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Homes for Lambeth

Energy Statement

Former Coral Day Nursery, Wootton Street

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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.

Executive Summary

The energy strategy for the Former Coral Day Nursery, Wootton Street has been formulated following the London Plan energy hierarchy: ***Be Lean***, ***Be Clean*** and ***Be Green***. The overriding objective is the formulation of a strategy which effectively balances a number of key elements, including CO_2 emissions, affordability of heat, climate change adaption, and the provision of high quality buildings. These elements need to work with the regulatory and planning requirements for the development.

The Former Coral Day Nursery, Wootton Street development seeks to deliver a total of 36 dwellings and a shell for the purposes of a day care facility. The development of this energy strategy comes during a period of significant change in relation to the regulatory and policy energy landscape, with the New London Plan, The *Future Homes Standard*, and SAP methodology all challenging the more conventional energy strategy routes. It is becoming increasingly complex to develop an energy strategy which enables substantial CO_2 reductions both now and in the longer term, whilst ensuring residents' comfort or affordability of heat is not compromised.

In response to this, Homes for Lambeth have prioritised an energy strategy which emphasises the following:

> Energy demands to be reduced substantially through fabric '***Be Lean***' measures to achieve the New London Plan energy efficiency target. This locks in CO_2 savings irrespective of the source of the delivered energy;

> A holistic approach which balances further considerations such as daylighting, overheating, and noise to ensure resident comfort;

> A balanced strategy for the generation of low carbon heating. Homes for Lambeth are committed to the delivery of heat which is both low in CO_2 and not unreasonably costly. A strategy has therefore been proposed which utilises heat pumps in each dwelling.

> Provision of PV panels enabling on-site electrical generation.

The commitment to energy efficient design and renewable technologies will enable a reduction in Regulated CO_2 of 56% using SAP 10.0 CO_2 emissions factors, well above the minimum 35% site target. The remaining emissions shall be offset via the current Zero Carbon payment contribution. This has been calculated at £57,000.

	Dwelling Regulated CO_2 (kg/yr)	Non-domestic Regulated CO_2 (kg/yr)	Total Regulated CO_2 (kg/yr)
Baseline (TER)	46,428	4,508	50,936
Following *Be Lean* Measures	38,022	3,808	41,830
Following *Be Clean* Measures	38,022	3,808	41,830
Following *Be Green* Measures	20,097	2,260	22,357
% Improvement	**57%**	**50%**	**56%**

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1. INTRODUCTION

1.1 This document has been prepared by Hodkinson Consultancy, a specialist energy and environmental consultancy for planning and development. The report has been prepared on behalf of Homes for Lambeth in support of the detailed application for the proposed Former Coral Day Nursery, Wootton Street development, located in the London Borough of Lambeth.

1.2 The energy strategy for the site has been formulated to address a number of key objectives:

> To provide comfortable high-quality homes that people aspire to live in;

> To be low carbon from the outset, with opportunities for further decarbonisation;

> To adapt to climate change;

> To take account of specific site characteristics that link to the energy strategy, for instance acoustics and air quality;

> Provision of a resilient supply of reasonably priced heat to residents.

1.3 A number of these objectives compete with each other. This energy strategy and the development proposals seek to provide a sensible balance between them.

1.4 This statement first establishes a baseline assessment of the energy demands and associated CO_2 emissions for both the detailed and outline application elements. The report will then follow The London Plan Energy Hierarchy approach of ***Be Lean***, ***Be Clean*** and ***Be Green*** to enable the maximum viable reductions in Regulated and Total CO_2 emissions to be achieved.

2. DEVELOPMENT OVERVIEW

Site Location

2.1 2.1 The proposed development site at the site currently occupied by the former Coral Day Nursery, Wootton Street in the London Borough of Lambeth is bound by Wootton Street to the north, Great Street to the east, Ethelm Street to the south and Windmill Walk House to the west. The site location is shown in Figure 1.

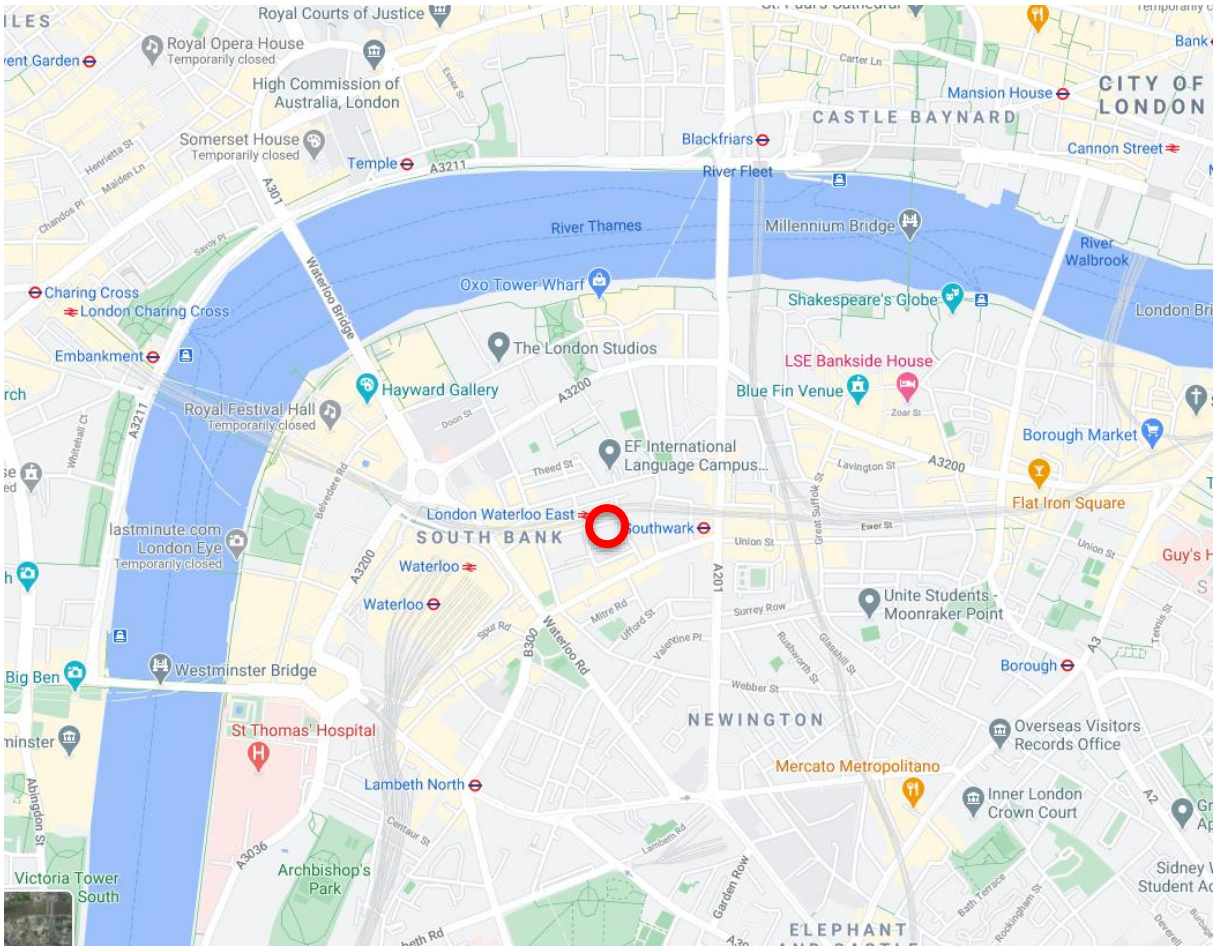


Figure 1: Site Location – Map data © 2020 Google

2.2 The site currently comprises of a single storey block which has previously been a special education needs school (Use Class D1), a play area and a car park are also located within the site boundary.

Development Proposals

2.3 The official development description is as follows:

"Demolition and clearance of existing structures and redevelopment comprising construction of a part 5/8/10 storey mixed use building comprising replacement community floorspace on ground floor, 36 no. residential units (Class C3) above with associated residents' amenities, cycle parking, car parking and public realm enhancement."

2.4 Figure 2 shows the development as planned with two blocks of flats (Blocks A and B) totalling 36 units.

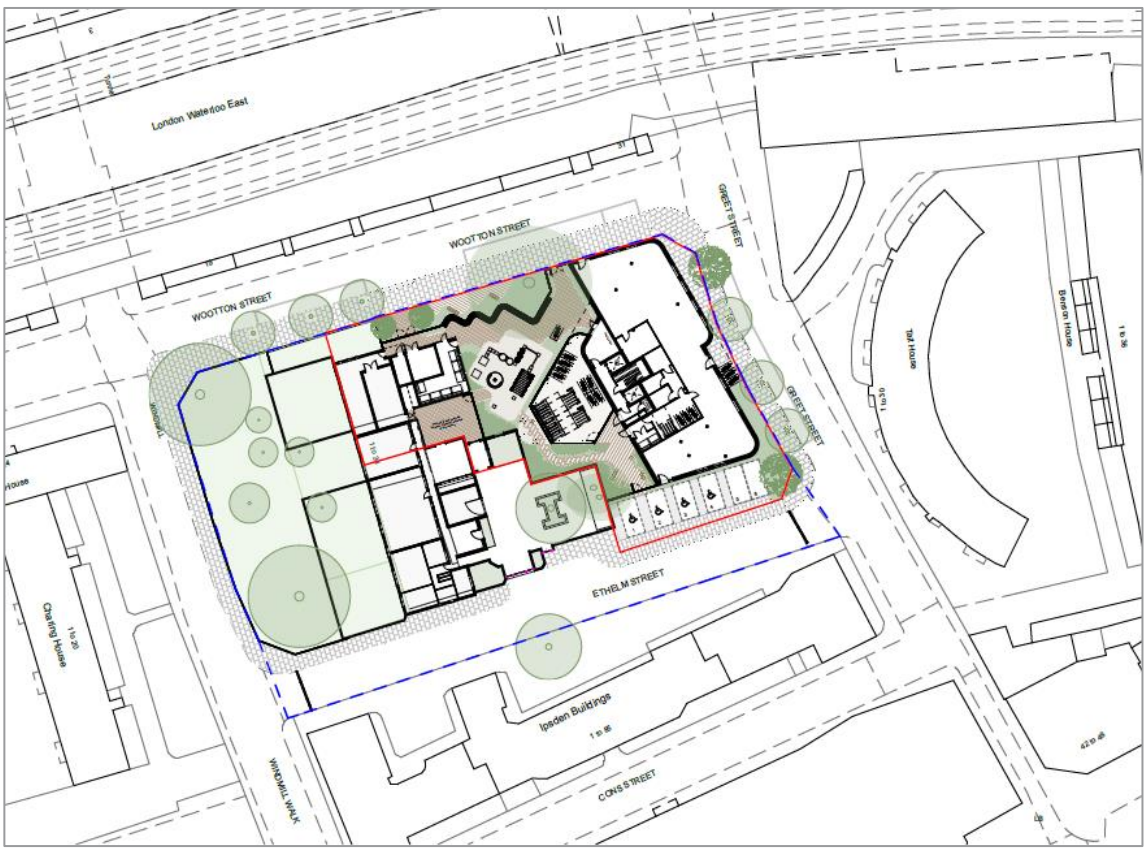


Figure 2: Proposed Site Layout – Stockwool Architects (December 2020).

3. RELEVANT PLANNING POLICY

3.1 The following planning policies and requirements will inform the energy strategy for the proposed development.

National Planning Policy

3.2 The revised National Planning Policy Framework (NPPF) was published on the 19th February 2019 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 National General Assembly). 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 and safe built environment, 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 contribute to protecting and enhancing our natural, built and historic environment; including making effective use of land, helping to improve biodiversity, using natural resources prudently, minimising waste and pollution, and mitigating and adapting to climate change, including moving to a low carbon economy.

Regional Policy

Intend to publish New London Plan (2020)

3.5 The Panel of Inspectors report into the draft London Plan was published in October 2019. The Mayor considered the Inspectors' recommendations and, in December 2019, issued to the Secretary of State the Intend to Publish London Plan. The Secretary of State responded to this in March 2020 and the Mayor is now considering the Secretary of State's response and taking the steps to finalise the plan.

3.6 The following policies in the draft New London Plan, as defined by the London Borough of Lambeth in Policy EN4 of their Local Plan, are considered relevant to this energy strategy:

3.7 **Policy SI2 Minimising Greenhouse Gas Emissions**, states:

'Major development should be net zero-carbon. This means reducing greenhouse gas emissions in operation, and minimising both annual and peak energy demand in accordance with the following energy hierarchy:

1) Be lean: use less energy and mange demand during operation;

2) Be clean: exploit local energy resources (such as secondary heat) and supply energy efficiently and cleanly;

3) Be green: maximise opportunities for renewable energy by producing, storing and using renewable energy on-site.

A minimum on-site reduction of at least 35 per cent beyond Building Regulations is required for major development. Residential development should achieve 10 per cent, and non-residential development should achieve 15 per cent through energy efficiency measures.'

3.8 **Policy SI3 Energy Infrastructure**, states:

'Major development proposals within Heat Network Priority Areas should have a communal low-temperature heating system. The heat source for the communal heating system should be selected in accordance with the following heating hierarchy:

a) Connect to local existing or planned heat networks;

b) Use zero-emission or local secondary heat sources (in conjunction with heat pump, if required);

c) Use low-emission combined heat and power (CHP) (only where there is a case for CHP to enable the delivery of an area-wide heat network);

d) Use ultra-low NOx gas boilers.'

3.9 **Policy SI4 Managing Heat Risk** seeks for energy strategies to demonstrate how they intend to reduce the risk of internal overheating, in line with the cooling hierarchy.

Adopted London Plan (2016)

3.10 **Policy 5.2 – Minimising Carbon Dioxide Emissions** requires that all residential and non-residential major development achieve a 35% improvement beyond Part L 2013.

Residential buildings are also required to achieve a standard of Zero Carbon. The remaining regulated carbon dioxide emissions, to 100%, are to be off-set through a cash in lieu contribution to the relevant borough to be ring fenced to secure delivery of carbon dioxide savings elsewhere. This is defined under the London Plan Housing SPG (2016).

The New London Plan (2020) also applies a target of 'Zero Carbon' to non-residential areas.

3.11 **Policy 5.3 – Sustainable Design and Construction** states that Major development should meet the minimum standards outlined in the London Plan Supplementary Planning Guidance and this should be clearly demonstrated. The standards include the following sustainable design principles (summarised):

> Minimising CO_2 emissions;

> Avoiding internal overheating and contributing to the urban heat island effect;

> Minimising pollution (including noise, air and urban run-off).

3.12 **Policy 5.5 – Decentralised Energy Networks** states the Mayor will prioritise the development of decentralised heating and cooling networks at the development and area wide levels, including larger scale heat transmission networks.

3.13 **Policy 5.6 - Decentralised Energy** requires that all developments should evaluate the feasibility of Combined Heat and Power (CHP) systems and examine the opportunities to extend the system beyond the site boundary to adjacent sites.

Local Policy

London Borough of Lambeth

Carbon Reduction Plan

3.14 The London borough of Lambeth became the first council in London to declare a climate emergency in response to the threat posed by increasing carbon emissions. The council have therefore outlined an action plan of how they propose to become carbon neutral by 2030.

3.15 **Action 1.3 Housing Development** states 'By 2030 all new council homes will be built to the highest efficiency standards.'

Lambeth Local Plan

3.16 **Policy EN3 – Decentralised Energy** states that all major developments will be expected to connect to and if possible, extend existing heating, cooling, and power networks unless a feasibility statement determines that this is not a viable option. Opportunities for potential connection to heat networks should be identified using the London heat map.

3.17 **Policy EN4: Sustainable design and construction** – The approach set out in London Plan policies SI1 Improving air quality, SI2 Minimising greenhouse gas emissions, SI4 Managing heat risk, SI5 C and E Water Infrastructure are to be followed. Development will be required to be resilient to climate change by including appropriate climate change adaptation measures.

Summary of Policy Targets

3.18 Achieve 35% Regulated CO_2 reduction over Part L 2013 onsite**.** With a Be Lean target of an improvement of regulated CO_2 emissions over the base line by 10% for dwellings and 15% for non-domestic units.

3.19 Implement the **Energy Hierarchy**: *Be Lean* (energy efficiency); *Be Clean* (heating infrastructure); and *Be Green* (renewable energy technologies).

3.20 Use SAP 10.0 carbon factors to determine carbon and energy savings.

3.21 The GLA Zero Carbon Homes policy will apply to the residential units only.

3.22 The cash-in-lieu sum based on £95 per ton CO_2 to offset.

4. ASSESSMENT METHODOLOGY – BASELINE EMISSIONS

4.1 This statement first establishes a baseline assessment of the energy demands and associated CO_2 emissions for the development.

4.2 The report will then follow the GLA hierarchy approach of ***Be Lean***, ***Be Clean*** and ***Be Green*** to enable the maximum viable reductions in Regulated and Total CO_2 emissions over the calculated baseline.

4.3 The estimated annual energy demand for dwellings has been calculated using Standard Assessment Procedure (SAP) methodology for dwellings and the Simplified Building Energy Modelling (SBEM) methodology for non-domestic units. SAP and SBEM calculate the Regulated energy demands associated with hot water, space heating and fixed electrical items. The unregulated energy demands for appliances and cooking are taken from BRE standard occupancy calculations for dwellings and the NCM methodology for non-domestic.

4.4 Calculations have been performed on representative dwelling types. These encompass an array of flats types which differ in orientation and take account of the impact of exposed floors, mid floors, and roofs. The selected dwellings therefore represent a fair aggregation of the proposed unit mix.

Baseline Emissions

4.5 A baseline calculation has been carried out to establish the Regulated CO_2 emissions by which this energy strategy will be compared against. As explained, SAP 10.0 emission factors have been utilised in this energy strategy. Calculations have been undertaken on the energy demands taken from the SAP outputs to convert the output Target Emission Rate (TER) and Dwelling Emission Rate (DER) figures in line with these SAP 10.0 factors.

4.6 Although the long-term trajectory for Part L compliance is unclear, the ***Be Lean*** strategy set out in this report does achieve the TER and Target Fabric Energy Efficiency (TFEE) standards under the current Part L (2013) Building Regulations.

4.7 Table 1 shows the Regulated and Total baseline CO_2 emissions rates for Former Coral Day Nursery, Wootton Street. TER worksheets supporting these calculations are presented in Appendix B.

Table 1: TER Baseline case.

Detailed Application – Baseline CO_2 emissions (kg CO_2 per annum)			
	Regulated - Dwellings	Regulated – Non domestic	Total (Regulated + Unregulated)
Baseline (TER)	46,428	4,508	68,919

5. *BE LEAN* – ENERGY EFFICIENCY

5.1 The development will achieve the 10% and 15% targets for domestic and non-domestic energy efficiency measures respectively, as set out in Policy SI2 of the New London Plan.

5.2 Section 5 sets out the potential measures to be implemented to enable these targets to be achieved, thereby locking in significant CO_2 reduction through a reduction in energy demands.

Insulation Standards

5.3 The development will incorporate enhanced insulation in the building envelope (walls, roofs, floors, and glazing) to achieve U-values which are likely to be similar to the following:

> Glazing with a U-value of 1.30 W/m^2.K;

> External wall U-value of 0.18 W/m^2.K;

> Corridors not to be actively heated. Corridor wall U-value of 0.18 W/m^2.K – minimum of 260mm thickness;

> Party walls will be fully insulated and sealed (achieving an effective U-Value of 0.0 W/m^2.K);

> Ground floor U-values of 0.10 – 0.13 W/m^2.K (depending on area/perimeter ratio);

> A main roof U-value of 0.10 W/m^2.K;

> Any localised roof terrace areas to achieve at least 0.15 W/m^2.K.

Air Tightness & Ventilation

5.4 Air tightness standards will conform to, and exceed, Approved Document Part L requirements. By reducing air leakage loss and convective bypass of insulation, an improvement of design air permeability rate from 10 m^3/h.m^2 to 3. 5m^3/h.m^2 or less for all dwellings will further reduce space heating requirements.

5.5 Parts L & F compliant (System 4) Mechanical Ventilation Heat Recovery (MVHR) will be installed in all dwellings. These systems will remove stale air and odours from kitchens and wet rooms, whilst retaining the heat within the home, as shown in Figure 3. In this way substantial energy savings will be made.

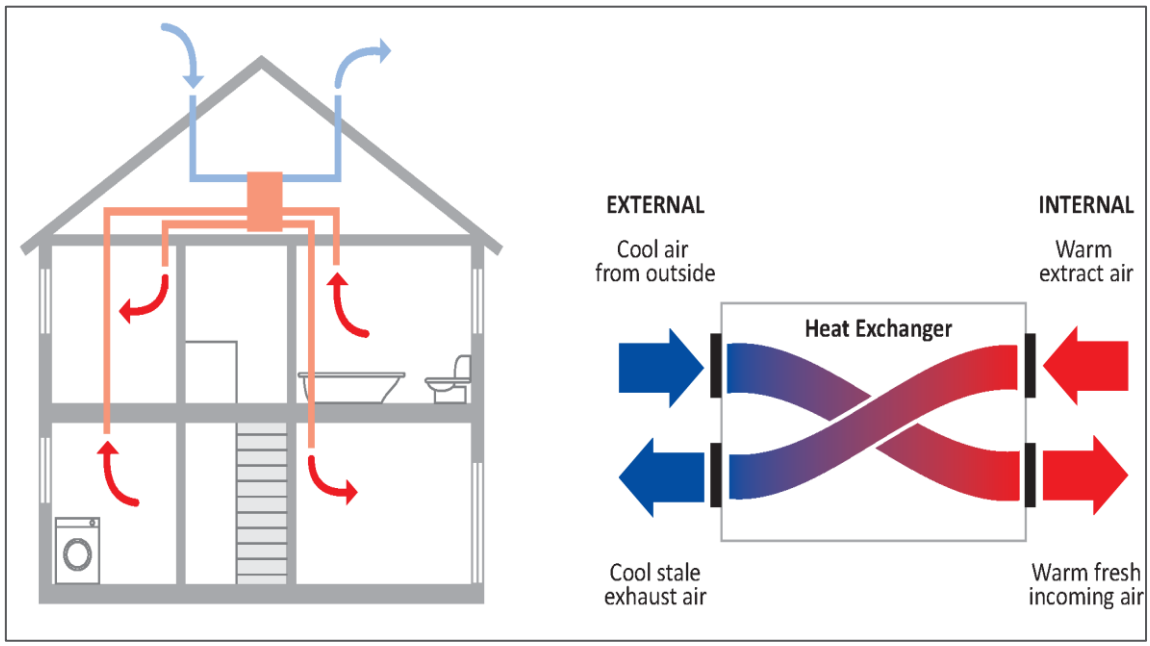


Figure 3: MVHR in operation

5.6 The selected MVHR units have heat recovery efficiencies of at least 92%, with the Specific Fan Power (SFP) targeted as follows:

> ≤ 0.48 SFP for units with a kitchen and 1 wet rooms;

> ≤ 0.52 SFP for units with a kitchen and 2 wet rooms.

5.7 Additionally, all homes will have openable windows and therefore the ability to naturally ventilate should the occupant desire. Convective ventilation and night purging of heat will therefore be facilitated.

5.8 The non-domestic shell unit will similarly benefit from an improvement in air permeability rate of 9 $m^3/h.m^2$ or less. Ventilation will be mechanically provided with the use of heat recovery where possible. It would be expected that the associated specific fan power would be less than 1.30 w/l/s and heat recovery at least 75%.

Thermal Bridging

5.9 In well insulated dwellings, 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. Homes for Lambeth are committed to delivering a development which prioritises the conservation of energy through lean design and have therefore placed particular importance on the development of construction details for the dwellings which minimise the effect of thermal bridges.

5.10 Figure 4 illustrates the benefits of reducing thermal bridges.

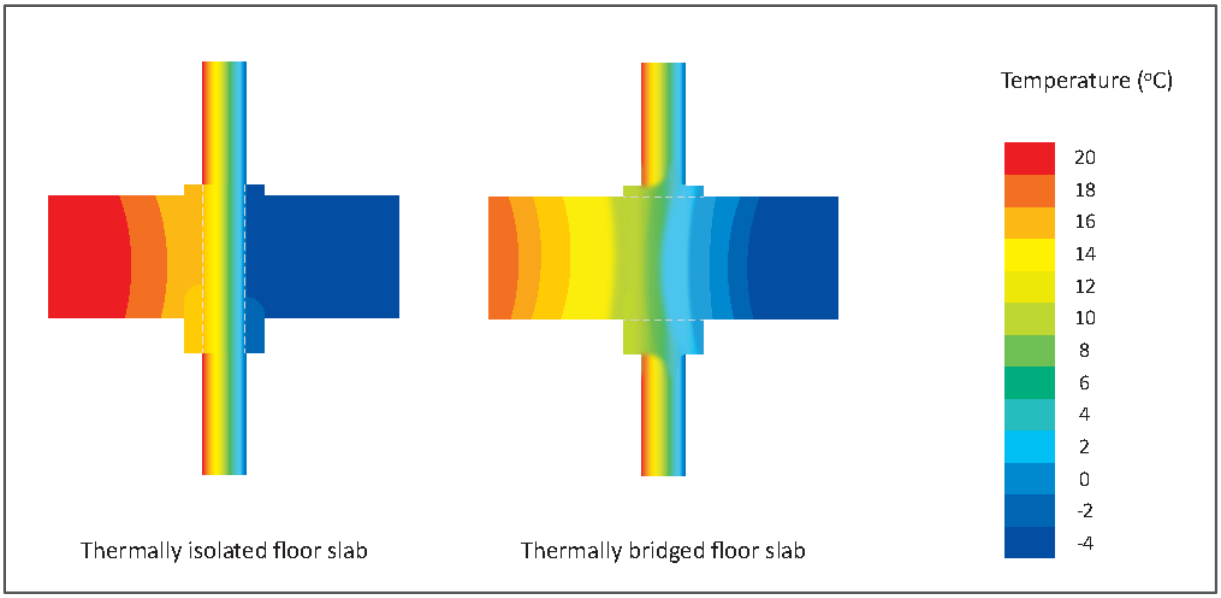


Figure 4: Thermal bridging

5.11 Detailed modelling of all major junctions will be undertaken at design stage. The results of initial assessments will be used to inform the design process and further modelling will continue to take place until the required performance targets are met. It should be noted that this bespoke approach to junction design goes significantly beyond the process followed for most developments, thus achieving lower energy performance.

