^2$]

| | Actual | Notional |
|---|---|---|
| Heating | 3.2 | 4.2 |
| Cooling | 0.83 | 1.07 |
| Auxiliary | 2.38 | 1.87 |
| Lighting | 9.62 | 10.91 |
| Hot water | 1.12 | 1.33 |
| Equipment* | 16.15 | 16.15 |
| **TOTAL**** | **17.16** | **19.38** |

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

## Energy Production by Technology [$kWh/m^2$]

| | Actual | Notional |
|---|---|---|
| Photovoltaic systems | 6.15 | 0.54 |
| Wind turbines | 0 | 0 |
| CHP generators | 0 | 0 |
| Solar thermal systems | 0 | 0 |
| *Displaced electricity* | *6.15* | *0.54* |

## Energy & $CO_2$ Emissions Summary

| | Actual | Notional |
|---|---|---|
| Heating + cooling demand [$MJ/m^2$] | 78.68 | 74.97 |
| Primary energy [$kWh_{PE}/m^2$] | 16.43 | 27.97 |
| Total emissions [$kg/m^2$] | 1.6 | 2.62 |

## HVAC Systems Performance

| System Type | | Heat dem MJ/m2 | Cool dem MJ/m2 | Heat con kWh/m2 | Cool con kWh/m2 | Aux con kWh/m2 | Heat SSEEF | Cool SSEER | Heat gen SEFF | Cool gen SEER |
|---|---|---|---|---|---|---|---|---|---|---|
| [ST] Other local room heater - unfanned, [HS] Room heater, [HFT] Natural Gas, [CFT] Natural Gas | | | | | | | | | | |
| | Actual | 348.1 | 5.2 | 120.9 | 0 | 5.3 | 0.8 | 0 | 1 | 0 |
| | Notional | 336.3 | 71.5 | 108.6 | 0 | 10.6 | 0.86 | 0 | ---- | ---- |
| [ST] Split or multi-split system, [HS] ASHP, [HFT] Electricity, [CFT] Electricity | | | | | | | | | | |
| | Actual | 21.9 | 41 | 1.4 | 2.2 | 1.1 | 4.41 | 5.23 | 4.5 | 7 |
| | Notional | 22.4 | 44.2 | 2.4 | 2.8 | 1 | 2.64 | 4.4 | ---- | ---- |
| [ST] Central heating using water: radiators, [HS] ASHP, [HFT] Electricity, [CFT] Natural Gas | | | | | | | | | | |
| | Actual | 59.4 | 28.6 | 4.1 | 0 | 3.2 | 4.01 | 0 | 4.5 | 0 |
| | Notional | 48.9 | 30.7 | 5.1 | 0 | 2.3 | 2.64 | 0 | ---- | ---- |

### Key to terms

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