5.12 It is also considered that a specification which actively seeks to design out poor junction performance demonstrates a more balanced approach than the use of very low U-values which have been specified to mitigate a lack of junction modelling.

5.13 The following psi values have been used in the initial modelling:

> Ground floor - 0.16 W/m.K;

> Intermediate floor – 0.07 W/m.K;

> Balcony junction to wall – 0.30 W/m.K;

> Flat roof – 0.08 W/m.K;

> Flat roof with parapet – 0.30 W/m.K;

> Party roof – 0.04 W/m.K;

> Corner (normal) – 0.09 W/m.K;

> Corner (inverted) – -0.09 W/m.K;

> Staggered party wall between dwellings – 0.12 W/m.K;

> Lintels – 0.30 W/m.K;

> Sills – 0.04 W/m.K;

> Jambs – 0.05 W/m.K.

5.14 Further details will be determined during the detailed design stage when further bespoke calculations are undertaken on the targeted junctions.

Space Heating & Hot Water

5.15 The space heating requirement will be reduced by the fabric, air tightness and ventilation measures detailed above.

5.16 In line with energy assessment guidance, a gas boiler baseline has been used in the ***Be Lean*** stage assessment for both the dwellings and non-domestic shell.

5.17 As is set out in Section 6, the size of development is the predominant reason as to why individual heat sources are more appropriate than a communal heating system.

Lighting & Appliances

5.18 Energy efficient lighting will be installed in 100% of internal fittings in the homes.

5.19 It is very difficult to design and construct homes to reduce the unregulated electricity demands, because this is almost entirely dependent on the occupant of a home and can vary substantially. However, Homes for Lambeth are committed to ensuring that all efforts are made to enable the residents to minimise their unregulated electricity consumption.

5.20 The non-domestic units are expected to utilise LED lighting, circa 100lm/W, with lighting controls such as perimeter photoelectric dimming and occupancy sensing.

Limiting the Risk of Summer Overheating

5.21 Minimising the risk of summer overheating is important so as to ensure that homes are adapted to climate change and remain comfortable to occupy in the future. Accordingly, dynamic thermal modelling has been undertaken on a selection of unit types to ensure that the development does not cause an unacceptable risk of summer overheating within the dwellings.

5.22 Home for Lambeth have adopted a holistic approach to the development of the energy strategy presented in this report. It is recognised that the varying implications of energy, overheating, daylighting, and noise cannot be considered only in isolation. It is a key aim of Homes for Lambeth to develop a strategy which ensures one of these elements does not get prioritised at the expense of another.

5.23 The following overheating measures are to be adopted for the development to assist in balancing these four central considerations:

> Solar control glazing to reduce uncomfortable solar heat gains whilst maximising energy efficiency. A g-value of 0.45 could be applied to most flats with a reduced g-value of 0.35 applied to the East façade.

> Shading to a significant proportion of the windows from the presence of balconies. 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;

> High performance MVHR systems to all dwellings to assist in background ventilation;

> Openable windows to allow for purging of internal heat.

5.24 The acoustic consultant has concluded that no façade is at a high risk in terms of external noise exposure, therefore it has been assumed that windows can be openable during summer nights to mitigate overheating in bedrooms.

5.25 Full details of the residential overheating modelling and applied strategy are presented in the overheating report which accompanies this application.

5.26 As the level of unregulated heat gains for the non-domestic shell cannot be determined at this stage, cooling has been assumed applicable. The seasonal energy efficiency ratio of the cooling plant is expected to be at least 6.5.

5.27 Cooling loads have however been minimised along with ensuring compliance with the Non-domestic ADL:2A Criteria 3. As a result, a g-value of 0.35 has been selected.

CO_2 Emissions at Be Lean Stage

5.28 Table 2 outlines the CO_2 emissions following the inclusion of the above energy efficiency measures. It can be seen that the TER baseline has been exceeded by 18% with both the dwellings and non-domestic shell meeting the requirements of Policy SI2 of the New London Plan.

Table 2: Regulated and total emissions following *Be Lean* measures.

	Dwelling Regulated CO_2 (kg/yr)	Non-domestic Regulated CO_2 (kg/yr)	Total Regulated CO_2 (kg/yr)
Baseline (TER)	46,428	4,508	50,936
Following *Be Lean* Measures	38,022	3,808	41,830
% Improvement	**18%**	**16%**	**18%**

5.29 The dwellings also exceed the Target Fabric Energy Efficiency (TFEE) requirements of Building Regulations Part L 2013, as shown in Table 3 by the representative SAP example dwellings used to formulate this strategy. As noted in Section 4, the future application of this metric may no longer be required upon the implementation of the new Part L (2020) Interim *Future Homes Standard*, however, it should provide security to the reader that fabric standards are being taken seriously in the determination of the proposed energy strategy.

Table 3: TFEE and DFEE results for sample dwelling types.

	TFEE (kWh/m²/yr)	DFEE (kWh/m²/yr)
Area weighted	**55.78**	**49.73**
Reduction Achieved (Area Weighted)	**11%**	

5.30 Further calculations including Dwelling Emissions Rate (DER) worksheets on representative dwelling types can be seen in appendices A, B and C.

6. *BE CLEAN*: DECENTRALISED ENERGY

6.1 In line with Policy SI3 of the New London Plan, the application of decentralised heating networks as a ***Be Clean*** measure has been evaluated. This is the next step in the Energy Hierarchy after ***Be Lean***.

6.2 Returning to the aims of energy strategy as set out in Section 1, the following key points can be extracted in relation to the supply of heat:

> To be low carbon from the outset and for the lifetime of the development;

> Provision of a resilient supply of reasonably priced heat to residents;

> Address energy planning policy.

Area Wide Networks

6.3 Figure 5 below, shows the Former Coral Day Nursery, Wootton Street site (red pin) on the London Heat Map.

6.4 Existing networks are shown in red, with proposed networks in orange. It can be seen from the image that a proposed network route features on the Heat Map, but that no existing network does.

6.5 The proposed route is understood to be that of the Southbank Decentralised Energy Network. However, the Former Coral Day Nursery, Wootton Street development is not covered by this potential network.

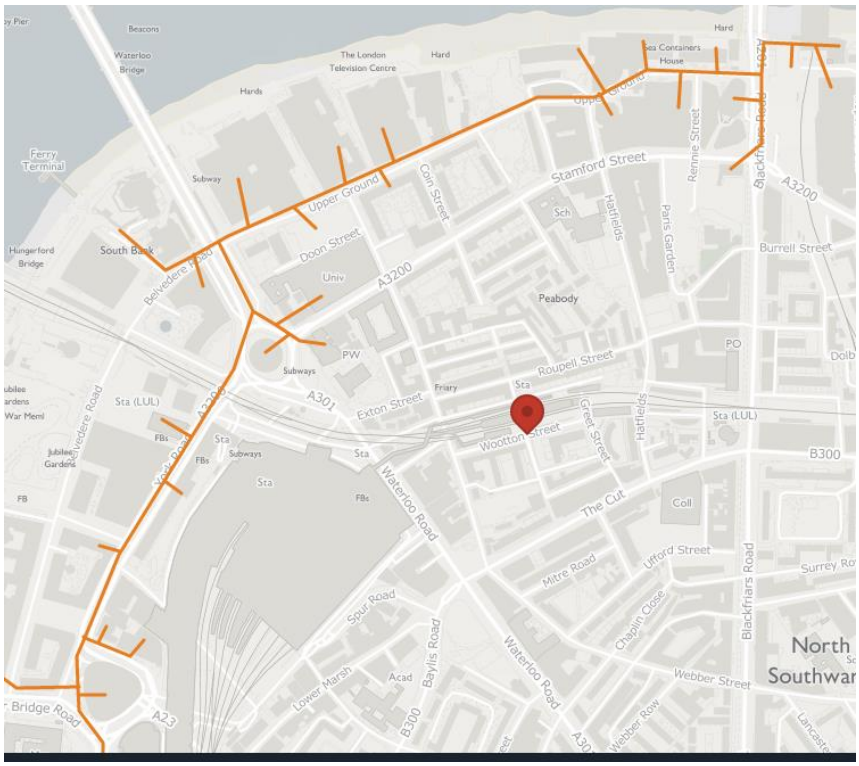


Figure 5: Former Coral Day Nursery, Wootton Street site (red pin) on the London heat map

Site Network

6.6 As the proposed heat network is not currently being developed, and the development is not on the proposed route a connection cannot be considered to be feasible.

6.7 The installation of a site network should not negatively impact both development CO_2 emissions and heat costs to residents, otherwise it would eminently not be an appropriate strategy for the site.

6.8 At 36 units the site will not provide a high baseload demand for heat. Additionally, the surrounding area is also predominantly low-rise and residential, so it is not possible to rely on local offsite connections to bolster the magnitude and diversity of the heat demand sufficiently.

6.9 The GLA's *Energy Assessment Guidance* (2018) outlines how individual heating would be more appropriate in the event that it could be demonstrated that a site-wide heat network is uneconomic.

6.10 An indicative cost assessment has been undertaken for the Former Coral Day Nursery, Wootton Street development with the following three heating scenarios:

> Individual heating via gas boilers;

> Individual heating via heat pumps;

> Heat Network via heat pumps.

6.11 Table 5, below, summarises the estimated annual heat costs for residents from these three scenarios.

6.12 It can be seen that a heat network led by low carbon plant would result in costs to residents which are significantly above those in both the individual heating scenarios.

Table 5: Indicative Heat Costs

Heating Strategy	Fixed Cost for Operation, Maintenance, Customer Services	Fixed Cost for Capital Replacement	Variable Cost (based on 3,500 kWh/yr)	Total (£/dwelling/yr)
Gas Boilers	£303	£128	£175	**£606**
Air Source Heat Pumps	£275	£267	£206	**£748**
Heat Network - Air Source Heat Pumps	£410	£550	£284	**£1,244**

Proposed Heating Strategy

6.13 As two of the central aims in the preparation of this energy strategy are to be low in CO_2 emissions for the lifespan of the development and for the cost of heat to not be unreasonably high, it is proposed for individual dwelling heat pumps to be installed.

6.14 The selection of air over ground or water source has been made due to restrictions that the site location would place on access to the latter two. Air source does not require the expensive and complex boreholes that ground source does, or the unique access that water source does.

6.15 In line with GLA guidance, heat pumps have been considered as a ***Be Green*** measure.

7. *BE GREEN*: RENEWABLE ENERGY TECHNOLOGIES

7.1 The final part of the Energy Hierarchy is ***Be Green*** which seeks for renewable energy technologies to be specified to provide, where feasible, a reduction in expected CO_2 emissions.

Solar Thermal Panels

7.2 Solar thermal panels generate heat for hot water. They would conflict with available roof space which could otherwise by utilised for the specification of photovoltaics (PVs). As the electrical load on site is likely to be relatively high due to the use of heat pumps, having a means of generating electricity on site is considered to be more valuable.

Wind Turbines

7.3 Small rooftop wind turbines are designed to generate electricity from the wind for use within each dwelling. However, urban rooftop wind turbines do not generally perform sufficiently well to warrant their installation, due to the low and turbulent wind conditions present. They are therefore likely to remain technically unfeasible.

Air Source Heat Pumps (Proposed)

7.4 ASHPs generate heat via compression of a refrigerant which has extracted ambient heat from the external air. The compressive action raises the temperature of the refrigerant and allows it to provide heating.

7.5 They have been specified for heating and hot water provision in each dwelling for this development.

7.6 The layout of the apartments has where possible catered for the flexibility to incorporate differing heat pump systems. For instance, balcony and roof space has been maximised so as to allow for the inclusion of external units for most dwellings. Additionally, space has been set aside within the apartments should a system which houses all elements (both the fan and compressor unit as well as the hot water cylinder) within the dwelling be specified.

7.7 A Monobloc Mitsubishi Ecodan unit (datasheet provided as Appendix D) has been used in the calculations for this energy strategy. Homes for Lambeth shall aim to match the performance characteristics of this unit with whichever system and model they select once the design has progressed further.

7.8 For the purposes of the non-domestic shell, cooling has been assumed. There would be a likelihood that a reversible air source heat pump would be installed. This would be expected to have a season coefficient of performance of at least 4.5.

Photovoltaic (PV) Panels (Proposed)

7.9 PV panels will enable the development to generate its own electricity on site, so supplement the use of heat pumps well.

7.10 Homes for Lambeth are committed to installing PV panels across the most appropriate roof spaces. It has been calculated that 5.2 kWp of installed capacity could be accommodated on the taller apartment block.

7.11 Panels are to be positioned at an angle of 5-10 degrees towards a southerly direction. An indicative roof plan has been provided in Appendix E.

CO_2 Emissions at *Be Green* Stage

7.12 Table 6, below, shows the Regulated and Total CO_2 reductions following the application of ***Be Green*** measures. DER worksheets can be found in Appendix F and G.

Table 6: *Be Green* Reductions

	Dwelling Regulated CO_2 (kg/yr)	Non-domestic Regulated CO_2 (kg/yr)	Total Regulated CO_2 (kg/yr)
Baseline (TER)	46,428	4,508	50,936
Following *Be Lean* Measures	38,022	3,808	41,830
Following *Be Clean* Measures	38,022	3,808	41,830
Following *Be Green* Measures	20,097	2,260	22,357
% Improvement	**57%**	**50%**	**56%**

8. BE SEEN

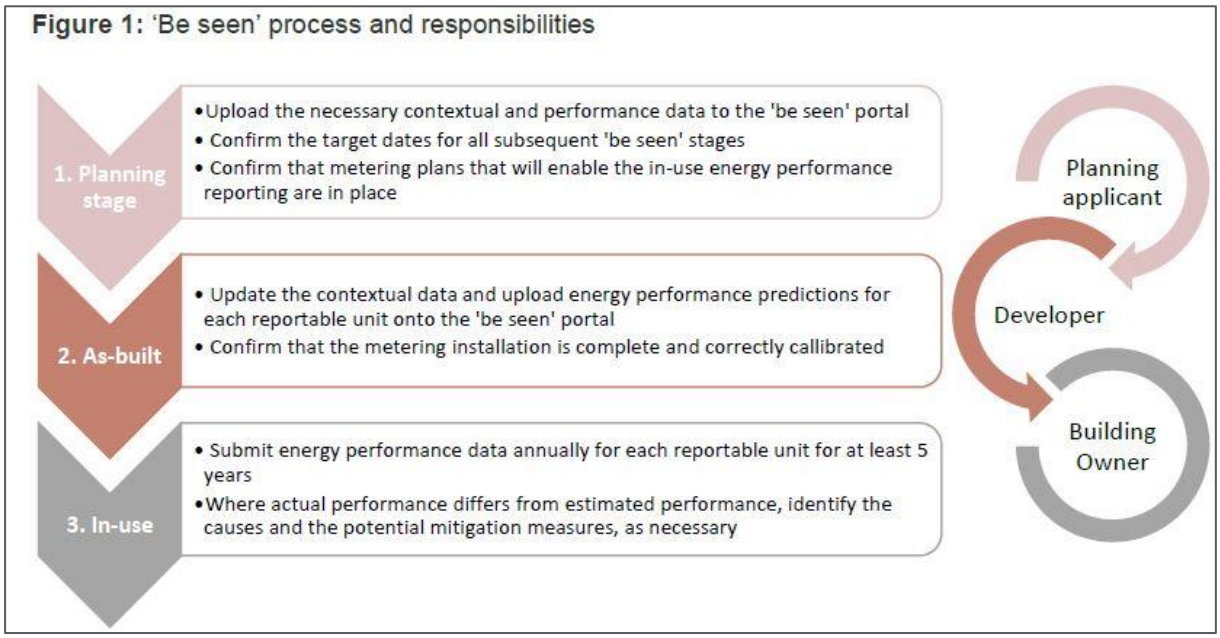
8.1 The New London Plan introduces a fourth stage to the energy hierarchy; the ***Be Seen*** stage, which proposes monitoring and reporting of the actual operational energy performance of major developments for at least five years.

8.2 An effectively implemented post-construction monitoring regime can have several benefits including environmental (e.g. reduced grid infrastructure strain, carbon emissions reduction) and socio-economic (e.g. reduced occupants bills and raised awareness around energy use).

8.3 The ***Be Seen*** stage aims to monitor the actual energy and carbon performance of buildings and compare with the estimated figures put forward at both planning and as-built stages. This will assist with achieving a zero-carbon London and determining the effectiveness of the incumbent policies.

8.4 Figure 6: *Be Seen* Stages below, outlines the three stages for submission of information, and who is responsible for compiling all necessary outputs.

Figure 6: *Be Seen* Stages



8.5 In line with the GLA guidance document (October 2020), the following data points are to be monitored:

> Electricity consumption for dwellings (this encapsulates all energy used);

> Electricity consumption for non-residential units;

> Electricity consumption for common areas;

> Generation from PV panels.

8.6 The metering and controls strategy will be further developed during the detailed design process. Carbon emissions associated with these energy uses will also be accounted for.

8.7 A reduction in unregulated demands will also be encouraged. More information on e.g. supply of white goods can be found in the sustainability statement.

9. ZERO CARBON

9.1 The New London Plan and the London Borough of Lambeth planning policies require a minimum reduction in Regulated CO_2 emissions of 35% beyond the calculated baseline.

9.2 In addition to this, the development is also subject to an additional off-setting contribution to meet a total 100% in Regulated CO_2 emissions in order to achieve a standard of *Zero Carbon*.

9.3 Table 7 shows the reduction achieved following the implementation of ***Be Lean***, ***Be Clean*** and ***Be Green*** measures.

Table 7: CO_2 emissions to achieve 100% reduction

Zero Carbon - Regulated Carbon dioxide savings (Detailed Component)		
	(tCO_2 per annum)	**Percent CO_2 saving (%)**
Part L Baseline	-	-
Savings after *Be Lean* Measures	8	18%
Savings after *Be Clean* Measures	8	18%
Savings after *Be Green* Measures	**26**	**57%**
Additional Surplus (to meet 100%)	20	43%

9.4 The remaining 43**%** is therefore to be met through a carbon offset payment to be paid to the London Borough of Lambeth's offsetting fund. As shown in the table above, the development is required to offset a further 20 tonnes of Regulated CO_2 emissions in total.

9.5 In line with the Lambeth S106 planning obligations, a price of £95 per tonne of regulated CO_2 per year, for a period of 30 years, has been used to calculate the contribution required. The calculated offsetting costs are outlined below:

> 20 tonnes of CO_2 x £695 = £1,900

> £1,900 x 30-year period = **£57,000.**

9.6 The calculations above should be refined at the detailed design stage.

10. SUMMARY

10.1 The energy strategy for the Former Coral Day Nursery, Wootton Street has been formulated following the London Plan energy hierarchy: Be Lean, Be Clean and Be Green. The overriding objective is the formulation of a strategy which effectively balances several key elements, including CO_2 emissions, affordability of heat, climate change adaption, and the provision of high-quality buildings. These elements need to work with the regulatory and planning requirements for the development.

10.2 The Former Coral Day Nursery, Wootton Street development seeks to deliver a total of 36 dwellings and a shell for the purposes of a day care facility. The development of this energy strategy comes during a period of significant change in relation to the regulatory and policy energy landscape, with the New London Plan, The Future Homes Standard, and SAP methodology all challenging the more conventional energy strategy routes. It is becoming increasingly complex to develop an energy strategy which enables substantial CO_2 reductions both now and in the longer term, whilst ensuring residents' comfort or affordability of heat is not compromised.

10.3 In response to this, Homes for Lambeth have prioritised an energy strategy which emphasises the following:

> Energy demands to be reduced substantially through fabric '***Be Lean***' measures to achieve the New London Plan energy efficiency target. This locks in CO_2 savings irrespective of the source of the delivered energy;

> A holistic approach which balances further considerations such as daylighting, overheating, and noise to ensure resident comfort;

> A balanced strategy for the generation of low carbon heating. Homes for Lambeth are committed to the delivery of heat which is both low in CO_2 and not unreasonably costly. A strategy has therefore been proposed which utilises heat pumps in each dwelling.

> Provision of PV panels enabling on-site electrical generation.

10.4 The commitment to energy efficient design and renewable technologies will enable a reduction in Regulated CO_2 of 56% using SAP 10.0 CO_2 emissions factors, well above the minimum 35% site target. The remaining emissions shall be offset via the current Zero Carbon payment contribution. This has been calculated at £57,000.

	Dwelling Regulated CO_2 (kg/yr)	Non-domestic Regulated CO_2 (kg/yr)	Total Regulated CO_2 (kg/yr)
Baseline (TER)	46,428	4,508	50,936
Following *Be Lean* Measures	38,022	3,808	41,830
Following *Be Clean* Measures	38,022	3,808	41,830
Following *Be Green* Measures	20,097	2,260	22,357
% Improvement	**57%**	**50%**	**56%**

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APPENDICES

Appendix A
GLA Tables

Appendix B
DER and TER Worksheets for Representative Dwellings Be Lean)

Appendix C
Be Lean BRUKL

Appendix D
Indicative Dwelling Heat Pump Specification

Appendix E
Indicative Roof Plan for PV Panels

Appendix F
DER Worksheets for Representative Dwellings (Be Green)

Appendix G
Be Green BRUKL

Appendix A
GLA Tables

SAP 2012 PERFORMANCE

DOMESTIC

Table 1: Carbon Dioxide Emissions after each stage of the Energy Hierarchy for domestic buildings

	Carbon Dioxide Emissions for domestic buildings (Tonnes CO_2 per annum)	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building Regulations Compliant Development	52	35
After energy demand reduction	45	35
After heat network / CHP	45	35
After renewable energy	47	35

Table 2: Regulated Carbon Dioxide savings from each stage of the Energy Hierarchy for domestic buildings

	Regulated domestic carbon dioxide savings	
	(Tonnes CO_2 per annum)	(%)
Savings from energy demand reduction	7	14%
Savings from heat network / CHP	0	0%
Savings from renewable energy	-2	-4%
Cumulative on site savings	**5**	**10%**
Annual savings from off-set payment	47	-
	(Tonnes CO2)	
Cumulative savings for off-set payment	**1,403**	-
Cash in-lieu contribution (£)	**84,157**	

SAP10 PERFORMANCE

Table 1: Carbon Dioxide Emissions after each stage of the Energy Hierarchy for domestic buildings

	Carbon Dioxide Emissions for domestic buildings (Tonnes CO_2 per annum)	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building Regulations Compliant Development	46	16
After energy demand reduction	38	16
After heat network / CHP	38	16
After renewable energy	21	16

Table 2: Regulated Carbon Dioxide savings from each stage of the Energy Hierarchy for domestic buildings

	Regulated domestic carbon dioxide savings	
	(Tonnes CO_2 per annum)	(%)
Savings from energy demand reduction	8	18%
Savings from heat network / CHP	0	0%
Savings from renewable energy	17	37%
Cumulative on site savings	**25**	**55%**
Annual savings from off-set payment	21	-
	(Tonnes CO2)	
Cumulative savings for off-set payment	**630**	-
Cash in-lieu contribution (£)	**37,782**	

NON-DOMESTIC

Table 3: Carbon Dioxide Emissions after each stage of the Energy Hierarchy for non-domestic buildings

	Carbon Dioxide Emissions for non-domestic buildings (Tonnes CO2 per annum)	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building Regulations Compliant Development	7	5
After energy demand reduction	6	5
After heat network / CHP	6	5
After renewable energy	5	5

Table 4: Regulated Carbon Dioxide savings from each stage of the Energy Hierarchy for non-domestic buildings

	Regulated non-domestic carbon dioxide savings	
	(Tonnes CO_2 per annum)	(%)
Savings from energy demand reduction	1	16%
Savings from heat network / CHP	0	0%
Savings from renewable energy	1	11%
Total Cumulative Savings	**2**	**27%**

Table 5: Shortfall in regulated carbon dioxide savings

	Annual Shortfall (Tonnes CO_2)	Cumulative Shortfall (Tonnes CO_2)
Total Target Savings	**2**	-
Shortfall	1	16
Cash in-lieu contribution (£)	**988**	-

Table 3: Carbon Dioxide Emissions after each stage of the Energy Hierarchy for non-domestic buildings

	Carbon Dioxide Emissions for non-domestic buildings (Tonnes CO2 per annum)	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building Regulations Compliant Development	5	2
After energy demand reduction	4	2
After heat network / CHP	4	2
After renewable energy	2	2

Table 4: Regulated Carbon Dioxide savings from each stage of the Energy Hierarchy for non-domestic buildings

	Regulated non-domestic carbon dioxide savings	
	(Tonnes CO_2 per annum)	(%)
Savings from energy demand reduction	1	15%
Savings from heat network / CHP	0	0%
Savings from renewable energy	2	36%
Total Cumulative Savings	**2**	**50%**

Table 5: Shortfall in regulated carbon dioxide savings

	Annual Shortfall (Tonnes CO_2)	Cumulative Shortfall (Tonnes CO_2)
Total Target Savings	2	-
Shortfall	-1	-20
Cash in-lieu contribution (£)	**-1,228**	-

SITE-WIDE

	Total regulated emissions (Tonnes CO2 / year)	CO2 savings (Tonnes CO2 / year)	Percentage savings (%)
Part L 2013 baseline	59		
Be lean	50	8	14%
Be clean	50	0	0%
Be green	52	-1	-2%
	-	**CO_2 savings off-set (Tonnes CO_2)**	-
Off-set	-	**1,419**	-

	Total regulated emissions (Tonnes CO2 / year)	CO2 savings (Tonnes CO2 / year)	Percentage savings (%)
Part L 2013 baseline	51		
Be lean	42	9	18%
Be clean	42	0	0%
Be green	23	19	37%
	-	**CO_2 savings off-set (Tonnes CO_2)**	-
Off-set	-	**609**	-

Building use	Energy demand following energy efficiency measures (MWh/year)						
	Space Heating	Hot Water	Lighting	Auxilary	Cooling	Unregulated electricity	Unregulated gas
Domestic	96	64	12	8	0	6.791	
Non-domestic	10	1	4	2	1	9.28368	

	Target Fabric Energy Efficiency (kWh/m^2)	Dwelling Fabric Energy Efficiency (kWh/m^2)	Improvement (%)
Development total	55.78	49.73	11%

	Area weighted average non-domestic cooling demand (MJ/m^2)	Total area weighted non-domestic cooling demand (MJ/year)
Actual	47.4	17917.2
Notional	83.7	31638.6

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Appendix B

TER Worksheets for Representative Dwellings

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

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Property Reference	A.01.05 Wootton	**Issued on Date**	27/11/2020
Assessment Reference	A.01.05 Wootton boiler	**Prop Type Ref**	Blk A 3B5P (exposed Floor)
Property			

SAP Rating	85 B	**DER**	15.99	**TER**	18.18
Environmental	87 B	**% DER<TER**	12.06		
CO_2 Emissions (t/year)	1.28	**DFEE**	51.57	**TFEE**	56.93
General Requirements Compliance	Pass	**% DFEE<TFEE**	9.43		

Assessor Details	Mr. Jonathan Peck, Jonathan Peck, Tel: 02036031622, Jonathan@hodkinsonconsultancy.com	**Assessor ID**	M976-0001
Client			

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

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

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DWELLING AS DESIGNED

Mid-floor flat, total floor area 99 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 18.18 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 15.99 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)56.9 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)51.6 kWh/m²/yrOK

---

2 Fabric U-values

Element	Average	Highest	
External wall	0.18 (max. 0.30)	0.18 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.15 (max. 0.25)	0.15 (max. 0.70)	OK
Roof	(no roof)		
Openings	1.28 (max. 2.00)	1.30 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

---

3 Air permeability
Air permeability at 50 pascals: 3.50 (design value)
Maximum 10.0 OK

---

4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 24
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

---

5 Cylinder insulation
Hot water storage: No cylinder

---

6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock: Yes OK

---

7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK

---

8 Mechanical ventilation
Continuous supply and extract system
Specific fan power: 0.52
Maximum 1.5 OK
MVHR efficiency: 92%
Minimum: 70% OK

---

9 Summertime temperature
Overheating risk (Thames Valley): Medium OK
Based on:
Overshading: Average
Windows facing North East: 3.00 m², No overhang
Windows facing South: 8.33 m², No overhang
Windows facing South West: 7.00 m², No overhang
Windows facing North West: 9.99 m², No overhang
Air change rate: 3.00 ach
Blinds/curtains: None

---

10 Key features
Party wall U-value 0.00 W/m²K
Door U-value 1.00 W/m²K
Air permeability 3.5 m³/m²h

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	98.9700 (1b)	x	2.5000 (2b)	=	247.4250	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	98.9700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	247.4250	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent 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)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Measured/design AP50		3.5000	
Infiltration rate		0.1750	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1619	(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	0.2064	0.2023	0.1983	0.1781	0.1740	0.1538	0.1538	0.1497	0.1619	0.1740	0.1821	0.1902	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation:	0.5000	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	78.2000	(23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.3154	0.3113	0.3073	0.2871	0.2830	0.2628	0.2628	0.2587	0.2709	0.2830	0.2911	0.2992	(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	
Window (Uw = 1.30)			28.3200	1.2357	34.9962			(27)
Front Door			2.1400	1.0000	2.1400			(26)
Heat Loss Floor bike store			90.0000	0.1500	13.5000			(28b)
Heat Loss Floor over external			8.7300	0.1500	1.3095			(28b)
External Wall 1	68.9900	30.4600	38.5300	0.1800	6.9354			(29a)
Wall to Corridor	29.7800		29.7800	0.1800	5.3604			(29a)
Total net area of external elements Aum(A, m2)			197.5000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		64.2415			(33)
Party Wall 1			5.0000	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	19.4712	(36)
Total fabric heat loss (33) + (36) =	83.7127	(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	25.7517	25.4213	25.0909	23.4387	23.1083	21.4562	21.4562	21.1257	22.1170	23.1083	23.7692	24.4300	(38)
Heat transfer coeff	109.4644	109.1340	108.8036	107.1514	106.8210	105.1689	105.1689	104.8384	105.8297	106.8210	107.4819	108.1427	(39)
Average = Sum(39)m / 12 =												107.0688	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1060	1.1027	1.0994	1.0827	1.0793	1.0626	1.0626	1.0593	1.0693	1.0793	1.0860	1.0927	(40)
HLP (average)												1.0818	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7298 (42)
Average daily hot water use (litres/day)	99.0324 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.9356	104.9743	101.0130	97.0517	93.0904	89.1291	89.1291	93.0904	97.0517	101.0130	104.9743	108.9356	(44)
Energy conte	161.5484	141.2912	145.7999	127.1119	121.9669	105.2481	97.5279	111.9147	113.2513	131.9834	144.0702	156.4510	(45)
Energy content (annual)											Total = Sum(45)m =	1558.1648	(45)

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

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

	24.2323	21.1937	21.8700	19.0668	18.2950	15.7872	14.6292	16.7872	16.9877	19.7975	21.6105	23.4676	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	16.3016	14.7046	16.2354	15.6372	16.0999	15.5131	15.9882	16.0606	15.5807	16.1774	15.7242	16.2802	(61)
Total heat required for water heating calculated for each month													
	177.8499	155.9958	162.0353	142.7491	138.0668	120.7612	113.5160	127.9753	128.8320	148.1608	159.7944	172.7311	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	177.8499	155.9958	162.0353	142.7491	138.0668	120.7612	113.5160	127.9753	128.8320	148.1608	159.7944	172.7311	(64)
								Total per year (kWh/year) = Sum(64)m =				1748.4680	(64)
Heat gains from water heating, kWh/month													
	57.7902	50.6555	52.5373	46.1740	44.5790	38.8733	36.4251	41.2268	41.5512	47.9288	51.8344	56.0900	(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	136.4892	136.4892	136.4892	136.4892	136.4892	136.4892	136.4892	136.4892	136.4892	136.4892	136.4892	136.4892	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	22.7024	20.1641	16.3985	12.4147	9.2802	7.8347	8.4657	11.0040	14.7695	18.7533	21.8879	23.3334	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	254.6518	257.2943	250.6353	236.4591	218.5642	201.7455	190.5096	187.8671	194.5261	208.7023	226.5972	243.4159	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.6489	36.6489	36.6489	36.6489	36.6489	36.6489	36.6489	36.6489	36.6489	36.6489	36.6489	36.6489	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-109.1914	-109.1914	-109.1914	-109.1914	-109.1914	-109.1914	-109.1914	-109.1914	-109.1914	-109.1914	-109.1914	-109.1914	(71)
Water heating gains (Table 5)													
	77.6750	75.3802	70.6147	64.1306	59.9180	53.9907	48.9584	55.4123	57.7100	64.4205	71.9922	75.3898	(72)
Total internal gains													
	421.9760	419.7853	404.5953	379.9512	354.7091	330.5176	314.8805	321.2302	333.9525	358.8229	387.4241	409.0858	(73)

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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	
Northeast	3.0000	11.2829	0.4500	0.8000	0.7700	8.4446	(75)
South	8.3300	46.7521	0.4500	0.8000	0.7700	97.1587	(78)
Southwest	7.0000	36.7938	0.4500	0.8000	0.7700	64.2553	(79)
Northwest	9.9900	11.2829	0.4500	0.8000	0.7700	28.1205	(81)

Solar gains	197.9791	343.0008	486.5448	634.8669	742.5861	751.6679	718.6294	635.6572	537.2890	383.5515	238.1376	168.8041	(83)
Total gains	619.9551	762.7860	891.1401	1014.8181	1097.2952	1082.1855	1033.5098	956.8875	871.2415	742.3744	625.5617	577.8899	(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, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	62.7868	62.9769	63.1681	64.1421	64.3405	65.3513	65.3513	65.5572	64.9432	64.3405	63.9449	63.5541	
alpha	5.1858	5.1985	5.2112	5.2761	5.2894	5.3568	5.3568	5.3705	5.3295	5.2894	5.2630	5.2369	
util living area													
	0.9976	0.9926	0.9772	0.9240	0.7964	0.6025	0.4444	0.4976	0.7595	0.9573	0.9940	0.9983	(86)
MIT	19.8429	20.0429	20.3230	20.6553	20.8851	20.9797	20.9967	20.9941	20.9340	20.6152	20.1626	19.8110	(87)
Th 2	19.9959	19.9986	20.0014	20.0150	20.0178	20.0315	20.0315	20.0342	20.0260	20.0178	20.0123	20.0068	(88)
util rest of house													
	0.9968	0.9901	0.9696	0.8997	0.7411	0.5196	0.3484	0.3965	0.6799	0.9384	0.9917	0.9977	(89)
MIT 2	18.4545	18.7474	19.1527	19.6239	19.9117	20.0188	20.0303	20.0319	19.9769	19.5821	18.9330	18.4158	(90)
Living area fraction									fLA = Living area / (4) =			0.3966	(91)
MIT	19.0051	19.2611	19.6168	20.0329	20.2977	20.3999	20.4135	20.4135	20.3564	19.9918	19.4206	18.9691	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.8551	19.1111	19.4668	19.8829	20.1477	20.2499	20.2635	20.2635	20.2064	19.8418	19.2706	18.8191	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9954	0.9871	0.9643	0.8959	0.7490	0.5389	0.3716	0.4209	0.6958	0.9341	0.9891	0.9967	(94)
Useful gains	617.1119	752.9755	859.3564	909.1695	821.8859	583.1531	384.0631	402.7246	606.2463	693.4618	618.7710	576.0012	(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													
	1593.2642	1550.9192	1410.8354	1176.8367	902.3941	594.1939	385.2891	405.0428	646.2433	987.2218	1308.1228	1580.9491	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	726.2573	536.2182	410.3004	192.7204	59.8981	0.0000	0.0000	0.0000	0.0000	218.5575	496.3333	747.6812	(98)
Space heating												3387.9663	(98)
Space heating per m2											(98) / (4) =	34.2323	(99)

8c. Space cooling requirement

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Not applicable

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 %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3743.6092	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	726.2573	536.2182	410.3004	192.7204	59.8981	0.0000	0.0000	0.0000	0.0000	218.5575	496.3333	747.6812	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	802.4943	592.5063	453.3706	212.9507	66.1857	0.0000	0.0000	0.0000	0.0000	241.5000	548.4346	826.1671	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	177.8499	155.9958	162.0353	142.7491	138.0668	120.7612	113.5160	127.9753	128.8320	148.1608	159.7944	172.7311	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8521	89.7585	89.5705	89.1101	88.2441	87.3000	87.3000	87.3000	87.3000	89.1793	89.6992	89.8817	(217)
Fuel for water heating, kWh/month	197.9363	173.7949	180.9026	160.1941	156.4601	138.3290	130.0298	146.5925	147.5739	166.1381	178.1447	192.1761	(219)
Water heating fuel used												1968.2722	(219)
Annual totals kWh/year													
Space heating fuel - main system												3743.6092	(211)
Space heating fuel - secondary												0.0000	(215)

Electricity for pumps and fans:		
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.6500)		
mechanical ventilation fans (SFP = 0.6500)	196.2080	(230a)
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	271.2080	(231)
Electricity for lighting (calculated in Appendix L)	400.9313	(232)
Total delivered energy for all uses	6384.0208	(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	3743.6092	0.2160	808.6196	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1968.2722	0.2160	425.1468	(264)
Space and water heating			1233.7664	(265)
Pumps and fans	271.2080	0.5190	140.7570	(267)
Energy for lighting	400.9313	0.5190	208.0834	(268)
Total CO2, kg/year			1582.6067	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			15.9900	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		15.9900	ZC1
Total Floor Area	TFA	98.9700	
Assumed number of occupants	N	2.7298	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		15.2472	ZC2
CO2 emissions from cooking, equation (L16)		1.8644	ZC3
Total CO2 emissions		33.1015	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		33.1015	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	98.9700 (1b)	x	2.5000 (2b)	=	247.4250	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	98.9700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	247.4250	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent 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)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1212	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3712	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3434	(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	0.4378	0.4293	0.4207	0.3777	0.3692	0.3262	0.3262	0.3176	0.3434	0.3692	0.3863	0.4035	(22b)
Effective ac	0.5959	0.5921	0.5885	0.5713	0.5681	0.5532	0.5532	0.5505	0.5590	0.5681	0.5746	0.5814	(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	
TER Opaque door			2.1400	1.0000	2.1400			(26)
TER Opening Type (Uw = 1.40)			22.6000	1.3258	29.9621			(27)
Heat Loss Floor bike store			90.0000	0.1300	11.7000			(28b)
Heat Loss Floor over external			8.7300	0.1300	1.1349			(28b)
External Wall 1	68.9900	24.7400	44.2500	0.1800	7.9650			(29a)
Wall to Corridor	29.7800		29.7800	0.1800	5.3604			(29a)
Total net area of external elements Aum(A, m2)			197.5000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		58.2624			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							18.8437	(36)
Total fabric heat loss					(33) + (36) =		77.1061	(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	48.6515	48.3476	48.0497	46.6505	46.3888	45.1701	45.1701	44.9444	45.6395	46.3888	46.9183	47.4720	(38)
Heat transfer coeff	125.7576	125.4537	125.1558	123.7567	123.4949	122.2762	122.2762	122.0506	122.7456	123.4949	124.0245	124.5781	(39)
Average = Sum(39)m / 12 =												123.7554	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2707	1.2676	1.2646	1.2504	1.2478	1.2355	1.2355	1.2332	1.2402	1.2478	1.2532	1.2587	(40)
HLP (average)												1.2504	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.7298	(42)
Average daily hot water use (litres/day)												99.0324	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.9356	104.9743	101.0130	97.0517	93.0904	89.1291	89.1291	93.0904	97.0517	101.0130	104.9743	108.9356	(44)
Energy conte	161.5484	141.2912	145.7999	127.1119	121.9669	105.2481	97.5279	111.9147	113.2513	131.9834	144.0702	156.4510	(45)
Energy content (annual)										Total = Sum(45)m =		1558.1648	(45)
Distribution loss (46)m = 0.15 x (45)m	24.2323	21.1937	21.8700	19.0668	18.2950	15.7872	14.6292	16.7872	16.9877	19.7975	21.6105	23.4676	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	46.0274	50.9589	47.8611	47.4379	43.9541	45.4192	47.4379	47.8611	50.9589	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month													
	212.5073	187.3186	196.7588	174.9730	169.4047	149.2022	142.9471	159.3525	161.1124	182.9423	193.3853	207.4099	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	212.5073	187.3186	196.7588	174.9730	169.4047	149.2022	142.9471	159.3525	161.1124	182.9423	193.3853	207.4099	(64)
								Total per year (kWh/year) = Sum(64)m =				2137.3142	(64)
Heat gains from water heating, kWh/month													
	66.4546	58.4862	61.2182	54.2300	52.4135	45.9835	43.7828	49.0711	49.6213	56.6242	60.2321	64.7597	(65)

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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	136.4892	136.4892	136.4892	136.4892	136.4892	136.4892	136.4892	136.4892	136.4892	136.4892	136.4892	136.4892	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	22.7024	20.1641	16.3985	12.4147	9.2802	7.8347	8.4657	11.0040	14.7695	18.7533	21.8879	23.3334	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	254.6518	257.2943	250.6353	236.4591	218.5642	201.7455	190.5096	187.8671	194.5261	208.7023	226.5972	243.4159	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.6489	36.6489	36.6489	36.6489	36.6489	36.6489	36.6489	36.6489	36.6489	36.6489	36.6489	36.6489	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-109.1914	-109.1914	-109.1914	-109.1914	-109.1914	-109.1914	-109.1914	-109.1914	-109.1914	-109.1914	-109.1914	-109.1914	(71)
Water heating gains (Table 5)													
	89.3206	87.0330	82.2825	75.3194	70.4482	63.8660	58.8479	65.9558	68.9185	76.1078	83.6557	87.0426	(72)
Total internal gains													
	433.6216	431.4381	416.2631	391.1400	365.2393	340.3930	324.7699	331.7736	345.1609	370.5102	399.0876	420.7386	(73)

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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	
Northeast	2.3900	11.2829	0.6300	0.7000	0.7700	8.2412	(75)
South	6.6500	46.7521	0.6300	0.7000	0.7700	95.0155	(78)
Southwest	5.5900	36.7938	0.6300	0.7000	0.7700	62.8577	(79)
Northwest	7.9700	11.2829	0.6300	0.7000	0.7700	27.4823	(81)

Solar gains	193.5967	335.3970	475.7299	620.7086	725.9859	734.8481	702.5556	621.4660	525.3305	375.0410	232.8642	165.0688	(83)
Total gains	627.2183	766.8351	891.9930	1011.8487	1091.2252	1075.2411	1027.3255	953.2397	870.4914	745.5512	631.9518	585.8074	(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, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	54.6521	54.7845	54.9149	55.5357	55.6535	56.2081	56.2081	56.3120	55.9932	55.6535	55.4158	55.1695	
alpha	4.6435	4.6523	4.6610	4.7024	4.7102	4.7472	4.7472	4.7541	4.7329	4.7102	4.6944	4.6780	
util living area													
	0.9974	0.9931	0.9811	0.9425	0.8453	0.6756	0.5118	0.5685	0.8141	0.9661	0.9943	0.9981	(86)
MIT	19.6308	19.8310	20.1266	20.4933	20.7892	20.9475	20.9886	20.9817	20.8709	20.4741	19.9795	19.5966	(87)
Th 2	19.8639	19.8663	19.8687	19.8799	19.8819	19.8917	19.8917	19.8935	19.8880	19.8819	19.8777	19.8733	(88)
util rest of house													
	0.9965	0.9908	0.9744	0.9216	0.7917	0.5790	0.3890	0.4419	0.7328	0.9496	0.9919	0.9975	(89)
MIT 2	18.0521	18.3453	18.7741	19.2980	19.6819	19.8583	19.8878	19.8864	19.7887	19.2834	18.5709	18.0086	(90)
Living area fraction									fLA = Living area / (4) =			0.3966	(91)
MIT	18.6782	18.9345	19.3104	19.7720	20.1210	20.2902	20.3244	20.3208	20.2179	19.7556	19.1296	18.6384	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6782	18.9345	19.3104	19.7720	20.1210	20.2902	20.3244	20.3208	20.2179	19.7556	19.1296	18.6384	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9952	0.9881	0.9701	0.9192	0.8045	0.6156	0.4380	0.4924	0.7596	0.9472	0.9897	0.9964	(94)
Useful gains	624.2097	757.6953	865.2957	930.0469	877.8435	661.9054	450.0192	469.3606	661.2201	706.1858	625.4452	583.7266	(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													
	1808.1699	1760.6810	1603.3024	1345.4825	1039.9565	695.7812	455.3998	478.5353	750.9424	1130.6737	1491.9589	1798.7074	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	880.8664	674.0064	549.0770	299.1136	120.6121	0.0000	0.0000	0.0000	0.0000	315.8190	623.8899	903.9457	(98)
Space heating												4367.3300	(98)
Space heating per m2											(98) / (4) =	44.1278	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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 %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4675.9422	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	880.8664	674.0064	549.0770	299.1136	120.6121	0.0000	0.0000	0.0000	0.0000	315.8190	623.8899	903.9457	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	943.1118	721.6342	587.8769	320.2501	129.1350	0.0000	0.0000	0.0000	0.0000	338.1359	667.9763	967.8219	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	212.5073	187.3186	196.7588	174.9730	169.4047	149.2022	142.9471	159.3525	161.1124	182.9423	193.3853	207.4099	(64)
Efficiency of water heater												80.3000	(216)
(217)m	88.2428	87.9930	87.4967	86.3897	84.2129	80.3000	80.3000	80.3000	80.3000	86.4133	87.7873	88.3266	(217)
Fuel for water heating, kWh/month													
	240.8211	212.8789	224.8756	202.5393	201.1624	185.8060	178.0163	198.4465	200.6381	211.7061	220.2885	234.8214	(219)
Water heating fuel used												2512.0003	(219)
Annual totals kWh/year													
Space heating fuel - main system												4675.9422	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												400.9313	(232)
Total delivered energy for all uses												7663.8738	(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	4675.9422	0.2160	1010.0035	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2512.0003	0.2160	542.5921	(264)
Space and water heating			1552.5956	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	400.9313	0.5190	208.0834	(268)
Total CO2, kg/m2/year			1799.6039	(272)
Emissions per m2 for space and water heating			15.6875	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.1025	(272b)
Emissions per m2 for pumps and fans			0.3933	(272c)
Target Carbon Dioxide Emission Rate (TER) = (15.6875 * 1.00) + 2.1025 + 0.3933, rounded to 2 d.p.			18.1800	(273)

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

HODKINSON

Property Reference	A.03.02 Wootton	**Issued on Date**	27/11/2020
Assessment Reference	A.03.02 Wootton Boiler	**Prop Type Ref**	Blk A 1B2P (Mid floor)
Property			

SAP Rating	86 B	**DER**	13.32	**TER**	15.85
Environmental	91 B	**% DER<TER**	15.99		
CO_2 Emissions (t/year)	0.64	**DFEE**	30.52	**TFEE**	31.17
General Requirements Compliance	Pass	**% DFEE<TFEE**	2.07		

Assessor Details	Mr. Jonathan Peck, Jonathan Peck, Tel: 02036031622, Jonathan@hodkinsonconsultancy.com	**Assessor ID**	M976-0001
Client			

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

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

DWELLING AS DESIGNED

Mid-floor flat, total floor area 56 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 15.85 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 13.32 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)31.2 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)30.5 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.18 (max. 0.30)	0.18 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	(no floor)		
Roof	(no roof)		
Openings	1.26 (max. 2.00)	1.30 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability
Air permeability at 50 pascals: 3.50 (design value)
Maximum 10.0 OK

4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 24
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

5 Cylinder insulation
Hot water storage No cylinder

6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock Yes OK

7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK

8 Mechanical ventilation
Continuous supply and extract system
Specific fan power: 0.48
Maximum 1.5 OK
MVHR efficiency: 92%
Minimum: 70% OK

9 Summertime temperature
Overheating risk (Thames Valley): Medium OK
Based on:
Overshading: Average
Windows facing South: 7.86 m², No overhang
Windows facing South West: 4.68 m², No overhang
Air change rate: 3.00 ach
Blinds/curtains: None

10 Key features
Party wall U-value 0.00 W/m²K
Door U-value 1.00 W/m²K
Air permeability 3.5 m³/m²h

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	55.9100 (1b)	x	2.5000 (2b)	=	139.7750	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	55.9100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	139.7750	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent 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)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Measured/design AP50		3.5000	
Infiltration rate		0.1750	(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) =	0.1356	(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	0.1729	0.1695	0.1661	0.1492	0.1458	0.1288	0.1288	0.1255	0.1356	0.1458	0.1526	0.1594	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation:	0.5000	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	78.2000	(23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.2819	0.2785	0.2751	0.2582	0.2548	0.2378	0.2378	0.2345	0.2446	0.2548	0.2616	0.2684	(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	
Window (Uw = 1.30)			12.5400	1.2357	15.4962			(27)
Front Door			2.1400	1.0000	2.1400			(26)
External Wall 1	32.7500	14.6800	18.0700	0.1800	3.2526			(29a)
Wall to Corridor	14.5500		14.5500	0.1800	2.6190			(29a)
Total net area of external elements Aum(A, m2)			47.3000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		23.5078			(33)
Party Wall 1			39.2800	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	7.0548	(36)
Total fabric heat loss (33) + (36) =	30.5626	(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	13.0039	12.8475	12.6911	11.9091	11.7527	10.9707	10.9707	10.8143	11.2835	11.7527	12.0655	12.3783	(38)
Heat transfer coeff	43.5665	43.4101	43.2537	42.4717	42.3153	41.5333	41.5333	41.3769	41.8461	42.3153	42.6281	42.9409	(39)
Average = Sum(39)m / 12 =												42.4326	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.7792	0.7764	0.7736	0.7596	0.7568	0.7429	0.7429	0.7401	0.7485	0.7568	0.7624	0.7680	(40)
HLP (average)												0.7589	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.8640 (42)
Average daily hot water use (litres/day)	78.4693 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	86.3162	83.1774	80.0386	76.8999	73.7611	70.6223	70.6223	73.7611	76.8999	80.0386	83.1774	86.3162	(44)
Energy conte	128.0044	111.9535	115.5260	100.7183	96.6416	83.3944	77.2772	88.6767	89.7357	104.5784	114.1555	123.9654	(45)
Energy content (annual)										Total = Sum(45)m =		1234.6270	(45)
Distribution loss (46)m = 0.15 x (45)m	19.2007	16.7930	17.3289	15.1077	14.4962	12.5092	11.5916	13.3015	13.4604	15.6868	17.1233	18.5948	(46)

Water storage loss:

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	16.0871	14.5023	16.0114	15.4444	15.9225	15.3665	15.8523	15.8978	15.4089	15.9746	15.5179	16.0725	(61)
Total heat required for water heating calculated for each month													
	144.0915	126.4557	131.5374	116.1627	112.5641	98.7608	93.1294	104.5745	105.1447	120.5530	129.6734	140.0379	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	144.0915	126.4557	131.5374	116.1627	112.5641	98.7608	93.1294	104.5745	105.1447	120.5530	129.6734	140.0379	(64)
								Total per year (kWh/year) = Sum(64)m =				1422.6851	(64)
Heat gains from water heating, kWh/month													
	46.5832	40.8501	42.4152	37.3499	36.1140	31.5702	29.6577	33.4594	33.6894	38.7660	41.8362	45.2366	(65)

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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	93.1984	93.1984	93.1984	93.1984	93.1984	93.1984	93.1984	93.1984	93.1984	93.1984	93.1984	93.1984	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	14.4894	12.8694	10.4661	7.9235	5.9229	5.0004	5.4031	7.0231	9.4264	11.9690	13.9696	14.8921	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	162.5275	164.2140	159.9640	150.9163	139.4951	128.7609	121.5897	119.9032	124.1532	133.2009	144.6221	155.3563	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	32.3198	32.3198	32.3198	32.3198	32.3198	32.3198	32.3198	32.3198	32.3198	32.3198	32.3198	32.3198	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-74.5588	-74.5588	-74.5588	-74.5588	-74.5588	-74.5588	-74.5588	-74.5588	-74.5588	-74.5588	-74.5588	-74.5588	(71)
Water heating gains (Table 5)													
	62.6119	60.7888	57.0097	51.8749	48.5403	43.8476	39.8625	44.9724	46.7908	52.1048	58.1058	60.8019	(72)
Total internal gains													
	293.5883	291.8318	281.3994	264.6742	247.9179	231.5684	220.8149	225.8582	234.3300	251.2343	270.6570	285.0099	(73)

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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	
South	7.8600	46.7521	0.4500	0.8000	0.7700	91.6767	(78)
Southwest	4.6800	36.7938	0.4500	0.8000	0.7700	42.9592	(79)

Solar gains	134.6360	223.3183	291.3772	340.2159	364.2051	354.7226	344.7986	327.5718	308.1996	242.8176	160.1235	115.9813	(83)
Total gains	428.2243	515.1501	572.7766	604.8902	612.1229	586.2910	565.6135	553.4301	542.5296	494.0519	430.7804	400.9912	(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, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	89.1199	89.4410	89.7644	91.4171	91.7550	93.4825	93.4825	93.8359	92.7837	91.7550	91.0817	90.4183	
alpha	6.9413	6.9627	6.9843	7.0945	7.1170	7.2322	7.2322	7.2557	7.1856	7.1170	7.0721	7.0279	
util living area													
	0.9895	0.9655	0.9107	0.7947	0.6327	0.4526	0.3230	0.3438	0.5295	0.8206	0.9690	0.9928	(86)
MIT	20.4526	20.6368	20.8097	20.9400	20.9887	20.9991	20.9999	20.9999	20.9974	20.9373	20.6835	20.4163	(87)
Th 2	20.2714	20.2738	20.2762	20.2884	20.2909	20.3031	20.3031	20.3056	20.2982	20.2909	20.2860	20.2811	(88)
util rest of house													
	0.9865	0.9569	0.8913	0.7604	0.5879	0.4037	0.2719	0.2920	0.4768	0.7820	0.9597	0.9907	(89)
MIT 2	19.5501	19.8133	20.0509	20.2256	20.2812	20.3026	20.3031	20.3055	20.2964	20.2280	19.8925	19.5056	(90)
Living area fraction										fLA = Living area / (4) =		0.5139	(91)
MIT	20.0139	20.2365	20.4408	20.5927	20.6447	20.6605	20.6612	20.6623	20.6566	20.5925	20.2990	19.9736	(92)
Temperature adjustment												-0.1500	
adjusted MIT	19.8639	20.0865	20.2908	20.4427	20.4947	20.5105	20.5112	20.5123	20.5066	20.4425	20.1490	19.8236	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9844	0.9543	0.8918	0.7681	0.6009	0.4183	0.2872	0.3074	0.4926	0.7907	0.9576	0.9890	(94)
Useful gains	421.5559	491.6327	510.7859	464.6461	367.8507	245.2202	162.4303	170.1335	267.2329	390.6309	412.5242	396.5870	(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													
	678.0625	659.2463	596.5015	490.2383	372.1524	245.4835	162.4442	170.1562	268.0916	416.4868	556.2518	670.8902	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	190.8409	112.6364	63.7724	18.4264	3.2005	0.0000	0.0000	0.0000	0.0000	19.2368	103.4839	204.0816	(98)
Space heating												715.6788	(98)
Space heating per m2											(98) / (4) =	12.8006	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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 %)		90.5000 (206)
Efficiency of secondary/supplementary heating system, %		0.0000 (208)
Space heating requirement		790.8054 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	190.8409	112.6364	63.7724	18.4264	3.2005	0.0000	0.0000	0.0000	0.0000	19.2368	103.4839	204.0816	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	210.8739	124.4601	70.4668	20.3606	3.5365	0.0000	0.0000	0.0000	0.0000	21.2562	114.3468	225.5045	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	144.0915	126.4557	131.5374	116.1627	112.5641	98.7608	93.1294	104.5745	105.1447	120.5530	129.6734	140.0379	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.0950	88.7789	88.3197	87.7247	87.3854	87.3000	87.3000	87.3000	87.3000	87.7269	88.6919	89.1699	(217)
Fuel for water heating, kWh/month	161.7279	142.4390	148.9332	132.4174	128.8134	113.1281	106.6775	119.7875	120.4406	137.4185	146.2065	157.0462	(219)
Water heating fuel used												1615.0359	(219)
Annual totals kWh/year													
Space heating fuel - main system												790.8054	(211)
Space heating fuel - secondary												0.0000	(215)

Electricity for pumps and fans:		
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.6000)		
mechanical ventilation fans (SFP = 0.6000)		102.3153 (230a)
central heating pump		30.0000 (230c)
main heating flue fan		45.0000 (230e)
Total electricity for the above, kWh/year		177.3153 (231)
Electricity for lighting (calculated in Appendix L)		255.8881 (232)
Total delivered energy for all uses		2839.0447 (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	790.8054	0.2160	170.8140	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1615.0359	0.2160	348.8478	(264)
Space and water heating			519.6617	(265)
Pumps and fans	177.3153	0.5190	92.0266	(267)
Energy for lighting	255.8881	0.5190	132.8059	(268)
Total CO2, kg/year			744.4943	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			13.3200	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		13.3200	ZC1
Total Floor Area	TFA	55.9100	
Assumed number of occupants	N	1.8640	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		17.2260	ZC2
CO2 emissions from cooking, equation (L16)		2.9286	ZC3
Total CO2 emissions		33.4745	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		33.4745	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	55.9100 (1b)	x	2.5000 (2b)	=	139.7750	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	55.9100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	139.7750	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent 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)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1431	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3931	(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) =	0.3046	(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	0.3884	0.3808	0.3732	0.3351	0.3275	0.2894	0.2894	0.2818	0.3046	0.3275	0.3427	0.3580	(22b)
Effective ac	0.5754	0.5725	0.5696	0.5561	0.5536	0.5419	0.5419	0.5397	0.5464	0.5536	0.5587	0.5641	(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	
TER Opaque door			2.1400	1.0000	2.1400			(26)
TER Opening Type (Uw = 1.40)			11.8400	1.3258	15.6970			(27)
External Wall 1	32.7500	13.9800	18.7700	0.1800	3.3786			(29a)
Wall to Corridor	14.5500		14.5500	0.1800	2.6190			(29a)
Total net area of external elements Aum(A, m2)			47.3000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	23.8346			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		3.7238 (36)
Total fabric heat loss	(33) + (36) =	27.5584 (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	26.5424	26.4072	26.2748	25.6528	25.5364	24.9946	24.9946	24.8943	25.2033	25.5364	25.7718	26.0180	(38)
Heat transfer coeff	54.1007	53.9656	53.8332	53.2111	53.0947	52.5530	52.5530	52.4526	52.7616	53.0947	53.3302	53.5763	(39)
Average = Sum(39)m / 12 =												53.2106	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9676	0.9652	0.9629	0.9517	0.9496	0.9400	0.9400	0.9382	0.9437	0.9496	0.9539	0.9583	(40)
HLP (average)												0.9517	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.8640 (42)
Average daily hot water use (litres/day)	78.4693 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	86.3162	83.1774	80.0386	76.8999	73.7611	70.6223	70.6223	73.7611	76.8999	80.0386	83.1774	86.3162	(44)
Energy conte	128.0044	111.9535	115.5260	100.7183	96.6416	83.3944	77.2772	88.6767	89.7357	104.5784	114.1555	123.9654	(45)
Energy content (annual)										Total = Sum(45)m =		1234.6270	(45)
Distribution loss (46)m = 0.15 x (45)m	19.2007	16.7930	17.3289	15.1077	14.4962	12.5092	11.5916	13.3015	13.4604	15.6868	17.1233	18.5948	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	43.9858	38.2844	40.7868	37.9232	37.5878	34.8275	35.9884	37.5878	37.9232	40.7868	41.0190	43.9858	(61)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Total heat required for water heating calculated for each month

	171.9902	150.2379	156.3128	138.6416	134.2295	118.2218	113.2655	126.2645	127.6590	145.3652	155.1745	167.9512	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	171.9902	150.2379	156.3128	138.6416	134.2295	118.2218	113.2655	126.2645	127.6590	145.3652	155.1745	167.9512	(64)
								Total per year (kWh/year) = Sum(64)m =				1705.3135	(64)
Heat gains from water heating, kWh/month													
	53.5579	46.7956	48.6091	42.9697	41.5303	36.4355	34.6917	38.8820	39.3179	44.9690	48.2114	52.2150	(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	93.1984	93.1984	93.1984	93.1984	93.1984	93.1984	93.1984	93.1984	93.1984	93.1984	93.1984	93.1984	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	14.5210	12.8974	10.4889	7.9408	5.9358	5.0113	5.4149	7.0384	9.4470	11.9951	14.0001	14.9246	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	162.5275	164.2140	159.9640	150.9163	139.4951	128.7609	121.5897	119.9032	124.1532	133.2009	144.6221	155.3563	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	32.3198	32.3198	32.3198	32.3198	32.3198	32.3198	32.3198	32.3198	32.3198	32.3198	32.3198	32.3198	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-74.5588	-74.5588	-74.5588	-74.5588	-74.5588	-74.5588	-74.5588	-74.5588	-74.5588	-74.5588	-74.5588	-74.5588	(71)
Water heating gains (Table 5)													
	71.9864	69.6364	65.3348	59.6801	55.8203	50.6049	46.6287	52.2607	54.6083	60.4422	66.9603	70.1814	(72)
Total internal gains													
	302.9945	300.7073	289.7472	272.4967	255.2108	238.3365	227.5928	233.1619	242.1680	259.5978	279.5420	294.4219	(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	
South	7.4200	46.7521	0.6300	0.7000	0.7700	106.0172	(78)
Southwest	4.4200	36.7938	0.6300	0.7000	0.7700	49.7015	(79)

Solar gains	155.7187	258.2889	337.0079	393.4986	421.2480	410.2818	398.8028	378.8756	356.4661	280.8424	185.1975	134.1428	(83)
Total gains	458.7132	558.9962	626.7552	665.9953	676.4588	648.6183	626.3956	612.0374	598.6340	540.4402	464.7395	428.5646	(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	71.7669	71.9465	72.1235	72.9667	73.1266	73.8805	73.8805	74.0218	73.5883	73.1266	72.8038	72.4693	
alpha	5.7845	5.7964	5.8082	5.8644	5.8751	5.9254	5.9254	5.9348	5.9059	5.8751	5.8536	5.8313	
util living area													
	0.9901	0.9709	0.9290	0.8395	0.6949	0.5134	0.3685	0.3933	0.5951	0.8636	0.9747	0.9930	(86)
MIT	20.2194	20.4331	20.6551	20.8523	20.9587	20.9942	20.9993	20.9990	20.9864	20.8510	20.4978	20.1741	(87)
Th 2	20.1104	20.1124	20.1144	20.1238	20.1255	20.1337	20.1337	20.1352	20.1305	20.1255	20.1220	20.1183	(88)
util rest of house													
	0.9872	0.9629	0.9109	0.8040	0.6404	0.4462	0.2963	0.3199	0.5255	0.8247	0.9663	0.9909	(89)
MIT 2	19.0861	19.3927	19.7018	19.9661	20.0893	20.1301	20.1334	20.1348	20.1213	19.9722	19.4959	19.0267	(90)
Living area fraction									fLA = Living area / (4) =			0.5139	(91)
MIT	19.6684	19.9273	20.1917	20.4215	20.5361	20.5741	20.5784	20.5789	20.5658	20.4238	20.0107	19.6163	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.6684	19.9273	20.1917	20.4215	20.5361	20.5741	20.5784	20.5789	20.5658	20.4238	20.0107	19.6163	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9854	0.9609	0.9127	0.8167	0.6666	0.4806	0.3334	0.3576	0.5608	0.8390	0.9651	0.9894	(94)
Useful gains	452.0023	537.1589	572.0236	543.9262	450.9285	311.7436	208.8657	218.8747	335.7366	453.4034	448.5124	424.0183	(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													
	831.4431	810.9580	737.0664	613.0697	469.1478	313.9575	209.0749	219.1923	341.1471	521.5913	688.5322	825.9499	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	282.3040	183.9930	122.7918	49.7833	13.5552	0.0000	0.0000	0.0000	0.0000	50.7318	172.8143	299.0372	(98)
Space heating												1175.0104	(98)
Space heating per m2											(98) / (4) =	21.0161	(99)

8c. Space cooling requirement

Not applicable

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

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

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												1258.0412	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	282.3040	183.9930	122.7918	49.7833	13.5552	0.0000	0.0000	0.0000	0.0000	50.7318	172.8143	299.0372	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	302.2526	196.9946	131.4687	53.3012	14.5131	0.0000	0.0000	0.0000	0.0000	54.3167	185.0260	320.1683	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	171.9902	150.2379	156.3128	138.6416	134.2295	118.2218	113.2655	126.2645	127.6590	145.3652	155.1745	167.9512	(64)
Efficiency of water heater												80.3000	(216)
(217)m	86.2910	85.5625	84.4511	82.7425	81.1314	80.3000	80.3000	80.3000	80.3000	82.6901	85.3227	86.4877	(217)
Fuel for water heating, kWh/month													
	199.3142	175.5885	185.0927	167.5579	165.4470	147.2252	141.0530	157.2410	158.9775	175.7951	181.8677	194.1910	(219)
Water heating fuel used												2049.3508	(219)
Annual totals kWh/year													
Space heating fuel - main system												1258.0412	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												256.4459	(232)
Total delivered energy for all uses												3638.8379	(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	1258.0412	0.2160	271.7369	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2049.3508	0.2160	442.6598	(264)
Space and water heating			714.3967	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	256.4459	0.5190	133.0954	(268)
Total CO2, kg/m2/year			886.4171	(272)
Emissions per m2 for space and water heating			12.7776	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.3805	(272b)
Emissions per m2 for pumps and fans			0.6962	(272c)
Target Carbon Dioxide Emission Rate (TER) = (12.7776 * 1.00) + 2.3805 + 0.6962, rounded to 2 d.p.			15.8500	(273)

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

HODKINSON

Property Reference	B.04.05 Wootton	**Issued on Date**	27/11/2020
Assessment Reference	B.04.05 Wootton Boiler	**Prop Type Ref**	Blk B 3B5P (exposed roof)
Property			

SAP Rating	85 B	**DER**	15.40	**TER**	18.59
Environmental	87 B	**% DER<TER**	17.18		
CO_2 Emissions (t/year)	1.23	**DFEE**	49.03	**TFEE**	59.04
General Requirements Compliance	Pass	**% DFEE<TFEE**	16.95		

Assessor Details	Mr. Jonathan Peck, Jonathan Peck, Tel: 02036031622, Jonathan@hodkinsonconsultancy.com	**Assessor ID**	M976-0001
Client			

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

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

DWELLING AS DESIGNED

Top-floor flat, total floor area 99 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 18.59 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 15.40 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)59.0 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)49.0 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.18 (max. 0.30)	0.18 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	(no floor)		
Roof	0.10 (max. 0.20)	0.10 (max. 0.35)	OK
Openings	1.28 (max. 2.00)	1.30 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability
Air permeability at 50 pascals: 3.50 (design value)
Maximum 10.0 OK

4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 24
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

5 Cylinder insulation
Hot water storage No cylinder

6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock Yes OK

7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK

8 Mechanical ventilation
Continuous supply and extract system
Specific fan power: 0.52
Maximum 1.5 OK
MVHR efficiency: 92%
Minimum: 70% OK

9 Summertime temperature
Overheating risk (Thames Valley): Medium OK
Based on:
Overshading: Average
Windows facing North East: 3.00 m², No overhang
Windows facing South: 8.33 m², No overhang
Windows facing South West: 7.00 m², No overhang
Windows facing North West: 9.99 m², No overhang
Air change rate: 3.00 ach
Blinds/curtains: None

10 Key features
Party wall U-value 0.00 W/m²K
Roof U-value 0.10 W/m²K
Door U-value 1.00 W/m²K
Air permeability 3.5 m³/m²h

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	98.9700 (1b)	x	2.5000 (2b)	=	247.4250	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	98.9700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	247.4250	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent 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)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Measured/design AP50		3.5000	
Infiltration rate		0.1750	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1619	(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	0.2064	0.2023	0.1983	0.1781	0.1740	0.1538	0.1538	0.1497	0.1619	0.1740	0.1821	0.1902	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation:	0.5000	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	78.2000	(23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.3154	0.3113	0.3073	0.2871	0.2830	0.2628	0.2628	0.2587	0.2709	0.2830	0.2911	0.2992	(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	
Window (Uw = 1.30)			28.3200	1.2357	34.9962			(27)
Front Door			2.1400	1.0000	2.1400			(26)
External Wall 1	68.9900	30.4600	38.5300	0.1800	6.9354			(29a)
Wall to Corridor	29.7800		29.7800	0.1800	5.3604			(29a)
External Roof 1	98.9700		98.9700	0.1000	9.8970			(30)
Total net area of external elements Aum(A, m2)			197.7400					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	59.3290			(33)
Party Wall 1			5.0000	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	19.8866 (36)
Total fabric heat loss (33) + (36) =	79.2156 (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	25.7517	25.4213	25.0909	23.4387	23.1083	21.4562	21.4562	21.1257	22.1170	23.1083	23.7692	24.4300	(38)
Heat transfer coeff	104.9673	104.6369	104.3065	102.6543	102.3239	100.6718	100.6718	100.3413	101.3326	102.3239	102.9848	103.6456	(39)

Average = Sum(39)m / 12 =	102.5717 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0606	1.0573	1.0539	1.0372	1.0339	1.0172	1.0172	1.0139	1.0239	1.0339	1.0406	1.0472	(40)
HLP (average)												1.0364	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7298 (42)
Average daily hot water use (litres/day)	99.0324 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.9356	104.9743	101.0130	97.0517	93.0904	89.1291	89.1291	93.0904	97.0517	101.0130	104.9743	108.9356	(44)
Energy conte	161.5484	141.2912	145.7999	127.1119	121.9669	105.2481	97.5279	111.9147	113.2513	131.9834	144.0702	156.4510	(45)
Energy content (annual)										Total = Sum(45)m =		1558.1648	(45)
Distribution loss (46)m = 0.15 x (45)m	24.2323	21.1937	21.8700	19.0668	18.2950	15.7872	14.6292	16.7872	16.9877	19.7975	21.6105	23.4676	(46)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

```
Water storage loss:
Total storage loss
                0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000 (56)
If cylinder contains dedicated solar storage
                0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000 (57)
Combi loss     16.3016   14.7046   16.2354   15.6372   16.0999   15.5131   15.9882   16.0606   15.5807   16.1774   15.7242   16.2802 (61)
Total heat required for water heating calculated for each month
              177.8499  155.9958  162.0353  142.7491  138.0668  120.7612  113.5160  127.9753  128.8320  148.1608  159.7944  172.7311 (62)
Solar input     0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000 (63)
                                                                                  Solar input (sum of months) = Sum(63)m =      0.0000 (63)
Output from w/h
              177.8499  155.9958  162.0353  142.7491  138.0668  120.7612  113.5160  127.9753  128.8320  148.1608  159.7944  172.7311 (64)
                                                                                    Total per year (kWh/year) = Sum(64)m =   1748.4680 (64)
Heat gains from water heating, kWh/month
               57.7902   50.6555   52.5373   46.1740   44.5790   38.8733   36.4251   41.2268   41.5512   47.9288   51.8344   56.0900 (65)
```

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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         136.4892  136.4892  136.4892  136.4892  136.4892  136.4892  136.4892  136.4892  136.4892  136.4892  136.4892  136.4892 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
               22.7024   20.1641   16.3985   12.4147    9.2802    7.8347    8.4657   11.0040   14.7695   18.7533   21.8879   23.3334 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
              254.6518  257.2943  250.6353  236.4591  218.5642  201.7455  190.5096  187.8671  194.5261  208.7023  226.5972  243.4159 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
               36.6489   36.6489   36.6489   36.6489   36.6489   36.6489   36.6489   36.6489   36.6489   36.6489   36.6489   36.6489 (69)
Pumps, fans     3.0000    3.0000    3.0000    3.0000    3.0000    3.0000    3.0000    3.0000    3.0000    3.0000    3.0000    3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
            -109.1914 -109.1914 -109.1914 -109.1914 -109.1914 -109.1914 -109.1914 -109.1914 -109.1914 -109.1914 -109.1914 -109.1914 (71)
Water heating gains (Table 5)
               77.6750   75.3802   70.6147   64.1306   59.9180   53.9907   48.9584   55.4123   57.7100   64.4205   71.9922   75.3898 (72)
Total internal gains
              421.9760  419.7853  404.5953  379.9512  354.7091  330.5176  314.8805  321.2302  333.9525  358.8229  387.4241  409.0858 (73)
```

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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	
Northeast	3.0000	11.2829	0.4500	0.8000	0.7700	8.4446	(75)
South	8.3300	46.7521	0.4500	0.8000	0.7700	97.1587	(78)
Southwest	7.0000	36.7938	0.4500	0.8000	0.7700	64.2553	(79)
Northwest	9.9900	11.2829	0.4500	0.8000	0.7700	28.1205	(81)

```
Solar gains   197.9791  343.0008  486.5448  634.8669  742.5861  751.6679  718.6294  635.6572  537.2890  383.5515  238.1376  168.8041 (83)
Total gains   619.9551  762.7860  891.1401 1014.8181 1097.2952 1082.1855 1033.5098  956.8875  871.2415  742.3744  625.5617  577.8899 (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, nil,m (see Table 9a)
                Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
tau           65.4767   65.6835   65.8916   66.9520   67.1682   68.2706   68.2706   68.4954   67.8253   67.1682   66.7372   66.3117
alpha          5.3651    5.3789    5.3928    5.4635    5.4779    5.5514    5.5514    5.5664    5.5217    5.4779    5.4491    5.4208
util living area
               0.9975    0.9922    0.9755    0.9168    0.7797    0.5814    0.4264    0.4780    0.7408    0.9534    0.9938    0.9983 (86)

MIT           19.9056   20.1045   20.3788   20.6980   20.9069   20.9853   20.9978   20.9959   20.9478   20.6545   20.2159   19.8740 (87)
Th 2          20.0331   20.0359   20.0386   20.0524   20.0552   20.0690   20.0690   20.0718   20.0635   20.0552   20.0497   20.0442 (88)
util rest of house
               0.9967    0.9897    0.9675    0.8914    0.7244    0.5028    0.3374    0.3839    0.6626    0.9335    0.9914    0.9977 (89)
MIT 2         18.5729   18.8641   19.2606   19.7115   19.9699   20.0599   20.0682   20.0702   20.0250   19.6655   19.0379   18.5349 (90)
Living area fraction                                                                          fLA = Living area / (4) =     0.3966 (91)
MIT           19.1014   19.3560   19.7041   20.1027   20.3415   20.4269   20.4369   20.4373   20.3910   20.0577   19.5051   19.0660 (92)
Temperature adjustment                                                                                                    -0.1500
adjusted MIT  18.9514   19.2060   19.5541   19.9527   20.1915   20.2769   20.2869   20.2873   20.2410   19.9077   19.3551   18.9160 (93)
```

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8. Space heating requirement

```
                Jan       Feb       Mar       Apr       May       Jun       Jul       Aug       Sep       Oct       Nov       Dec
Utilisation    0.9954    0.9868    0.9624    0.8883    0.7330    0.5208    0.3583    0.4060    0.6784    0.9297    0.9889    0.9968 (94)
Useful gains  617.1194  752.6943  857.6076  901.4742  804.2757  563.5892  370.3546  388.4924  591.0721  690.1564  618.5999  576.0233 (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
             1537.9213 1496.9392 1361.6224 1134.6124  868.8838  571.5001  371.1635  390.0611  622.2794  952.4006 1262.0856 1525.2466 (97)
Month fracti    1.0000    1.0000    1.0000    1.0000    1.0000    0.0000    0.0000    0.0000    0.0000    1.0000    1.0000    1.0000 (97a)
Space heating kWh
              685.0766  500.1326  374.9870  167.8595   48.0684    0.0000    0.0000    0.0000    0.0000  195.1097  463.3097  706.2221 (98)
Space heating                                                                                                            3140.7656 (98)
Space heating per m2                                                                                        (98) / (4) =    31.7345 (99)
```

8c. Space cooling requirement

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Not applicable

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 %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3470.4593	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	685.0766	500.1326	374.9870	167.8595	48.0684	0.0000	0.0000	0.0000	0.0000	195.1097	463.3097	706.2221	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	756.9907	552.6327	414.3503	185.4801	53.1143	0.0000	0.0000	0.0000	0.0000	215.5908	511.9444	780.3560	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	177.8499	155.9958	162.0353	142.7491	138.0668	120.7612	113.5160	127.9753	128.8320	148.1608	159.7944	172.7311	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8214	89.7181	89.5100	89.0007	88.1045	87.3000	87.3000	87.3000	87.3000	89.0905	89.6572	89.8528	(217)
Fuel for water heating, kWh/month													
	198.0039	173.8733	181.0248	160.3910	156.7080	138.3290	130.0298	146.5925	147.5739	166.3037	178.2282	192.2380	(219)
Water heating fuel used												1969.2962	(219)
Annual totals kWh/year													
Space heating fuel - main system												3470.4593	(211)
Space heating fuel - secondary												0.0000	(215)

Electricity for pumps and fans:		
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.6500)		
mechanical ventilation fans (SFP = 0.6500)	196.2080	(230a)
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	271.2080	(231)
Electricity for lighting (calculated in Appendix L)	400.9313	(232)
Total delivered energy for all uses	6111.8948	(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	3470.4593	0.2160	749.6192	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1969.2962	0.2160	425.3680	(264)
Space and water heating			1174.9872	(265)
Pumps and fans	271.2080	0.5190	140.7570	(267)
Energy for lighting	400.9313	0.5190	208.0834	(268)
Total CO2, kg/year			1523.8275	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			15.4000	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		15.4000	ZC1
Total Floor Area	TFA	98.9700	
Assumed number of occupants	N	2.7298	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		15.2472	ZC2
CO2 emissions from cooking, equation (L16)		1.8644	ZC3
Total CO2 emissions		32.5115	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		32.5115	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	98.9700 (1b)	x	2.5000 (2b)	=	247.4250	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	98.9700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	247.4250	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent 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)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1212	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3712	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3434	(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	0.4378	0.4293	0.4207	0.3777	0.3692	0.3262	0.3262	0.3176	0.3434	0.3692	0.3863	0.4035	(22b)
Effective ac	0.5959	0.5921	0.5885	0.5713	0.5681	0.5532	0.5532	0.5505	0.5590	0.5681	0.5746	0.5814	(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	
TER Opaque door			2.1400	1.0000	2.1400			(26)
TER Opening Type (Uw = 1.40)			22.6000	1.3258	29.9621			(27)
External Wall 1	68.9900	24.7400	44.2500	0.1800	7.9650			(29a)
Wall to Corridor	29.7800		29.7800	0.1800	5.3604			(29a)
External Roof 1	98.9700		98.9700	0.1300	12.8661			(30)
Total net area of external elements Aum(A, m2)			197.7400					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	58.2936			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	22.0531	(36)
Total fabric heat loss (33) + (36) =	80.3467	(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	48.6515	48.3476	48.0497	46.6505	46.3888	45.1701	45.1701	44.9444	45.6395	46.3888	46.9183	47.4720	(38)
Heat transfer coeff	128.9982	128.6943	128.3964	126.9973	126.7355	125.5168	125.5168	125.2912	125.9862	126.7355	127.2651	127.8187	(39)
Average = Sum(39)m / 12 =												126.9960	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3034	1.3003	1.2973	1.2832	1.2805	1.2682	1.2682	1.2660	1.2730	1.2805	1.2859	1.2915	(40)
HLP (average)												1.2832	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7298	(42)
Average daily hot water use (litres/day)	99.0324	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.9356	104.9743	101.0130	97.0517	93.0904	89.1291	89.1291	93.0904	97.0517	101.0130	104.9743	108.9356	(44)
Energy conte	161.5484	141.2912	145.7999	127.1119	121.9669	105.2481	97.5279	111.9147	113.2513	131.9834	144.0702	156.4510	(45)
Energy content (annual)										Total = Sum(45)m =		1558.1648	(45)
Distribution loss (46)m = 0.15 x (45)m	24.2323	21.1937	21.8700	19.0668	18.2950	15.7872	14.6292	16.7872	16.9877	19.7975	21.6105	23.4676	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Combi loss	50.9589	46.0274	50.9589	47.8611	47.4379	43.9541	45.4192	47.4379	47.8611	50.9589	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month													
	212.5073	187.3186	196.7588	174.9730	169.4047	149.2022	142.9471	159.3525	161.1124	182.9423	193.3853	207.4099	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	212.5073	187.3186	196.7588	174.9730	169.4047	149.2022	142.9471	159.3525	161.1124	182.9423	193.3853	207.4099	(64)
									Total per year (kWh/year) = Sum(64)m =			2137.3142	(64)
Heat gains from water heating, kWh/month													
	66.4546	58.4862	61.2182	54.2300	52.4135	45.9835	43.7828	49.0711	49.6213	56.6242	60.2321	64.7597	(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	136.4892	136.4892	136.4892	136.4892	136.4892	136.4892	136.4892	136.4892	136.4892	136.4892	136.4892	136.4892	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	22.7024	20.1641	16.3985	12.4147	9.2802	7.8347	8.4657	11.0040	14.7695	18.7533	21.8879	23.3334	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	254.6518	257.2943	250.6353	236.4591	218.5642	201.7455	190.5096	187.8671	194.5261	208.7023	226.5972	243.4159	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.6489	36.6489	36.6489	36.6489	36.6489	36.6489	36.6489	36.6489	36.6489	36.6489	36.6489	36.6489	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-109.1914	-109.1914	-109.1914	-109.1914	-109.1914	-109.1914	-109.1914	-109.1914	-109.1914	-109.1914	-109.1914	-109.1914	(71)
Water heating gains (Table 5)													
	89.3206	87.0330	82.2825	75.3194	70.4482	63.8660	58.8479	65.9558	68.9185	76.1078	83.6557	87.0426	(72)
Total internal gains													
	433.6216	431.4381	416.2631	391.1400	365.2393	340.3930	324.7699	331.7736	345.1609	370.5102	399.0876	420.7386	(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	
Northeast	2.3900	11.2829	0.6300	0.7000	0.7700	8.2412	(75)
South	6.6500	46.7521	0.6300	0.7000	0.7700	95.0155	(78)
Southwest	5.5900	36.7938	0.6300	0.7000	0.7700	62.8577	(79)
Northwest	7.9700	11.2829	0.6300	0.7000	0.7700	27.4823	(81)

Solar gains	193.5967	335.3970	475.7299	620.7086	725.9859	734.8481	702.5556	621.4660	525.3305	375.0410	232.8642	165.0688	(83)
Total gains	627.2183	766.8351	891.9930	1011.8487	1091.2252	1075.2411	1027.3255	953.2397	870.4914	745.5512	631.9518	585.8074	(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	53.2792	53.4050	53.5289	54.1186	54.2304	54.7569	54.7569	54.8556	54.5529	54.2304	54.0047	53.7708	
alpha	4.5519	4.5603	4.5686	4.6079	4.6154	4.6505	4.6505	4.6570	4.6369	4.6154	4.6003	4.5847	
util living area													
	0.9974	0.9932	0.9816	0.9449	0.8520	0.6868	0.5233	0.5802	0.8220	0.9674	0.9943	0.9981	(86)
MIT	19.5888	19.7897	20.0887	20.4621	20.7693	20.9398	20.9864	20.9784	20.8573	20.4468	19.9438	19.5544	(87)
Th 2	19.8382	19.8406	19.8429	19.8540	19.8561	19.8658	19.8658	19.8676	19.8621	19.8561	19.8519	19.8475	(88)
util rest of house													
	0.9965	0.9909	0.9750	0.9244	0.7989	0.5884	0.3956	0.4493	0.7408	0.9512	0.9920	0.9975	(89)
MIT 2	17.9732	18.2673	18.7013	19.2356	19.6364	19.8273	19.8611	19.8592	19.7519	19.2263	18.5011	17.9293	(90)
Living area fraction										fLA = Living area / (4) =		0.3966	(91)
MIT	18.6139	18.8711	19.2515	19.7220	20.0857	20.2685	20.3074	20.3031	20.1903	19.7103	19.0732	18.5738	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6139	18.8711	19.2515	19.7220	20.0857	20.2685	20.3074	20.3031	20.1903	19.7103	19.0732	18.5738	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9951	0.9881	0.9706	0.9216	0.8109	0.6254	0.4467	0.5016	0.7671	0.9485	0.9897	0.9964	(94)
Useful gains	624.1722	757.7289	865.7756	932.5065	884.8605	672.4269	458.8608	478.1323	667.7425	707.1754	625.4537	583.6899	(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													
	1846.4698	1797.9986	1637.2469	1374.3687	1062.7662	711.4901	465.3364	489.0206	767.2903	1154.6016	1523.7731	1837.2386	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	909.3894	699.0612	573.9746	318.1408	132.3618	0.0000	0.0000	0.0000	0.0000	332.8851	646.7900	932.6403	(98)
Space heating												4545.2433	(98)
Space heating per m2											(98) / (4) =	45.9255	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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 %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4866.4275	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	909.3894	699.0612	573.9746	318.1408	132.3618	0.0000	0.0000	0.0000	0.0000	332.8851	646.7900	932.6403	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	973.6503	748.4596	614.5339	340.6219	141.7150	0.0000	0.0000	0.0000	0.0000	356.4080	692.4946	998.5442	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	212.5073	187.3186	196.7588	174.9730	169.4047	149.2022	142.9471	159.3525	161.1124	182.9423	193.3853	207.4099	(64)
Efficiency of water heater												80.3000	(216)
(217)m	88.2964	88.0593	87.5876	86.5378	84.4379	80.3000	80.3000	80.3000	80.3000	86.5396	87.8565	88.3777	(217)
Fuel for water heating, kWh/month													
	240.6750	212.7187	224.6423	202.1926	200.6264	185.8060	178.0163	198.4465	200.6381	211.3972	220.1150	234.6859	(219)
Water heating fuel used												2509.9600	(219)
Annual totals kWh/year													
Space heating fuel - main system												4866.4275	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												400.9313	(232)
Total delivered energy for all uses												7852.3188	(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	4866.4275	0.2160	1051.1483	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2509.9600	0.2160	542.1514	(264)
Space and water heating			1593.2997	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	400.9313	0.5190	208.0834	(268)
Total CO2, kg/m2/year			1840.3081	(272)
Emissions per m2 for space and water heating			16.0988	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.1025	(272b)
Emissions per m2 for pumps and fans			0.3933	(272c)
Target Carbon Dioxide Emission Rate (TER) = (16.0988 * 1.00) + 2.1025 + 0.3933, rounded to 2 d.p.			18.5900	(273)

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

HODKINSON

Property Reference	B.06.03 Wootton	**Issued on Date**	27/11/2020
Assessment Reference	B.06.03 Wootton boiler	**Prop Type Ref**	Blk B 2B4P (Mid floor)
Property			

SAP Rating	86 B	**DER**	13.78	**TER**	15.60
Environmental	90 B	**% DER<TER**	11.68		
CO_2 Emissions (t/year)	0.82	**DFEE**	37.44	**TFEE**	36.39
General Requirements Compliance	Fail	**% DFEE<TFEE**	-2.90		

Assessor Details	Mr. Jonathan Peck, Jonathan Peck, Tel: 02036031622, Jonathan@hodkinsonconsultancy.com	**Assessor ID**	M976-0001
Client			

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

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

DWELLING AS DESIGNED

Mid-floor flat, total floor area 73 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 15.60 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 13.78 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)36.4 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)37.4 kWh/m²/yrFail
Excess energy =1.0 kWh/m²/yr (2.7%)

2 Fabric U-values

Element	Average	Highest	
External wall	0.18 (max. 0.30)	0.18 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	(no floor)		
Roof	(no roof)		
Openings	1.27 (max. 2.00)	1.30 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability
Air permeability at 50 pascals: 3.50 (design value)
Maximum 10.0 OK

4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 24
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

5 Cylinder insulation
Hot water storage: No cylinder

6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock: Yes OK

7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK

8 Mechanical ventilation
Continuous supply and extract system
Specific fan power: 0.52
Maximum 1.5 OK
MVHR efficiency: 92%
Minimum: 70% OK

9 Summertime temperature
Overheating risk (Thames Valley): Medium OK
Based on:
Overshading: Average
Windows facing North East: 9.99 m², No overhang
Windows facing South East: 11.93 m², No overhang
Air change rate: 3.00 ach
Blinds/curtains: None

10 Key features
Party wall U-value 0.00 W/m²K
Door U-value 1.00 W/m²K
Air permeability 3.5 m³/m²h

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	72.8300 (1b)	x	2.5000 (2b)	=	182.0750	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	72.8300					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	182.0750	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent 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)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Measured/design AP50		3.5000	
Infiltration rate		0.1750	(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) =	0.1488	(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	0.1897	0.1859	0.1822	0.1636	0.1599	0.1413	0.1413	0.1376	0.1488	0.1599	0.1673	0.1748	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation:	0.5000	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	78.2000	(23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.2987	0.2949	0.2912	0.2726	0.2689	0.2503	0.2503	0.2466	0.2578	0.2689	0.2763	0.2838	(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	
Front Door			2.1400	1.0000	2.1400			(26)
Window G=0.37 (Uw = 1.30)			21.9200	1.2357	27.0875			(27)
External Wall 1	42.6300	24.0600	18.5700	0.1800	3.3426			(29a)
Wall to Corridor	8.7500		8.7500	0.1800	1.5750			(29a)
Total net area of external elements Aum(A, m2)			51.3800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		34.1451			(33)
Party Wall 1			56.7000	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	7.6179	(36)
Total fabric heat loss (33) + (36) =	41.7630	(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	17.9447	17.7212	17.4978	16.3806	16.1572	15.0400	15.0400	14.8165	15.4868	16.1572	16.6040	17.0509	(38)
Heat transfer coeff	59.7076	59.4842	59.2608	58.1436	57.9201	56.8029	56.8029	56.5795	57.2498	57.9201	58.3670	58.8139	(39)
Average = Sum(39)m / 12 =												58.0877	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.8198	0.8168	0.8137	0.7983	0.7953	0.7799	0.7799	0.7769	0.7861	0.7953	0.8014	0.8076	(40)
HLP (average)												0.7976	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.3128 (42)
Average daily hot water use (litres/day)	89.1296 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	98.0425	94.4773	90.9122	87.3470	83.7818	80.2166	80.2166	83.7818	87.3470	90.9122	94.4773	98.0425	(44)
Energy conte	145.3942	127.1627	131.2205	114.4013	109.7707	94.7238	87.7755	100.7237	101.9266	118.7857	129.6639	140.8066	(45)
Energy content (annual)											Total = Sum(45)m =	1402.3552	(45)
Distribution loss (46)m = 0.15 x (45)m	21.8091	19.0744	19.6831	17.1602	16.4656	14.2086	13.1663	15.1086	15.2890	17.8179	19.4496	21.1210	(46)

Water storage loss:

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	16.2218	14.6157	16.1241	15.5388	16.0093	15.4382	15.9188	15.9775	15.4930	16.0766	15.6336	16.2029	(61)
Total heat required for water heating calculated for each month													
	161.6160	141.7785	147.3447	129.9400	125.7801	110.1620	103.6943	116.7012	117.4197	134.8623	145.2975	157.0094	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	161.6160	141.7785	147.3447	129.9400	125.7801	110.1620	103.6943	116.7012	117.4197	134.8623	145.2975	157.0094	(64)
									Total per year (kWh/year) = Sum(64)m =			1591.6057	(64)
Heat gains from water heating, kWh/month													
	52.3990	45.9355	47.6619	41.9231	40.5011	35.3552	33.1651	37.4850	37.7639	43.5154	47.0216	50.8689	(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	115.6412	115.6412	115.6412	115.6412	115.6412	115.6412	115.6412	115.6412	115.6412	115.6412	115.6412	115.6412	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	18.1698	16.1383	13.1245	9.9361	7.4274	6.2705	6.7755	8.8070	11.8208	15.0092	17.5179	18.6748	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	203.8099	205.9249	200.5954	189.2495	174.9273	161.4665	152.4739	150.3590	155.6885	167.0344	181.3565	194.8173	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	34.5641	34.5641	34.5641	34.5641	34.5641	34.5641	34.5641	34.5641	34.5641	34.5641	34.5641	34.5641	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-92.5130	-92.5130	-92.5130	-92.5130	-92.5130	-92.5130	-92.5130	-92.5130	-92.5130	-92.5130	-92.5130	-92.5130	(71)
Water heating gains (Table 5)													
	70.4288	68.3565	64.0616	58.2265	54.4370	49.1045	44.5767	50.3831	52.4498	58.4884	65.3078	68.3722	(72)
Total internal gains													
	353.1009	351.1119	338.4739	318.1045	297.4840	277.5339	264.5184	270.2414	280.6514	301.2244	324.8746	342.5567	(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	
Northeast	9.9900	11.2829	0.3500	0.8000	0.7700	21.8715	(75)
Southeast	11.9300	36.7938	0.3500	0.8000	0.7700	85.1739	(77)

Solar gains	107.0455	189.6029	278.7196	377.6914	452.5681	462.2812	440.2843	382.4376	312.6812	214.7544	129.5388	90.7525	(83)
Total gains	460.1464	540.7148	617.1935	695.7958	750.0521	739.8151	704.8028	652.6790	593.3327	515.9788	454.4134	433.3092	(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	84.7067	85.0249	85.3455	86.9854	87.3209	89.0384	89.0384	89.3900	88.3434	87.3209	86.6524	85.9940	
alpha	6.6471	6.6683	6.6897	6.7990	6.8214	6.9359	6.9359	6.9593	6.8896	6.8214	6.7768	6.7329	
util living area													
	0.9968	0.9903	0.9666	0.8765	0.6953	0.4896	0.3544	0.3984	0.6517	0.9289	0.9912	0.9978	(86)
MIT	20.2613	20.4203	20.6391	20.8710	20.9763	20.9981	20.9998	20.9996	20.9885	20.8304	20.5031	20.2357	(87)
Th 2	20.2362	20.2388	20.2415	20.2548	20.2574	20.2708	20.2708	20.2734	20.2654	20.2574	20.2521	20.2468	(88)
util rest of house													
	0.9959	0.9873	0.9570	0.8478	0.6470	0.4346	0.2958	0.3357	0.5880	0.9045	0.9881	0.9971	(89)
MIT 2	19.2449	19.4777	19.7915	20.1128	20.2365	20.2696	20.2707	20.2733	20.2572	20.0703	19.6095	19.2160	(90)
Living area fraction										fLA = Living area / (4) =		0.3525	(91)
MIT	19.6032	19.8099	20.0902	20.3801	20.4973	20.5264	20.5277	20.5293	20.5150	20.3382	19.9245	19.5754	(92)
Temperature adjustment												-0.1500	
adjusted MIT	19.4532	19.6599	19.9402	20.2301	20.3473	20.3764	20.3777	20.3793	20.3650	20.1882	19.7745	19.4254	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9945	0.9845	0.9524	0.8467	0.6530	0.4426	0.3044	0.3448	0.5969	0.9018	0.9855	0.9961	(94)
Useful gains	457.6055	532.3135	587.8337	589.1508	489.7930	327.4652	214.5446	225.0568	354.1590	465.3316	447.8159	431.6166	(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													
	904.7589	877.9816	796.4781	658.7702	500.8507	328.1155	214.5836	225.1463	358.6673	555.3502	739.7705	895.4674	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	332.6821	232.2889	155.2315	50.1260	8.2269	0.0000	0.0000	0.0000	0.0000	66.9738	210.2073	345.1050	(98)
Space heating												1400.8416	(98)
Space heating per m2											(98) / (4) =	19.2344	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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 %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	1547.8913	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	332.6821	232.2889	155.2315	50.1260	8.2269	0.0000	0.0000	0.0000	0.0000	66.9738	210.2073	345.1050	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	367.6046	256.6729	171.5265	55.3878	9.0905	0.0000	0.0000	0.0000	0.0000	74.0042	232.2733	381.3315	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	161.6160	141.7785	147.3447	129.9400	125.7801	110.1620	103.6943	116.7012	117.4197	134.8623	145.2975	157.0094	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.4282	89.2599	88.9129	88.1678	87.4899	87.3000	87.3000	87.3000	87.3000	88.3364	89.1642	89.4744	(217)
Fuel for water heating, kWh/month	180.7215	158.8378	165.7179	147.3780	143.7652	126.1879	118.7793	133.6783	134.5013	152.6689	162.9549	175.4796	(219)
Water heating fuel used												1800.6708	(219)
Annual totals kWh/year													
Space heating fuel - main system												1547.8913	(211)
Space heating fuel - secondary												0.0000	(215)

Electricity for pumps and fans:		
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.6500)		
mechanical ventilation fans (SFP = 0.6500)	144.3855	(230a)
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	219.3855	(231)
Electricity for lighting (calculated in Appendix L)	320.8844	(232)
Total delivered energy for all uses	3888.8320	(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	1547.8913	0.2160	334.3445	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1800.6708	0.2160	388.9449	(264)
Space and water heating			723.2894	(265)
Pumps and fans	219.3855	0.5190	113.8611	(267)
Energy for lighting	320.8844	0.5190	166.5390	(268)
Total CO2, kg/year			1003.6895	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			13.7800	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		13.7800	ZC1
Total Floor Area	TFA	72.8300	
Assumed number of occupants	N	2.3128	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		16.5829	ZC2
CO2 emissions from cooking, equation (L16)		2.3961	ZC3
Total CO2 emissions		32.7590	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		32.7590	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	72.8300 (1b)	x	2.5000 (2b)	=	182.0750	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	72.8300					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	182.0750	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent 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)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1648	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4148	(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) =	0.3526	(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	0.4495	0.4407	0.4319	0.3878	0.3790	0.3349	0.3349	0.3261	0.3526	0.3790	0.3966	0.4142	(22b)
Effective ac	0.6010	0.5971	0.5933	0.5752	0.5718	0.5561	0.5561	0.5532	0.5621	0.5718	0.5787	0.5858	(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	
TER Opaque door			2.1400	1.0000	2.1400			(26)
TER Opening Type (Uw = 1.40)			16.0600	1.3258	21.2917			(27)
External Wall 1	42.6300	18.2000	24.4300	0.1800	4.3974			(29a)
Wall to Corridor	8.7500		8.7500	0.1800	1.5750			(29a)
Total net area of external elements Aum(A, m2)			51.3800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		29.4041			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							4.5063	(36)
Total fabric heat loss					(33) + (36) =		33.9104	(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	36.1126	35.8768	35.6458	34.5606	34.3575	33.4124	33.4124	33.2373	33.7764	34.3575	34.7683	35.1977	(38)
Heat transfer coeff	70.0229	69.7872	69.5562	68.4710	68.2679	67.3227	67.3227	67.1477	67.6868	68.2679	68.6787	69.1081	(39)
Average = Sum(39)m / 12 =												68.4700	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9615	0.9582	0.9550	0.9401	0.9374	0.9244	0.9244	0.9220	0.9294	0.9374	0.9430	0.9489	(40)
HLP (average)												0.9401	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.3128 (42)
Average daily hot water use (litres/day)		89.1296 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	98.0425	94.4773	90.9122	87.3470	83.7818	80.2166	80.2166	83.7818	87.3470	90.9122	94.4773	98.0425	(44)
Energy conte	145.3942	127.1627	131.2205	114.4013	109.7707	94.7238	87.7755	100.7237	101.9266	118.7857	129.6639	140.8066	(45)
Energy content (annual)										Total = Sum(45)m =		1402.3552	(45)
Distribution loss (46)m = 0.15 x (45)m	21.8091	19.0744	19.6831	17.1602	16.4656	14.2086	13.1663	15.1086	15.2890	17.8179	19.4496	21.1210	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	49.9614	43.4855	46.3278	43.0752	42.6943	39.5589	40.8775	42.6943	43.0752	46.3278	46.5916	49.9614	(61)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Total heat required for water heating calculated for each month

	195.3556	170.6482	177.5484	157.4765	152.4650	134.2827	128.6530	143.4180	145.0019	165.1135	176.2554	190.7680	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	195.3556	170.6482	177.5484	157.4765	152.4650	134.2827	128.6530	143.4180	145.0019	165.1135	176.2554	190.7680	(64)
								Total per year (kWh/year) = Sum(64)m =				1936.9861	(64)
Heat gains from water heating, kWh/month													
	60.8339	53.1530	55.2128	48.8072	47.1723	41.3854	39.4047	44.1642	44.6594	51.0782	54.7611	59.3085	(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	115.6412	115.6412	115.6412	115.6412	115.6412	115.6412	115.6412	115.6412	115.6412	115.6412	115.6412	115.6412	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	18.1748	16.1427	13.1281	9.9388	7.4294	6.2722	6.7773	8.8094	11.8240	15.0133	17.5227	18.6799	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	203.8099	205.9249	200.5954	189.2495	174.9273	161.4665	152.4739	150.3590	155.6885	167.0344	181.3565	194.8173	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	34.5641	34.5641	34.5641	34.5641	34.5641	34.5641	34.5641	34.5641	34.5641	34.5641	34.5641	34.5641	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-92.5130	-92.5130	-92.5130	-92.5130	-92.5130	-92.5130	-92.5130	-92.5130	-92.5130	-92.5130	-92.5130	-92.5130	(71)
Water heating gains (Table 5)													
	81.7660	79.0967	74.2107	67.7878	63.4037	57.4797	52.9634	59.3605	62.0270	68.6535	76.0571	79.7158	(72)
Total internal gains													
	364.4431	361.8566	348.6265	327.6685	306.4527	285.9108	272.9069	279.2213	290.2318	311.3935	335.6287	353.9053	(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	
Northeast	7.3200	11.2829	0.6300	0.7000	0.7700	25.2409	(75)
Southeast	8.7400	36.7938	0.6300	0.7000	0.7700	98.2784	(77)

Solar gains	123.5194	218.7832	321.6182	435.8275	522.2334	533.4433	508.0596	441.3058	360.8084	247.8065	149.4745	104.7189	(83)
Total gains	487.9625	580.6397	670.2447	763.4959	828.6862	819.3541	780.9666	720.5270	651.0403	559.2000	485.1033	458.6242	(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	72.2283	72.4723	72.7130	73.8655	74.0852	75.1253	75.1253	75.3211	74.7212	74.0852	73.6421	73.1845	
alpha	5.8152	5.8315	5.8475	5.9244	5.9390	6.0084	6.0084	6.0214	5.9814	5.9390	5.9095	5.8790	
util living area													
	0.9964	0.9896	0.9673	0.8881	0.7224	0.5206	0.3786	0.4272	0.6865	0.9364	0.9909	0.9974	(86)
MIT	20.0877	20.2665	20.5183	20.7983	20.9514	20.9942	20.9993	20.9985	20.9730	20.7500	20.3649	20.0582	(87)
Th 2	20.1156	20.1183	20.1210	20.1335	20.1359	20.1468	20.1468	20.1489	20.1426	20.1359	20.1311	20.1261	(88)
util rest of house													
	0.9952	0.9864	0.9574	0.8587	0.6684	0.4535	0.3056	0.3490	0.6132	0.9123	0.9875	0.9966	(89)
MIT 2	18.8994	19.1607	19.5222	19.9106	20.0926	20.1432	20.1466	20.1483	20.1233	19.8591	19.3148	18.8644	(90)
Living area fraction									fLA = Living area / (4) =			0.3525	(91)
MIT	19.3182	19.5504	19.8733	20.2235	20.3953	20.4432	20.4471	20.4480	20.4228	20.1731	19.6849	19.2852	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.3182	19.5504	19.8733	20.2235	20.3953	20.4432	20.4471	20.4480	20.4228	20.1731	19.6849	19.2852	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9938	0.9837	0.9540	0.8621	0.6852	0.4771	0.3313	0.3766	0.6380	0.9135	0.9853	0.9955	(94)
Useful gains	484.9380	571.1824	639.4220	658.1924	567.8491	390.8736	258.7697	271.3337	415.3710	510.8171	477.9612	456.5604	(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													
	1051.6190	1022.4127	930.1957	775.3277	593.6119	393.3776	258.9980	271.8120	427.9696	653.5377	864.3166	1042.5093	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	421.6107	303.2268	216.3357	84.3374	19.1675	0.0000	0.0000	0.0000	0.0000	106.1841	278.1759	435.9460	(98)
Space heating												1864.9839	(98)
Space heating per m2											(98) / (4) =	25.6074	(99)

8c. Space cooling requirement

Not applicable

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

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

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												1996.7708	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	421.6107	303.2268	216.3357	84.3374	19.1675	0.0000	0.0000	0.0000	0.0000	106.1841	278.1759	435.9460	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	451.4033	324.6539	231.6228	90.2970	20.5220	0.0000	0.0000	0.0000	0.0000	113.6874	297.8328	466.7516	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	195.3556	170.6482	177.5484	157.4765	152.4650	134.2827	128.6530	143.4180	145.0019	165.1135	176.2554	190.7680	(64)
Efficiency of water heater												80.3000	(216)
(217)m	86.9376	86.4828	85.5497	83.5559	81.3146	80.3000	80.3000	80.3000	80.3000	83.9720	86.1950	87.0666	(217)
Fuel for water heating, kWh/month													
	224.7079	197.3203	207.5384	188.4684	187.5002	167.2262	160.2155	178.6027	180.5752	196.6293	204.4844	219.1059	(219)
Water heating fuel used												2312.3745	(219)
Annual totals kWh/year													
Space heating fuel - main system												1996.7708	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												320.9719	(232)
Total delivered energy for all uses												4705.1172	(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	1996.7708	0.2160	431.3025	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2312.3745	0.2160	499.4729	(264)
Space and water heating			930.7754	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	320.9719	0.5190	166.5844	(268)
Total CO2, kg/m2/year			1136.2848	(272)
Emissions per m2 for space and water heating			12.7801	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.2873	(272b)
Emissions per m2 for pumps and fans			0.5345	(272c)
Target Carbon Dioxide Emission Rate (TER) = (12.7801 * 1.00) + 2.2873 + 0.5345, rounded to 2 d.p.			15.6000	(273)

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

HODKINSON

Property Reference	B.09.01 Wootton	**Issued on Date**	27/11/2020
Assessment Reference	B.09.01 Wootton boiler	**Prop Type Ref**	Blk B 2B4P (Top F)
Property			

SAP Rating	83 B	**DER**	18.09	**TER**	21.41
Environmental	87 B	**% DER<TER**	15.52		
CO_2 Emissions (t/year)	1.08	**DFEE**	56.41	**TFEE**	65.41
General Requirements Compliance	Pass	**% DFEE<TFEE**	13.76		

Assessor Details	Mr. Jonathan Peck, Jonathan Peck, Tel: 02036031622, Jonathan@hodkinsonconsultancy.com	**Assessor ID**	M976-0001
Client			

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

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

DWELLING AS DESIGNED

Top-floor flat, total floor area 74 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 21.41 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 18.09 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)65.4 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)56.4 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.18 (max. 0.30)	0.18 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	(no floor)		
Roof	0.10 (max. 0.20)	0.10 (max. 0.35)	OK
Openings	1.27 (max. 2.00)	1.30 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability
Air permeability at 50 pascals: 3.50 (design value)
Maximum 10.0 OK

4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 24
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

5 Cylinder insulation
Hot water storage: No cylinder

6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock: Yes OK

7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK

8 Mechanical ventilation
Continuous supply and extract system
Specific fan power: 0.52
Maximum 1.5 OK
MVHR efficiency: 92%
Minimum: 70% OK

9 Summertime temperature
Overheating risk (Thames Valley): Not significant OK
Based on:
Overshading: Average
Windows facing North: 11.85 m², No overhang
Windows facing North East: 3.33 m², No overhang
Windows facing North West: 8.33 m², No overhang
Air change rate: 6.00 ach
Blinds/curtains: None

10 Key features
Party wall U-value 0.00 W/m²K
Roof U-value 0.10 W/m²K
Door U-value 1.00 W/m²K
Air permeability 3.5 m³/m²h

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	73.6900 (1b)	x	2.5000 (2b)	=	184.2250	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	73.6900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	184.2250	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent 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)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Measured/design AP50		3.5000	
Infiltration rate		0.1750	(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) =	0.1488	(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	0.1897	0.1859	0.1822	0.1636	0.1599	0.1413	0.1413	0.1376	0.1488	0.1599	0.1673	0.1748	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation:	0.5000	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	78.2000	(23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.2987	0.2949	0.2912	0.2726	0.2689	0.2503	0.2503	0.2466	0.2578	0.2689	0.2763	0.2838	(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	
Window (Uw = 1.30)			20.1800	1.2357	24.9373			(27)
Front Door			2.1400	1.0000	2.1400			(26)
Window G=0.37 (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
External Wall 1	56.5300	25.6500	30.8800	0.1800	5.5584			(29a)
Wall to Corridor	17.2300		17.2300	0.1800	3.1014			(29a)
External Roof 1	73.6900		73.6900	0.1000	7.3690			(30)
Total net area of external elements Aum(A, m2)			147.4500					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	47.2211			(33)
Party Wall 1			17.6000	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	14.4553	(36)
Total fabric heat loss (33) + (36) =	61.6764	(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	18.1566	17.9305	17.7044	16.5740	16.3480	15.2176	15.2176	14.9915	15.6697	16.3480	16.8001	17.2523	(38)
Heat transfer coeff	79.8330	79.6069	79.3808	78.2504	78.0243	76.8939	76.8939	76.6679	77.3461	78.0243	78.4765	78.9286	(39)
Average = Sum(39)m / 12 =												78.1939	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0834	1.0803	1.0772	1.0619	1.0588	1.0435	1.0435	1.0404	1.0496	1.0588	1.0650	1.0711	(40)
HLP (average)												1.0611	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.3323	(42)
Average daily hot water use (litres/day)	89.5916	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	98.5507	94.9671	91.3834	87.7998	84.2161	80.6324	80.6324	84.2161	87.7998	91.3834	94.9671	98.5507	(44)
Energy conte	146.1479	127.8219	131.9007	114.9943	110.3397	95.2148	88.2305	101.2458	102.4550	119.4014	130.3360	141.5364	(45)
Energy content (annual)										Total = Sum(45)m =		1409.6245	(45)

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

	21.9222	19.1733	19.7851	17.2491	16.5510	14.2822	13.2346	15.1869	15.3682	17.9102	19.5504	21.2305	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	16.2280	14.6210	16.1293	15.5432	16.0134	15.4416	15.9219	15.9812	15.4969	16.0813	15.6390	16.2089	(61)
Total heat required for water heating calculated for each month													
	162.3759	142.4429	148.0301	130.5374	126.3531	110.6564	104.1524	117.2270	117.9519	135.4828	145.9749	157.7454	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	162.3759	142.4429	148.0301	130.5374	126.3531	110.6564	104.1524	117.2270	117.9519	135.4828	145.9749	157.7454	(64)
								Total per year (kWh/year) = Sum(64)m =				1598.9300	(64)
Heat gains from water heating, kWh/month													
	52.6512	46.1560	47.8893	42.1214	40.6913	35.5193	33.3171	37.6595	37.9405	43.7213	47.2465	51.1131	(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	116.6139	116.6139	116.6139	116.6139	116.6139	116.6139	116.6139	116.6139	116.6139	116.6139	116.6139	116.6139	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	18.3429	16.2920	13.2496	10.0308	7.4981	6.3302	6.8400	8.8909	11.9334	15.1522	17.6848	18.8527	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	205.7517	207.8868	202.5065	191.0525	176.5939	163.0049	153.9266	151.7915	157.1718	168.6258	183.0844	196.6734	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	34.6614	34.6614	34.6614	34.6614	34.6614	34.6614	34.6614	34.6614	34.6614	34.6614	34.6614	34.6614	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-93.2911	-93.2911	-93.2911	-93.2911	-93.2911	-93.2911	-93.2911	-93.2911	-93.2911	-93.2911	-93.2911	-93.2911	(71)
Water heating gains (Table 5)													
	70.7677	68.6846	64.3674	58.5019	54.6926	49.3324	44.7811	50.6176	52.6952	58.7652	65.6201	68.7004	(72)
Total internal gains													
	355.8465	353.8475	341.1076	320.5694	299.7688	279.6516	266.5318	272.2842	282.7845	303.5273	327.3734	345.2107	(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	11.8500	10.6334	0.4500	0.8000	0.7700	31.4359	(74)
Northwest	8.3300	11.2829	0.4500	0.8000	0.7700	23.4479	(81)
Northeast	3.3300	11.2829	0.3500	0.8000	0.7700	7.2905	(75)

Solar gains	62.1743	122.6444	214.8123	349.1053	469.7408	501.7706	468.9582	373.0114	260.0992	147.9762	77.4570	51.3090	(83)
Total gains	418.0208	476.4919	555.9198	669.6747	769.5096	781.4222	735.4900	645.2956	542.8837	451.5035	404.8305	396.5197	(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	64.1009	64.2829	64.4660	65.3972	65.5867	66.5509	66.5509	66.7471	66.1619	65.5867	65.2088	64.8353	
alpha	5.2734	5.2855	5.2977	5.3598	5.3724	5.4367	5.4367	5.4498	5.4108	5.3724	5.3473	5.3224	
util living area													
	0.9985	0.9966	0.9889	0.9486	0.8173	0.6099	0.4563	0.5371	0.8367	0.9805	0.9969	0.9989	(86)
MIT	19.8185	19.9586	20.2234	20.5964	20.8747	20.9798	20.9965	20.9921	20.8969	20.5221	20.1103	19.7975	(87)
Th 2	20.0144	20.0170	20.0195	20.0321	20.0346	20.0473	20.0473	20.0498	20.0422	20.0346	20.0296	20.0245	(88)
util rest of house													
	0.9980	0.9955	0.9850	0.9305	0.7645	0.5275	0.3595	0.4310	0.7662	0.9707	0.9956	0.9985	(89)
MIT 2	18.4322	18.6385	19.0252	19.5616	19.9169	20.0346	20.0460	20.0466	19.9592	19.4692	18.8699	18.4089	(90)
Living area fraction										fLA = Living area / (4) =		0.4896	(91)
MIT	19.1109	19.2848	19.6119	20.0683	20.3859	20.4974	20.5114	20.5095	20.4183	19.9847	19.4772	19.0888	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.9609	19.1348	19.4619	19.9183	20.2359	20.3474	20.3614	20.3595	20.2683	19.8347	19.3272	18.9388	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9972	0.9940	0.9820	0.9279	0.7765	0.5542	0.3917	0.4663	0.7848	0.9681	0.9942	0.9979	(94)
Useful gains	416.8404	473.6453	545.9170	621.3991	597.4881	433.0500	288.1267	300.9105	426.0585	437.0855	402.5025	395.6688	(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													
	1170.4256	1133.1906	1028.9223	862.1842	666.0049	441.9378	289.2272	303.5695	477.0941	720.5349	959.5499	1163.3126	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	560.6674	443.2145	359.3560	173.3653	50.9765	0.0000	0.0000	0.0000	0.0000	210.8864	401.0741	571.1270	(98)
Space heating												2770.6672	(98)
Space heating per m2											(98) / (4) =	37.5990	(99)

8c. Space cooling requirement

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Not applicable

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 %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3061.5107	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	560.6674	443.2145	359.3560	173.3653	50.9765	0.0000	0.0000	0.0000	0.0000	210.8864	401.0741	571.1270	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	619.5220	489.7397	397.0784	191.5639	56.3276	0.0000	0.0000	0.0000	0.0000	233.0237	443.1758	631.0796	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	162.3759	142.4429	148.0301	130.5374	126.3531	110.6564	104.1524	117.2270	117.9519	135.4828	145.9749	157.7454	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7611	89.7003	89.5424	89.0972	88.1965	87.3000	87.3000	87.3000	87.3000	89.2208	89.6234	89.7877	(217)
Fuel for water heating, kWh/month													
	180.8978	158.7987	165.3184	146.5113	143.2632	126.7541	119.3040	134.2806	135.1110	151.8511	162.8760	175.6870	(219)
Water heating fuel used												1800.6532	(219)
Annual totals kWh/year													
Space heating fuel - main system												3061.5107	(211)
Space heating fuel - secondary												0.0000	(215)

Electricity for pumps and fans:		
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.6500)		
mechanical ventilation fans (SFP = 0.6500)	146.0904	(230a)
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	221.0904	(231)
Electricity for lighting (calculated in Appendix L)	323.9416	(232)
Total delivered energy for all uses	5407.1959	(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	3061.5107	0.2160	661.2863	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1800.6532	0.2160	388.9411	(264)
Space and water heating			1050.2274	(265)
Pumps and fans	221.0904	0.5190	114.7459	(267)
Energy for lighting	323.9416	0.5190	168.1257	(268)
Total CO2, kg/year			1333.0990	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			18.0900	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		18.0900	ZC1
Total Floor Area	TFA	73.6900	
Assumed number of occupants	N	2.3323	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		16.5455	ZC2
CO2 emissions from cooking, equation (L16)		2.3745	ZC3
Total CO2 emissions		37.0100	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		37.0100	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	73.6900 (1b)	x	2.5000 (2b)	=	184.2250	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	73.6900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	184.2250	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent 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)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1628	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4128	(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) =	0.3509	(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	0.4474	0.4386	0.4299	0.3860	0.3772	0.3334	0.3334	0.3246	0.3509	0.3772	0.3948	0.4123	(22b)
Effective ac	0.6001	0.5962	0.5924	0.5745	0.5712	0.5556	0.5556	0.5527	0.5616	0.5712	0.5779	0.5850	(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	
TER Opaque door			2.1400	1.0000	2.1400			(26)
TER Opening Type (Uw = 1.40)			16.2900	1.3258	21.5966			(27)
External Wall 1	56.5300	18.4300	38.1000	0.1800	6.8580			(29a)
Wall to Corridor	17.2300		17.2300	0.1800	3.1014			(29a)
External Roof 1	73.6900		73.6900	0.1300	9.5797			(30)
Total net area of external elements Aum(A, m2)			147.4500					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		43.2757			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							16.0810	(36)
Total fabric heat loss					(33) + (36) =		59.3567	(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	36.4822	36.2459	36.0143	34.9264	34.7229	33.7754	33.7754	33.5999	34.1403	34.7229	35.1346	35.5651	(38)
Heat transfer coeff	95.8389	95.6026	95.3710	94.2831	94.0796	93.1321	93.1321	92.9566	93.4970	94.0796	94.4913	94.9218	(39)
Average = Sum(39)m / 12 =												94.2821	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3006	1.2974	1.2942	1.2795	1.2767	1.2638	1.2638	1.2615	1.2688	1.2767	1.2823	1.2881	(40)
HLP (average)												1.2794	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.3323	(42)
Average daily hot water use (litres/day)	89.5916	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	98.5507	94.9671	91.3834	87.7998	84.2161	80.6324	80.6324	84.2161	87.7998	91.3834	94.9671	98.5507	(44)
Energy conte	146.1479	127.8219	131.9007	114.9943	110.3397	95.2148	88.2305	101.2458	102.4550	119.4014	130.3360	141.5364	(45)
Energy content (annual)										Total = Sum(45)m =		1409.6245	(45)
Distribution loss (46)m = 0.15 x (45)m	21.9222	19.1733	19.7851	17.2491	16.5510	14.2822	13.2346	15.1869	15.3682	17.9102	19.5504	21.2305	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Combi loss	50.2204	43.7109	46.5680	43.2985	42.9156	39.7639	41.0894	42.9156	43.2985	46.5680	46.8331	50.2204	(61)
Total heat required for water heating calculated for each month													
	196.3683	171.5328	178.4687	158.2928	153.2553	134.9787	129.3199	144.1614	145.7535	165.9694	177.1691	191.7568	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	196.3683	171.5328	178.4687	158.2928	153.2553	134.9787	129.3199	144.1614	145.7535	165.9694	177.1691	191.7568	(64)
									Total per year (kWh/year) = Sum(64)m =			1947.0268	(64)
Heat gains from water heating, kWh/month													
	61.1493	53.4285	55.4990	49.0602	47.4169	41.5999	39.6090	44.3931	44.8909	51.3430	55.0450	59.6160	(65)

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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	116.6139	116.6139	116.6139	116.6139	116.6139	116.6139	116.6139	116.6139	116.6139	116.6139	116.6139	116.6139	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	18.3466	16.2953	13.2522	10.0328	7.4996	6.3315	6.8414	8.8927	11.9358	15.1552	17.6884	18.8565	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	205.7517	207.8868	202.5065	191.0525	176.5939	163.0049	153.9266	151.7915	157.1718	168.6258	183.0844	196.6734	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	34.6614	34.6614	34.6614	34.6614	34.6614	34.6614	34.6614	34.6614	34.6614	34.6614	34.6614	34.6614	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-93.2911	-93.2911	-93.2911	-93.2911	-93.2911	-93.2911	-93.2911	-93.2911	-93.2911	-93.2911	-93.2911	-93.2911	(71)
Water heating gains (Table 5)													
	82.1899	79.5067	74.5954	68.1392	63.7323	57.7776	53.2379	59.6682	62.3485	69.0094	76.4514	80.1290	(72)
Total internal gains													
	367.2724	364.6729	351.3383	330.2087	308.8100	288.0982	274.9900	281.3366	292.4402	313.7745	338.2083	356.6431	(73)

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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	8.2100	10.6334	0.6300	0.7000	0.7700	26.6801	(74)
Northeast	2.3100	11.2829	0.6300	0.7000	0.7700	7.9654	(75)
Northwest	5.7700	11.2829	0.6300	0.7000	0.7700	19.8962	(81)

Solar gains	54.5416	107.7000	188.8181	306.9719	413.0334	441.1667	412.3308	327.9955	228.6750	130.0011	67.9703	44.9950	(83)
Total gains	421.8140	472.3729	540.1564	637.1806	721.8435	729.2649	687.3208	609.3321	521.1153	443.7757	406.1786	401.6380	(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, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	53.3955	53.5274	53.6574	54.2766	54.3940	54.9474	54.9474	55.0511	54.7329	54.3940	54.1570	53.9114	
alpha	4.5597	4.5685	4.5772	4.6184	4.6263	4.6632	4.6632	4.6701	4.6489	4.6263	4.6105	4.5941	
util living area													
	0.9983	0.9969	0.9917	0.9689	0.8913	0.7317	0.5734	0.6555	0.8983	0.9857	0.9969	0.9987	(86)
MIT	19.5370	19.6740	19.9479	20.3482	20.7115	20.9221	20.9804	20.9648	20.7792	20.3261	19.8694	19.5161	(87)
Th 2	19.8404	19.8429	19.8454	19.8570	19.8591	19.8693	19.8693	19.8712	19.8654	19.8591	19.8547	19.8501	(88)
util rest of house													
	0.9977	0.9957	0.9885	0.9559	0.8466	0.6341	0.4374	0.5164	0.8366	0.9778	0.9956	0.9982	(89)
MIT 2	17.8991	18.1010	18.5016	19.0838	19.5736	19.8175	19.8622	19.8565	19.6770	19.0615	18.3950	17.8752	(90)
Living area fraction									fLA = Living area / (4) =			0.4896	(91)
MIT	18.7010	18.8712	19.2097	19.7029	20.1307	20.3583	20.4097	20.3991	20.2167	19.6807	19.1169	18.6786	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7010	18.8712	19.2097	19.7029	20.1307	20.3583	20.4097	20.3991	20.2167	19.6807	19.1169	18.6786	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9969	0.9944	0.9861	0.9538	0.8587	0.6791	0.5045	0.5849	0.8590	0.9762	0.9944	0.9975	(94)
Useful gains	420.4960	469.7196	532.6678	607.7302	619.8287	495.2355	346.7551	356.3942	447.6143	433.2077	403.8910	400.6386	(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													
	1380.1783	1335.6810	1212.1382	1018.5296	793.1594	536.2833	354.8077	371.7466	571.8893	854.3062	1135.4929	1374.3387	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	714.0037	581.9260	505.5260	295.7756	128.9580	0.0000	0.0000	0.0000	0.0000	313.2973	526.7533	724.4328	(98)
Space heating												3790.6728	(98)
Space heating per m2											(98) / (4) =	51.4408	(99)

8c. Space cooling requirement

Not applicable

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

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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 %)	93.4000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	4058.5362	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	714.0037	581.9260	505.5260	295.7756	128.9580	0.0000	0.0000	0.0000	0.0000	313.2973	526.7533	724.4328	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	764.4579	623.0471	541.2484	316.6763	138.0707	0.0000	0.0000	0.0000	0.0000	335.4361	563.9757	775.6240	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	196.3683	171.5328	178.4687	158.2928	153.2553	134.9787	129.3199	144.1614	145.7535	165.9694	177.1691	191.7568	(64)
Efficiency of water heater												80.3000	(216)
(217)m	88.0122	87.8835	87.5275	86.6027	84.6201	80.3000	80.3000	80.3000	80.3000	86.6268	87.6260	88.0812	(217)
Fuel for water heating, kWh/month													
	223.1149	195.1820	203.9002	182.7805	181.1098	168.0931	161.0460	179.5285	181.5112	191.5913	202.1877	217.7045	(219)
Water heating fuel used												2287.7496	(219)
Annual totals kWh/year													
Space heating fuel - main system												4058.5362	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												324.0069	(232)
Total delivered energy for all uses												6745.2927	(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	4058.5362	0.2160	876.6438	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2287.7496	0.2160	494.1539	(264)
Space and water heating			1370.7977	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	324.0069	0.5190	168.1596	(268)
Total CO2, kg/m2/year			1577.8823	(272)
Emissions per m2 for space and water heating			18.6022	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.2820	(272b)
Emissions per m2 for pumps and fans			0.5282	(272c)
Target Carbon Dioxide Emission Rate (TER) = (18.6022 * 1.00) + 2.2820 + 0.5282, rounded to 2 d.p.			21.4100	(273)

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

HODKINSON

Property Reference	B.09.02 Wootton	**Issued on Date**	27/11/2020
Assessment Reference	B.09.02 Wootton boiler	**Prop Type Ref**	Blk B 1B2P (Top F)
Property			

SAP Rating	82 B	**DER**	21.28	**TER**	23.85
Environmental	86 B	**% DER<TER**	10.76		
CO_2 Emissions (t/year)	0.89	**DFEE**	63.73	**TFEE**	69.60
General Requirements Compliance	Pass	**% DFEE<TFEE**	8.43		

Assessor Details	Mr. Jonathan Peck, Jonathan Peck, Tel: 02036031622, Jonathan@hodkinsonconsultancy.com	**Assessor ID**	M976-0001
Client			

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

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

DWELLING AS DESIGNED

Top-floor flat, total floor area 50 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 23.85 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 21.28 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)69.6 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)63.7 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.20 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	(no floor)		
Roof	0.10 (max. 0.20)	0.10 (max. 0.35)	OK
Openings	1.27 (max. 2.00)	1.30 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability
Air permeability at 50 pascals: 3.50 (design value)
Maximum 10.0 OK

4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 24
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

5 Cylinder insulation
Hot water storage: No cylinder

6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock: Yes OK

7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK

8 Mechanical ventilation
Continuous supply and extract system
Specific fan power: 0.48
Maximum 1.5 OK
MVHR efficiency: 92%
Minimum: 70% OK

9 Summertime temperature
Overheating risk (Thames Valley): Slight OK
Based on:
Overshading: Average
Windows facing North East: 12.16 m², No overhang
Windows facing South East: 5.00 m², No overhang
Air change rate: 6.00 ach
Blinds/curtains: None

10 Key features
Party wall U-value 0.00 W/m²K
Roof U-value 0.10 W/m²K
Door U-value 1.00 W/m²K
Air permeability 3.5 m³/m²h

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.4800 (1b)	x	2.5000 (2b)	=	126.2000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	50.4800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	126.2000	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent 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)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Measured/design AP50		3.5000	
Infiltration rate		0.1750	(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) =	0.1488	(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	0.1897	0.1859	0.1822	0.1636	0.1599	0.1413	0.1413	0.1376	0.1488	0.1599	0.1673	0.1748	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation:	0.5000	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	78.2000	(23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.2987	0.2949	0.2912	0.2726	0.2689	0.2503	0.2503	0.2466	0.2578	0.2689	0.2763	0.2838	(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	
Window (Uw = 1.30)			5.0000	1.2357	6.1787			(27)
Front Door			2.1400	1.0000	2.1400			(26)
Window G=0.37 (Uw = 1.30)			12.1600	1.2357	15.0266			(27)
External Wall 1	68.9900	19.3000	49.6900	0.1800	8.9442			(29a)
Wall to Corridor	11.5500		11.5500	0.1800	2.0790			(29a)
Wall to stair	12.3800		12.3800	0.2500	3.0950			(29a)
Wall to lift shaft	4.3800		4.3800	0.2500	1.0950			(29a)
External Roof 1	50.4800		50.4800	0.1000	5.0480			(30)
Total net area of external elements Aum(A, m2)			147.7800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	43.6065			(33)
Party Wall 1			16.8500	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	10.3904	(36)
Total fabric heat loss (33) + (36) =	53.9969	(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	12.4378	12.2830	12.1281	11.3537	11.1989	10.4245	10.4245	10.2696	10.7343	11.1989	11.5086	11.8184	(38)
Heat transfer coeff	66.4348	66.2799	66.1250	65.3507	65.1958	64.4214	64.4214	64.2666	64.7312	65.1958	65.5055	65.8153	(39)
Average = Sum(39)m / 12 =												65.3119	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3161	1.3130	1.3099	1.2946	1.2915	1.2762	1.2762	1.2731	1.2823	1.2915	1.2977	1.3038	(40)
HLP (average)												1.2938	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.7042 (42)
Average daily hot water use (litres/day)	74.6757 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	82.1433	79.1562	76.1692	73.1822	70.1952	67.2081	67.2081	70.1952	73.1822	76.1692	79.1562	82.1433	(44)
Energy conte	121.8161	106.5411	109.9409	95.8492	91.9695	79.3627	73.5412	84.3896	85.3975	99.5226	108.6367	117.9724	(45)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1174.9396 (45)
Distribution loss (46)m = 0.15 x (45)m													
	18.2724	15.9812	16.4911	14.3774	13.7954	11.9044	11.0312	12.6584	12.8096	14.9284	16.2955	17.6959	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	16.0433	14.4654	15.9748	15.4137	15.8942	15.3431	15.8307	15.8719	15.3816	15.9415	15.4803	16.0301	(61)
Total heat required for water heating calculated for each month													
	137.8594	121.0065	125.9157	111.2629	107.8638	94.7058	89.3719	100.2615	100.7791	115.4640	124.1169	134.0025	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Output from w/h													
	137.8594	121.0065	125.9157	111.2629	107.8638	94.7058	89.3719	100.2615	100.7791	115.4640	124.1169	134.0025	(64)
									Total per year (kWh/year) = Sum(64)m =			1362.6101	(64)
Heat gains from water heating, kWh/month													
	44.5147	39.0413	40.5491	35.7233	34.5534	30.2239	28.4101	32.0275	32.2401	37.0766	39.9918	43.2333	(65)

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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	85.2120	85.2120	85.2120	85.2120	85.2120	85.2120	85.2120	85.2120	85.2120	85.2120	85.2120	85.2120	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	13.2371	11.7571	9.5615	7.2387	5.4110	4.5682	4.9361	6.4161	8.6117	10.9346	12.7622	13.6051	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	148.4805	150.0213	146.1386	137.8729	127.4389	117.6323	111.0810	109.5402	113.4229	121.6886	132.1227	141.9292	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	31.5212	31.5212	31.5212	31.5212	31.5212	31.5212	31.5212	31.5212	31.5212	31.5212	31.5212	31.5212	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-68.1696	-68.1696	-68.1696	-68.1696	-68.1696	-68.1696	-68.1696	-68.1696	-68.1696	-68.1696	-68.1696	-68.1696	(71)
Water heating gains (Table 5)													
	59.8316	58.0971	54.5014	49.6157	46.4428	41.9776	38.1857	43.0477	44.7779	49.8342	55.5441	58.1093	(72)
Total internal gains													
	273.1129	271.4392	261.7652	246.2908	230.8562	215.7418	205.7663	210.5677	218.3761	234.0210	251.9926	265.2072	(73)

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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	
Southeast	5.0000	36.7938	0.4500	0.8000	0.7700	45.8966	(77)
Northeast	12.1600	11.2829	0.3500	0.8000	0.7700	26.6224	(75)

Solar gains	72.5190	132.3696	204.6022	292.8820	363.9873	377.1617	357.0462	301.5819	234.7925	152.6297	88.4714	61.0191	(83)
Total gains	345.6319	403.8088	466.3673	539.1728	594.8435	592.9035	562.8125	512.1496	453.1686	386.6506	340.4641	326.2263	(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, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	52.7669	52.8902	53.0141	53.6422	53.7697	54.4160	54.4160	54.5471	54.1556	53.7697	53.5154	53.2636	
alpha	4.5178	4.5260	4.5343	4.5761	4.5846	4.6277	4.6277	4.6365	4.6104	4.5846	4.5677	4.5509	
util living area													
	0.9964	0.9923	0.9801	0.9375	0.8287	0.6501	0.4930	0.5572	0.8157	0.9658	0.9930	0.9973	(86)
MIT	19.6184	19.7959	20.0930	20.4828	20.7944	20.9512	20.9891	20.9814	20.8602	20.4475	19.9629	19.5877	(87)
Th 2	19.8283	19.8307	19.8331	19.8451	19.8475	19.8595	19.8595	19.8620	19.8547	19.8475	19.8427	19.8379	(88)
util rest of house													
	0.9952	0.9897	0.9730	0.9148	0.7716	0.5523	0.3706	0.4292	0.7332	0.9489	0.9901	0.9963	(89)
MIT 2	18.0095	18.2694	18.7001	19.2556	19.6557	19.8292	19.8559	19.8549	19.7476	19.2206	18.5222	17.9713	(90)
Living area fraction										fLA = Living area / (4) =		0.4307	(91)
MIT	18.7024	18.9268	19.3000	19.7842	20.1461	20.3124	20.3439	20.3400	20.2267	19.7490	19.1426	18.6675	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.5524	18.7768	19.1500	19.6342	19.9961	20.1624	20.1939	20.1900	20.0767	19.5990	18.9926	18.5175	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9933	0.9863	0.9674	0.9098	0.7798	0.5797	0.4074	0.4675	0.7513	0.9442	0.9870	0.9947	(94)
Useful gains	343.3106	398.2919	451.1755	490.5486	463.8727	343.6874	229.2742	239.4365	340.4764	365.0585	336.0495	324.5136	(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													
	946.8571	919.7557	836.4784	701.4841	540.8686	358.3374	231.5241	243.5709	386.8806	586.6958	779.0335	942.3070	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	449.0386	350.4237	286.6654	151.8736	57.2849	0.0000	0.0000	0.0000	0.0000	164.8982	318.9485	459.6383	(98)
Space heating												2238.7711	(98)
Space heating per m2											(98) / (4) =	44.3497	(99)

8c. Space cooling requirement

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Not applicable

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 %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2473.7802	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	449.0386	350.4237	286.6654	151.8736	57.2849	0.0000	0.0000	0.0000	0.0000	164.8982	318.9485	459.6383	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	496.1753	387.2085	316.7573	167.8161	63.2982	0.0000	0.0000	0.0000	0.0000	182.2079	352.4293	507.8876	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	137.8594	121.0065	125.9157	111.2629	107.8638	94.7058	89.3719	100.2615	100.7791	115.4640	124.1169	134.0025	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7274	89.6565	89.4988	89.1187	88.3840	87.3000	87.3000	87.3000	87.3000	89.1541	89.5802	89.7573	(217)
Fuel for water heating, kWh/month													
	153.6425	134.9669	140.6898	124.8479	122.0399	108.4832	102.3733	114.8471	115.4400	129.5106	138.5540	149.2942	(219)
Water heating fuel used												1534.6893	(219)
Annual totals kWh/year													
Space heating fuel - main system												2473.7802	(211)
Space heating fuel - secondary												0.0000	(215)

Electricity for pumps and fans:		
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.6000)		
mechanical ventilation fans (SFP = 0.6000)	92.3784	(230a)
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	167.3784	(231)
Electricity for lighting (calculated in Appendix L)	233.7722	(232)
Total delivered energy for all uses	4409.6201	(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	2473.7802	0.2160	534.3365	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1534.6893	0.2160	331.4929	(264)
Space and water heating			865.8294	(265)
Pumps and fans	167.3784	0.5190	86.8694	(267)
Energy for lighting	233.7722	0.5190	121.3278	(268)
Total CO2, kg/year			1074.0266	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			21.2800	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		21.2800	ZC1
Total Floor Area	TFA	50.4800	
Assumed number of occupants	N	1.7042	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		17.4300	ZC2
CO2 emissions from cooking, equation (L16)		3.1676	ZC3
Total CO2 emissions		41.8776	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		41.8776	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.4800 (1b)	x	2.5000 (2b)	=	126.2000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	50.4800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	126.2000	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent 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)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1585	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4085	(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) =	0.3472	(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	0.4427	0.4340	0.4253	0.3819	0.3732	0.3298	0.3298	0.3212	0.3472	0.3732	0.3906	0.4080	(22b)
Effective ac	0.5980	0.5942	0.5905	0.5729	0.5697	0.5544	0.5544	0.5516	0.5603	0.5697	0.5763	0.5832	(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	
TER Opaque door			2.1400	1.0000	2.1400			(26)
TER Opening Type (Uw = 1.40)			10.4800	1.3258	13.8939			(27)
External Wall 1	68.9900	12.6200	56.3700	0.1800	10.1466			(29a)
Wall to Corridor	11.5500		11.5500	0.1800	2.0790			(29a)
Wall to stair	12.3800		12.3800	0.1800	2.2284			(29a)
Wall to lift shaft	4.3800		4.3800	0.1800	0.7884			(29a)
External Roof 1	50.4800		50.4800	0.1300	6.5624			(30)
Total net area of external elements Aum(A, m2)			147.7800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	37.8387			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	10.5386	(36)
Total fabric heat loss (33) + (36) =	48.3773	(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	24.9038	24.7453	24.5900	23.8604	23.7239	23.0885	23.0885	22.9708	23.3333	23.7239	24.0001	24.2887	(38)
Heat transfer coeff	73.2811	73.1226	72.9673	72.2378	72.1013	71.4659	71.4659	71.3482	71.7106	72.1013	72.3774	72.6661	(39)
Average = Sum(39)m / 12 =												72.2371	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.4517	1.4485	1.4455	1.4310	1.4283	1.4157	1.4157	1.4134	1.4206	1.4283	1.4338	1.4395	(40)
HLP (average)												1.4310	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.7042 (42)
Average daily hot water use (litres/day)	74.6757 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	82.1433	79.1562	76.1692	73.1822	70.1952	67.2081	67.2081	70.1952	73.1822	76.1692	79.1562	82.1433	(44)
Energy conte	121.8161	106.5411	109.9409	95.8492	91.9695	79.3627	73.5412	84.3896	85.3975	99.5226	108.6367	117.9724	(45)
Energy content (annual)										Total = Sum(45)m =		1174.9396	(45)
Distribution loss (46)m = 0.15 x (45)m	18.2724	15.9812	16.4911	14.3774	13.7954	11.9044	11.0312	12.6584	12.8096	14.9284	16.2955	17.6959	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	41.8593	36.4336	38.8150	36.0898	35.7707	33.1437	34.2485	35.7707	36.0898	38.8150	39.0360	41.8593 (61)
Total heat required for water heating calculated for each month												
	163.6754	142.9747	148.7559	131.9390	127.7402	112.5065	107.7898	120.1603	121.4874	138.3376	147.6726	159.8317 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
								Solar input (sum of months) = Sum(63)m =				0.0000 (63)
Output from w/h												
	163.6754	142.9747	148.7559	131.9390	127.7402	112.5065	107.7898	120.1603	121.4874	138.3376	147.6726	159.8317 (64)
								Total per year (kWh/year) = Sum(64)m =				1622.8711 (64)
Heat gains from water heating, kWh/month												
	50.9687	44.5333	46.2591	40.8923	39.5225	34.6740	33.0146	37.0022	37.4171	42.7950	45.8807	49.6906 (65)

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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	85.2120	85.2120	85.2120	85.2120	85.2120	85.2120	85.2120	85.2120	85.2120	85.2120	85.2120	85.2120	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	13.2848	11.7994	9.5959	7.2647	5.4305	4.5846	4.9539	6.4392	8.6427	10.9739	12.8082	13.6540	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	148.4805	150.0213	146.1386	137.8729	127.4389	117.6323	111.0810	109.5402	113.4229	121.6886	132.1227	141.9292	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	31.5212	31.5212	31.5212	31.5212	31.5212	31.5212	31.5212	31.5212	31.5212	31.5212	31.5212	31.5212	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-68.1696	-68.1696	-68.1696	-68.1696	-68.1696	-68.1696	-68.1696	-68.1696	-68.1696	-68.1696	-68.1696	-68.1696	(71)
Water heating gains (Table 5)													
	68.5063	66.2698	62.1762	56.7949	53.1217	48.1584	44.3745	49.7342	51.9682	57.5202	63.7232	66.7885	(72)
Total internal gains													
	281.8352	279.6542	269.4744	253.4961	237.5546	221.9390	211.9729	217.2772	225.5975	241.7463	260.2176	273.9353	(73)

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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	
Northeast	7.4300	11.2829	0.6300	0.7000	0.7700	25.6202	(75)
Southeast	3.0500	36.7938	0.6300	0.7000	0.7700	34.2963	(77)

Solar gains	59.9165	110.5699	173.8907	253.3469	318.3520	331.2615	313.0410	262.2187	201.0396	128.2980	73.3159	50.2732	(83)
Total gains	341.7517	390.2241	443.3651	506.8430	555.9066	553.2004	525.0139	479.4960	426.6371	370.0443	333.5335	324.2085	(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, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	47.8371	47.9408	48.0428	48.5280	48.6199	49.0522	49.0522	49.1331	48.8848	48.6199	48.4344	48.2420	
alpha	4.1891	4.1961	4.2029	4.2352	4.2413	4.2701	4.2701	4.2755	4.2590	4.2413	4.2290	4.2161	
util living area	0.9966	0.9935	0.9848	0.9557	0.8766	0.7264	0.5701	0.6351	0.8646	0.9740	0.9937	0.9973	(86)
MIT	19.4424	19.6068	19.9030	20.3103	20.6756	20.9014	20.9731	20.9580	20.7767	20.3105	19.8066	19.4139	(87)
Th 2	19.7239	19.7263	19.7286	19.7396	19.7417	19.7513	19.7513	19.7531	19.7476	19.7417	19.7375	19.7332	(88)
util rest of house	0.9953	0.9912	0.9791	0.9377	0.8258	0.6212	0.4223	0.4858	0.7882	0.9602	0.9910	0.9963	(89)
MIT 2	17.6831	17.9241	18.3552	18.9419	19.4286	19.6876	19.7422	19.7367	19.5691	18.9537	18.2241	17.6476	(90)
Living area fraction									fLA = Living area / (4) =			0.4307	(91)
MIT	18.4407	18.6487	19.0218	19.5312	19.9656	20.2104	20.2723	20.2627	20.0892	19.5380	18.9056	18.4083	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.4407	18.6487	19.0218	19.5312	19.9656	20.2104	20.2723	20.2627	20.0892	19.5380	18.9056	18.4083	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9936	0.9884	0.9748	0.9340	0.8363	0.6630	0.4866	0.5506	0.8125	0.9572	0.9885	0.9948	(94)
Useful gains	339.5480	385.6892	432.1776	473.3933	464.8811	366.7675	255.4685	263.9898	346.6588	354.1965	329.6994	322.5210	(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	1036.2489	1005.3437	913.6787	767.9730	595.9630	400.9490	262.4447	275.5940	429.4899	644.4432	854.4589	1032.4612	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	518.3455	416.4079	358.2368	212.0974	97.5249	0.0000	0.0000	0.0000	0.0000	215.9436	377.8268	528.1955	(98)
Space heating												2724.5785	(98)
Space heating per m2											(98) / (4) =	53.9734	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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 %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												2917.1076	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	518.3455	416.4079	358.2368	212.0974	97.5249	0.0000	0.0000	0.0000	0.0000	215.9436	377.8268	528.1955	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	554.9738	445.8328	383.5512	227.0850	104.4164	0.0000	0.0000	0.0000	0.0000	231.2030	404.5255	565.5198	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	163.6754	142.9747	148.7559	131.9390	127.7402	112.5065	107.7898	120.1603	121.4874	138.3376	147.6726	159.8317	(64)
Efficiency of water heater												80.3000	(216)
(217)m	87.7512	87.5843	87.1826	86.2401	84.3815	80.3000	80.3000	80.3000	80.3000	86.1680	87.3139	87.8336	(217)
Fuel for water heating, kWh/month													
	186.5221	163.2423	170.6257	152.9903	151.3841	140.1077	134.2338	149.6393	151.2919	160.5440	169.1285	181.9710	(219)
Water heating fuel used												1911.6808	(219)
Annual totals kWh/year													
Space heating fuel - main system												2917.1076	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												234.6135	(232)
Total delivered energy for all uses												5138.4019	(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	2917.1076	0.2160	630.0952	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1911.6808	0.2160	412.9231	(264)
Space and water heating			1043.0183	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	234.6135	0.5190	121.7644	(268)
Total CO2, kg/m2/year			1203.7077	(272)
Emissions per m2 for space and water heating			20.6620	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.4121	(272b)
Emissions per m2 for pumps and fans			0.7711	(272c)
Target Carbon Dioxide Emission Rate (TER) = (20.6620 * 1.00) + 2.4121 + 0.7711, rounded to 2 d.p.			23.8500	(273)

Appendix C
Be Lean BRUKL

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name **Shell and Core**

Wootton Street Planning SBEM

As designed

Date: Thu Nov 26 17:23:55 2020

Administrative information

Building Details

Address: ,

Certification tool

Calculation engine: SBEM

Calculation engine version: v5.6.b.0

Interface to calculation engine: DesignBuilder SBEM

Interface to calculation engine version: v6.1.7

BRUKL compliance check version: v5.6.b.0

Certifier details

Name:

Telephone number:

Address: , ,

Criterion 1: The calculated CO_2 emission rate for the building must not exceed the target

CO_2 emission rate from the notional building, $kgCO_2/m^2.annum$	18.1
Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	18.1
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	15.2
Are emissions from the building less than or equal to the target?	BER =< TER
Are as built details the same as used in the BER calculations?	Separate submission

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

Values which do not achieve the standards in the Non-Domestic Building Services Compliance Guide and Part L are displayed in red.

Building fabric

Element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	Surface where the maximum value occurs*
Wall**	0.35	0.19	0.2	"000 GF Non residential D1 - WC_P_7"
Floor	0.25	0.1	0.1	"000 GF Non residential D1 - WC_S_3"
Roof	0.25	0.15	0.15	"000 GF Non residential D1 - Refuse store_R_5"
Windows***, roof windows, and rooflights	2.2	1.3	1.3	"000 GF Non residential D1 - D1 Use type_Main Area 1
Personnel doors	2.2	2	2	"000 GF Non residential D1 - Refuse store_D_9"
Vehicle access & similar large doors	1.5	-	-	"No external vehicle access doors"
High usage entrance doors	3.5	-	-	"No external high usage entrance doors"

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [$W/(m^2K)$]
$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [$W/(m^2K)$]
$U_{i\text{-}Calc}$ = Calculated maximum individual element U-values [$W/(m^2K)$]

* There might be more than one surface where the maximum U-value occurs.
** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.
*** Display windows and similar glazing are excluded from the U-value check.
N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air Permeability	Worst acceptable standard	This building
$m^3/(h.m^2)$ at 50 Pa	10	9

Building services

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

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

1- Gas Boiler Be Lean heating only or indirectly heated

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	0.92	-	-	-	-
Standard value	0.91*	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 gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.

2- Gas Boiler Be Lean

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	0.92	4.2	-	-	-
Standard value	0.91*	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 gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.

1- Connecting to Gas Boiler

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

Local mechanical ventilation, exhaust, and terminal units

ID	**System type in Non-domestic Building Services Compliance Guide**
A	Local supply or extract ventilation units serving a single area
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 supply and extract ventilation units serving a single room or zone with heating and heat recovery
E	Local supply and extract ventilation system serving a single area with heating and heat recovery
F	Other local ventilation units
G	Fan-assisted terminal VAV unit
H	Fan coil units
I	Zonal extract system where the fan is remote from the zone with grease filter

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	1.9	1.6	0.5	1.1	0.5	1	**Zone**	**Standard**
000 GF Non residential D1 - WC	-	-	0.3	-	-	-	-	-	-	-	N/A
000 GF Non residential D1 - Kitchen	0.3	-	-	-	-	-	-	-	-	-	N/A
000 GF Non residential D1 - D1 Use type_Main Area 1				1.3	-	-	-	-	-	0.75	0.5

Shell and core configuration

Zone	**Assumed shell?**
000 GF Non residential D1 - WC	NO
000 GF Non residential D1 - D1 Use type_Corridor	NO
000 GF Non residential D1 - storage	NO
000 GF Non residential D1 - Kitchen	NO

Shell and core configuration

Zone	Assumed shell?
000 GF Non residential D1 - Refuse store	NO
000 GF Non residential D1 - D1 Use type_Main Area 1	NO

General lighting and display lighting

	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
000 GF Non residential D1 - WC	-	100	-	59
000 GF Non residential D1 - D1 Use type_Corridor	100	-	-	92
000 GF Non residential D1 - storage	100	-	-	11
000 GF Non residential D1 - Kitchen	100	-	-	145
000 GF Non residential D1 - Refuse store	100	-	-	13
000 GF Non residential D1 - D1 Use type_Main Area	100	-	-	1952

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

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
000 GF Non residential D1 - D1 Use type_Corridor	N/A	N/A
000 GF Non residential D1 - Kitchen	N/A	N/A
000 GF Non residential D1 - D1 Use type_Main Area	NO (-60.6%)	NO

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

Separate submission

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

Separate submission

EPBD (Recast): Consideration of alternative energy systems

Were alternative energy systems considered and analysed as part of the design process?	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
Area [m^2]	378.2	378.2
External area [m^2]	827.6	827.6
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	9	3
Average conductance [W/K]	206.4	371.05
Average U-value [W/m^2K]	0.25	0.45
Alpha value* [%]	21.87	15.34

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

Building Use

% Area	Building Type
	A1/A2 Retail/Financial and Professional services
	A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways
	B1 Offices and Workshop businesses
	B2 to B7 General Industrial and Special Industrial Groups
	B8 Storage or Distribution
	C1 Hotels
	C2 Residential Institutions: Hospitals and Care Homes
	C2 Residential Institutions: Residential schools
	C2 Residential Institutions: Universities and colleges
	C2A Secure Residential Institutions
	Residential spaces
100	**D1 Non-residential Institutions: Community/Day Centre**
	D1 Non-residential Institutions: Libraries, Museums, and Galleries
	D1 Non-residential Institutions: Education
	D1 Non-residential Institutions: Primary Health Care Building
	D1 Non-residential Institutions: Crown and County Courts
	D2 General Assembly and Leisure, Night Clubs, and Theatres
	Others: Passenger terminals
	Others: Emergency services
	Others: Miscellaneous 24hr activities
	Others: Car Parks 24 hrs
	Others: Stand alone utility block

Energy Consumption by End Use [kWh/m^2]

	Actual	Notional
Heating	25.08	29.66
Cooling	2.75	5.48
Auxiliary	4.58	2.61
Lighting	9.93	13.49
Hot water	3.74	3.78
Equipment*	24.56	24.56
TOTAL**	**46.08**	**55.03**

* 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

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m^2]	125.14	172.04
Primary energy* [kWh/m^2]	88.15	105.42
Total emissions [kg/m^2]	15.2	18.1

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

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] LTHW boiler, [HFT] Natural Gas, [CFT] Natural Gas										
	Actual	175.8	21	59.5	0	4.9	0.82	0	0.92	0
	Notional	161.3	89.8	54.7	0	5.6	0.82	0	----	----
[ST] Split or multi-split system, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	58.6	53.9	19	3.2	4.5	0.86	4.62	0.92	6.5
	Notional	74.3	83.7	25.2	6.5	2.1	0.82	3.6	----	----

Key to terms

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

Key Features

The Building Control Body is advised to give particular attention to items whose specifications are better than typically expected.

Building fabric

Element	$U_{i\text{-}Typ}$	$U_{i\text{-}Min}$	Surface where the minimum value occurs*
Wall	0.23	0.18	"000 GF Non residential D1 - Refuse store_W_8"
Floor	0.2	0.1	"000 GF Non residential D1 - WC_S_3"
Roof	0.15	0.15	"000 GF Non residential D1 - Refuse store_R_5"
Windows, roof windows, and rooflights	1.5	1.3	"000 GF Non residential D1 - D1 Use type_Main Area 1_G_7"
Personnel doors	1.5	2	"000 GF Non residential D1 - Refuse store_D_9"
Vehicle access & similar large doors	1.5	-	"No external vehicle access doors"
High usage entrance doors	1.5	-	"No external high usage entrance doors"

$U_{i\text{-}Typ}$ = Typical individual element U-values [W/(m²K)] $U_{i\text{-}Min}$ = Minimum individual element U-values [W/(m²K)]

* There might be more than one surface where the minimum U-value occurs.

Air Permeability	Typical value	This building
$m^3/(h.m^2)$ at 50 Pa	5	9

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Appendix D

Indicative Dwelling Heat Pump Specification

Heating

Product Information

PUHZ-(H)W50-140VHA(2)/YHA2(-BS)
Ecodan Monobloc Air Source Heat Pumps

Making a World of Difference

Designed to meet the demands of today's heating needs

Manufactured in the UK
PUHZ-W85VHA2

MELCloud

Qualified for Energy Technology List

QUIET MARK

APPROVED PRODUCT

Certificate Number: MCS HP0002
Product Type: Heat Pumps
Product Reference: PUHZ-W50VHA2-(BS), PUHZ-W85VHA2-(BS) PUHZ-W112VHA-(BS), PUHZ-HW140VHA2/YHA2-(BS)

Our range of Ecodan monobloc air source heat pumps includes 5, 8.5, 11.2 and 14kW sizes. Now with the ability to cascade up to six units of the same output, Ecodan monobloc systems offer a capacity range from 5 through to 84kW. Designed to suit a wide number of applications, these models offer a viable solution for the varying requirements that domestic and small commercial applications demand.

Key Features

- Self-contained unit, only requiring water and electric connections
- No need for gas supply, flues or ventilation
- Single phase power supply with a low starting current (3 phase available for 14kW)
- Low maintenance and quiet operation
- Operates with outside temperatures as low as -25°C
- Multiple unit connection
- Hybrid function, for use with conventional boilers
- 2-zone energy efficient space heating control
- Available as a standalone, packaged or semi packaged system
- Energy monitoring as standard
- Coastal protection models available (-BS)

Application Examples

- The vast majority of UK homes
- Small Retail Outlets
- Dental / Doctor's Surgeries
- Public Sector / Commercial Buildings

MITSUBISHI ELECTRIC

Air Conditioning | Heating
Ventilation | Controls

ecodan®
Renewable Heating Technology

Heating

Product Information

PUHZ-(H)W50-140VHA(2)/YHA2(-BS)

Ecodan Monobloc Air Source Heat Pumps

Making a World of Difference

OUTDOOR UNIT		PUHZ-W50VHA2(-BS)	PUHZ-W85VHA2(-BS)	PUHZ-W112VHA(-BS)	PUHZ-HW140VHA2(-BS)	PUHZ-HW140YHA2(-BS)
HEAT PUMP SPACE HEATER - 55°C	ErP Rating	A++	A++	A++	A++	A++
	η_s	127%	128%	125%	126%	126%
	SCOP	3.17	3.18	3.11	3.12	3.12
HEAT PUMP SPACE HEATER - 35°C	ErP Rating	A++	A++	A++	A++	A++
	η_s	162%	162%	164%	157%	157%
	SCOP	4.03	4.01	4.06	3.87	3.87
HEAT PUMP COMBINATION HEATER - Large Profile*1	ErP Rating	A	A	A	A	A
	η_{wh}	99%	97%	100%	96%	96%
HEATING*2 (A-3/W35)	Capacity (kW)	4.8	8.3	11.0	14.0	14.0
	Power Input (kW)	1.63	2.96	3.65	4.81	4.81
	COP	2.95	2.80	3.01	2.91	2.91
OPERATING AMBIENT TEMPERATURE (°C DB)		-15 ~ +35°C	-20 ~ +35°C	-20 ~ +35°C	-25 ~ +35°C	-25 ~ +35°C
SOUND PRESSURE LEVEL AT 1M (dBA)*3*4		45	48	53	53	53
LOW NOISE MODE (dBA)*3		40	42	46	46	46
WATER DATA	Pipework Size (mm)	22	22	28	28	28
	Flow Rate (l/min)	14.3	25.8	32.1	40.1	40.1
	Water Pressure Drop (kPa)	12	13.5	6.3	9	9
DIMENSIONS (mm)*7	Width	950	950	1020	1020	1020
	Depth	330+30*5	330+30*5	330+30*5	330+30*5	330+30*5
	Height	740	943	1350	1350	1350
WEIGHT (kg)		64	77	133	134	148
ELECTRICAL DATA	Electrical Supply	220-240v, 50Hz	220-240v, 50Hz	220-240v, 50Hz	220-240v, 50Hz	380-415v, 50Hz
	Phase	Single	Single	Single	Single	3
	Nominal Running Current [MAX] (A)	5.4 [13]	10.3 [23]	11.2 [29.5]	14.9 [35]	5.1 [13]
	Fuse Rating - MCB Sizes (A)*6	16	25	32	40	16

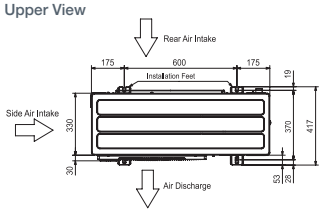
*1 Combination with EHPT20X-MHCW Cylinder
*2 Under normal heating conditions at outdoor temp: -3°CDB / -4°CWB, outlet water temp 35°C, inlet water temp 30°C.
*3 Under normal heating conditions at outdoor temp: 7°CDB / 6°CWB, outlet water temp 35°C, inlet water temp 30°C as tested to BS EN14511.
*4 Sound power level of the PUHZ-W50VHA2 is 61dBA, PUHZ-W85VHA2 is 62.5dBA, PUHZ-W112VHA is 65dBA, PUHZ-HW140VHA2 is 65.5dBA, PUHZ-HW140YHA2 is 67.5dBA. Tested to BS EN12102.
*5 Grille.
*6 MCB Sizes BS EN60898-2 & BS EN60947-2.
*7 Flow Temperature Controller (FTC) for standalone systems PAC-IF062B-E Dimensions WxDxH (mm) - 520x150x450

η_s is the seasonal space heating energy efficiency (SSHEE) η_{wh} is the water heating energy efficiency

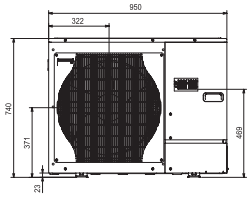
DIMENSIONS

PUHZ-W50VHA2(-BS)

Upper View

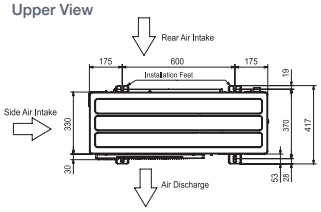


Front View

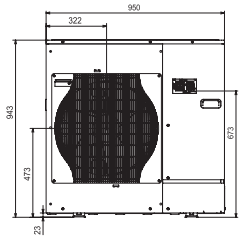


PUHZ-W85VHA2(-BS)

Upper View

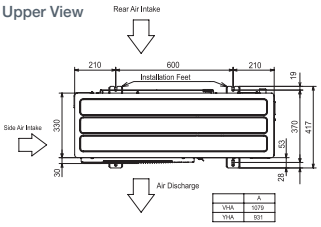


Front View

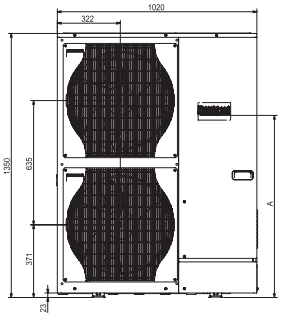


PUHZ-(H)W112-140VHA(2) / YHA2(-BS)

Upper View



Front View



MITSUBISHI ELECTRIC
Changes for the Better

Telephone: 01707 282880
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UNITED KINGDOM Mitsubishi Electric Europe Living Environmental Systems Division
Travellers Lane, Hatfield, Hertfordshire, AL10 8XB, England General Enquiries Telephone: 01707 282880 Fax: 01707 278881
IRELAND Mitsubishi Electric Europe Westgate Business Park, Ballymount, Dublin 24, Ireland
Telephone: Dublin (01) 419 8800 Fax: Dublin (01) 419 8890 International code: (003531)

Green Gateway
www.greengateway.mitsubishielectric.co.uk
Mitsubishi Electric UK's commitment to the environment

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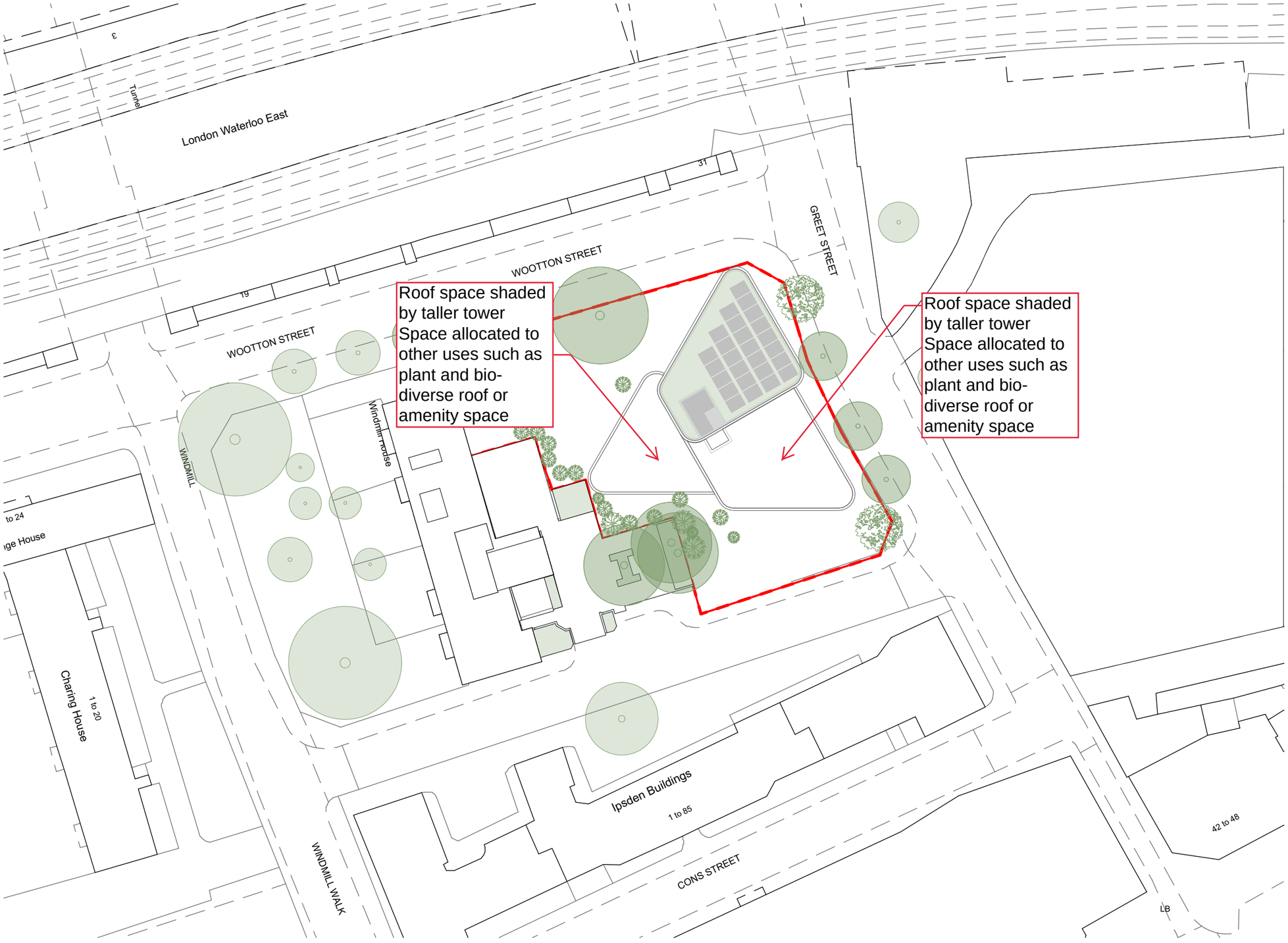
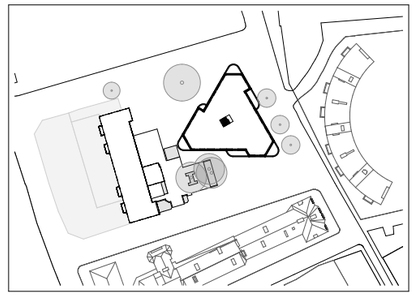
Mitsubishi Electric Living Environmental Systems UK
youtube.com/mitsubishielectric2

Effective as of August 2016 SAP No. 282526

Appendix E
Indicative Roof Plan for PV Panels





N

rev date description

0 5 10 15m

HFL HOMES FOR LAMBETH

stock wool

The Pump House 19 Hooper Street
London E1 8BU 020 7264 8600
info@stockwool.co.uk

Client
HOMES FOR LAMBETH

Project
WOOTTON

Drawing
PROPOSED SITE PLAN - ROOF LEVEL

Status
DESIGN FREEZE 2 - WIP

Scale **1:500@A3**
CAD File 3496W-Wootton-MainModel
Date **19.10.2019**
Drawn **AB/DF**
Checked **PM**

Project no_Drawing no_Revision
3496W_PL(90)106_

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Appendix F

DER Worksheets for Representative Dwellings (Be Green)

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

HODKINSON

Property Reference	A.01.05 Wootton	**Issued on Date**	26/11/2020
Assessment Reference	A.01.05 Wootton HP	**Prop Type Ref**	Blk A 3B5P (exposed Floor)
Property			

SAP Rating	86 B	**DER**	14.93	**TER**	26.28
Environmental	87 B	**% DER<TER**	43.18		
CO_2 Emissions (t/year)	1.24	**DFEE**	51.57	**TFEE**	56.93
General Requirements Compliance	Pass	**% DFEE<TFEE**	9.43		

Assessor Details	Mr. Jonathan Peck, Jonathan Peck, Tel: 02036031622, Jonathan@hodkinsonconsultancy.com	**Assessor ID**	M976-0001
Client			

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

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DWELLING AS DESIGNED

Mid-floor flat, total floor area 99 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Electricity
Fuel factor:1.55 (electricity)
Target Carbon Dioxide Emission Rate (TER) 26.28 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 14.93 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)56.9 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)51.6 kWh/m²/yrOK

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2 Fabric U-values

Element	Average	Highest	
External wall	0.18 (max. 0.30)	0.18 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.15 (max. 0.25)	0.15 (max. 0.70)	OK
Roof	(no roof)		
Openings	1.28 (max. 2.00)	1.30 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

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3 Air permeability
Air permeability at 50 pascals: 3.50 (design value)
Maximum 10.0 OK

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4 Heating efficiency
Main heating system: Heat pump with radiators or underfloor - Electric
Mitsubishi ECODAN 5kW PUHZ-W50VHA-BS

Secondary heating system: None

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5 Cylinder insulation
Hot water storage: Measured cylinder loss: 1.20 kWh/day
Permitted by DBSCG 2.03 OK
Primary pipework insulated: Yes OK

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6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: Cylinderstat OK
Independent timer for DHW OK

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7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK

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8 Mechanical ventilation
Continuous supply and extract system
Specific fan power: 0.52
Maximum 1.5 OK
MVHR efficiency: 92%
Minimum: 70% OK

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9 Summertime temperature
Overheating risk (Thames Valley): Medium OK
Based on:
Overshading: Average
Windows facing North East: 3.00 m², No overhang
Windows facing South: 8.33 m², No overhang
Windows facing South West: 7.00 m², No overhang
Windows facing North West: 9.99 m², No overhang
Air change rate: 3.00 ach
Blinds/curtains: None

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10 Key features
Party wall U-value 0.00 W/m²K
Door U-value 1.00 W/m²K
Air permeability 3.5 m³/m²h
Photovoltaic array 0.14 kW

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	98.9700 (1b)	x	2.5000 (2b)	=	247.4250	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	98.9700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	247.4250	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent 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)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Measured/design AP50		3.5000	
Infiltration rate		0.1750	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1619	(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	0.2064	0.2023	0.1983	0.1781	0.1740	0.1538	0.1538	0.1497	0.1619	0.1740	0.1821	0.1902	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation:	0.5000	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	78.2000	(23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.3154	0.3113	0.3073	0.2871	0.2830	0.2628	0.2628	0.2587	0.2709	0.2830	0.2911	0.2992	(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	
Window (Uw = 1.30)			28.3200	1.2357	34.9962			(27)
Front Door			2.1400	1.0000	2.1400			(26)
Heat Loss Floor bike store			90.0000	0.1500	13.5000			(28b)
Heat Loss Floor over external			8.7300	0.1500	1.3095			(28b)
External Wall 1	68.9900	30.4600	38.5300	0.1800	6.9354			(29a)
Wall to Corridor	29.7800		29.7800	0.1800	5.3604			(29a)
Total net area of external elements Aum(A, m2)			197.5000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		64.2415			(33)
Party Wall 1			5.0000	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	19.4712	(36)
Total fabric heat loss (33) + (36) =	83.7127	(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	25.7517	25.4213	25.0909	23.4387	23.1083	21.4562	21.4562	21.1257	22.1170	23.1083	23.7692	24.4300	(38)
Heat transfer coeff	109.4644	109.1340	108.8036	107.1514	106.8210	105.1689	105.1689	104.8384	105.8297	106.8210	107.4819	108.1427	(39)
Average = Sum(39)m / 12 =												107.0688	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1060	1.1027	1.0994	1.0827	1.0793	1.0626	1.0626	1.0593	1.0693	1.0793	1.0860	1.0927	(40)
HLP (average)												1.0818	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7298 (42)
Average daily hot water use (litres/day)	99.0324 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.9356	104.9743	101.0130	97.0517	93.0904	89.1291	89.1291	93.0904	97.0517	101.0130	104.9743	108.9356	(44)
Energy conte	161.5484	141.2912	145.7999	127.1119	121.9669	105.2481	97.5279	111.9147	113.2513	131.9834	144.0702	156.4510	(45)
Energy content (annual)										Total = Sum(45)m =		1558.1648	(45)

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

	24.2323	21.1937	21.8700	19.0668	18.2950	15.7872	14.6292	16.7872	16.9877	19.7975	21.6105	23.4676	(46)
Water storage loss:													
Store volume												170.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.2000	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.6480	(55)
Total storage loss													
	20.0880	18.1440	20.0880	19.4400	20.0880	19.4400	20.0880	20.0880	19.4400	20.0880	19.4400	20.0880	(56)
If cylinder contains dedicated solar storage													
	20.0880	18.1440	20.0880	19.4400	20.0880	19.4400	20.0880	20.0880	19.4400	20.0880	19.4400	20.0880	(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)
Total heat required for water heating calculated for each month													
	204.8988	180.4464	189.1503	169.0639	165.3173	147.2001	140.8783	155.2651	155.2033	175.3338	186.0222	199.8014	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	204.8988	180.4464	189.1503	169.0639	165.3173	147.2001	140.8783	155.2651	155.2033	175.3338	186.0222	199.8014	(64)
								Total per year (kWh/year) = Sum(64)m =				2068.5808	(64)
Heat gains from water heating, kWh/month													
	88.3952	78.3035	83.1588	75.8263	75.2343	68.5566	67.1083	71.8919	71.2176	78.5648	81.4650	86.7003	(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	136.4892	136.4892	136.4892	136.4892	136.4892	136.4892	136.4892	136.4892	136.4892	136.4892	136.4892	136.4892	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	22.7024	20.1641	16.3985	12.4147	9.2802	7.8347	8.4657	11.0040	14.7695	18.7533	21.8879	23.3334	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	254.6518	257.2943	250.6353	236.4591	218.5642	201.7455	190.5096	187.8671	194.5261	208.7023	226.5972	243.4159	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.6489	36.6489	36.6489	36.6489	36.6489	36.6489	36.6489	36.6489	36.6489	36.6489	36.6489	36.6489	(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)													
	-109.1914	-109.1914	-109.1914	-109.1914	-109.1914	-109.1914	-109.1914	-109.1914	-109.1914	-109.1914	-109.1914	-109.1914	(71)
Water heating gains (Table 5)													
	118.8107	116.5231	111.7726	105.3143	101.1214	95.2175	90.1994	96.6290	98.9134	105.5979	113.1458	116.5326	(72)
Total internal gains													
	460.1116	457.9282	442.7531	418.1349	392.9125	368.7445	353.1214	359.4468	372.1558	397.0003	425.5776	447.2286	(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	
Northeast	3.0000	11.2829	0.4500	0.8000	0.7700	8.4446	(75)
South	8.3300	46.7521	0.4500	0.8000	0.7700	97.1587	(78)
Southwest	7.0000	36.7938	0.4500	0.8000	0.7700	64.2553	(79)
Northwest	9.9900	11.2829	0.4500	0.8000	0.7700	28.1205	(81)

Solar gains	197.9791	343.0008	486.5448	634.8669	742.5861	751.6679	718.6294	635.6572	537.2890	383.5515	238.1376	168.8041	(83)
Total gains	658.0907	800.9289	929.2979	1053.0018	1135.4986	1120.4124	1071.7508	995.1041	909.4449	780.5518	663.7152	616.0327	(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	62.7868	62.9769	63.1681	64.1421	64.3405	65.3513	65.3513	65.5572	64.9432	64.3405	63.9449	63.5541	
alpha	5.1858	5.1985	5.2112	5.2761	5.2894	5.3568	5.3568	5.3705	5.3295	5.2894	5.2630	5.2369	
util living area													
	0.9968	0.9908	0.9729	0.9140	0.7800	0.5845	0.4290	0.4795	0.7375	0.9484	0.9922	0.9977	(86)
Tweekday	18.5068	18.7977	19.1975	19.6543	19.9232	20.0206	20.0305	20.0323	19.9841	19.6196	18.9839	18.4685	
Tweekend	20.2752	20.4038	20.5830	20.7925	20.9330	20.9886	20.9982	20.9968	20.9630	20.7697	20.4814	20.2547	
24 / 16	9	8	9	8	9	9	9	9	8	9	8	9	
24 / 9	22	20	22	22	22	21	22	22	22	22	22	22	
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	19.9959	19.9986	20.0014	20.0150	20.0178	20.0315	20.0315	20.0342	20.0260	20.0178	20.0123	20.0068	(88)
util rest of house													
	0.9957	0.9878	0.9641	0.8876	0.7233	0.5030	0.3361	0.3815	0.6570	0.9266	0.9891	0.9969	(89)
Tweekday	18.5068	18.7977	19.1975	19.6543	19.9232	20.0206	20.0305	20.0323	19.9841	19.6196	18.9839	18.4685	
Tweekend	18.5068	18.7977	19.1975	19.6543	19.9232	20.0206	20.0305	20.0323	19.9841	19.6196	18.9839	18.4685	
MIT 2	19.9959	19.9986	20.0014	20.0150	20.0178	20.0315	20.0315	20.0342	20.0260	20.0178	20.0123	20.0068	(90)
Living area fraction									fLA = Living area / (4) =			0.3966	(91)
MIT	20.3941	20.3958	20.3974	20.4056	20.4073	20.4156	20.4156	20.4172	20.4123	20.4073	20.4040	20.4007	(92)
Temperature adjustment												0.0000	
adjusted MIT	20.3941	20.3958	20.3974	20.4056	20.4073	20.4156	20.4156	20.4172	20.4123	20.4073	20.4040	20.4007	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9962	0.9891	0.9680	0.8990	0.7470	0.5360	0.3732	0.4208	0.6906	0.9362	0.9905	0.9973	(94)
Useful gains	655.5879	792.1823	899.5147	946.5992	848.2053	600.5323	399.9757	418.7512	628.1062	730.7723	657.4021	614.3543	(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													

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

	1761.7330	1691.1140	1512.0870	1232.8462	930.1221	611.6170	401.2793	421.1601	668.0245	1047.6252	1429.9379	1751.9872 (97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000 (97a)
Space heating kWh												
	822.9720	604.0821	455.7539	206.0978	60.9461	0.0000	0.0000	0.0000	0.0000	235.7385	556.2258	846.3988 (98)
Space heating												3788.2150 (98)
Space heating per m2											(98) / (4) =	38.2764 (99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000 (201)
Fraction of space heat from main system(s)	1.0000 (202)
Efficiency of main space heating system 1 (in %)	316.7912 (206)
Efficiency of secondary/supplementary heating system, %	100.0000 (208)
Space heating requirement	1195.8081 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	822.9720	604.0821	455.7539	206.0978	60.9461	0.0000	0.0000	0.0000	0.0000	235.7385	556.2258	846.3988	(98)
Space heating efficiency (main heating system 1)													
	316.7912	316.7912	316.7912	316.7912	316.7912	0.0000	0.0000	0.0000	0.0000	316.7912	316.7912	316.7912	(210)
Space heating fuel (main heating system)													
	259.7837	190.6878	143.8657	65.0579	19.2386	0.0000	0.0000	0.0000	0.0000	74.4145	175.5812	267.1788	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	204.8988	180.4464	189.1503	169.0639	165.3173	147.2001	140.8783	155.2651	155.2033	175.3338	186.0222	199.8014	(64)
Efficiency of water heater												178.1250	(216)
(217)m	178.1250	178.1250	178.1250	178.1250	178.1250	178.1250	178.1250	178.1250	178.1250	178.1250	178.1250	178.1250	(217)
Fuel for water heating, kWh/month													
	115.0309	101.3033	106.1896	94.9131	92.8097	82.6387	79.0896	87.1663	87.1317	98.4330	104.4335	112.1692	(219)
Water heating fuel used												1161.3085	(219)
Annual totals kWh/year													
Space heating fuel - main system												1195.8081	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.6500)													
mechanical ventilation fans (SFP = 0.6500)												196.2080	(230a)
Total electricity for the above, kWh/year												196.2080	(231)
Electricity for lighting (calculated in Appendix L)												400.9313	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 0.14 * 951 * 1.00) =												-106.4690	(233)
Total delivered energy for all uses												2847.7870	(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	1195.8081	0.5190	620.6244	(261)
Space heating - secondary	0.0000	0.5190	0.0000	(263)
Water heating (other fuel)	1161.3085	0.5190	602.7191	(264)
Space and water heating			1223.3435	(265)
Pumps and fans	196.2080	0.5190	101.8320	(267)
Energy for lighting	400.9313	0.5190	208.0834	(268)
Energy saving/generation technologies				
PV Unit	-106.4690	0.5190	-55.2574	(269)
Total CO2, kg/year			1478.0015	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			14.9300	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		14.9300	ZC1
Total Floor Area	TFA	98.9700	
Assumed number of occupants	N	2.7298	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		15.2472	ZC2
CO2 emissions from cooking, equation (L16)		1.8644	ZC3
Total CO2 emissions		32.0415	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		32.0415	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	98.9700 (1b)	x	2.5000 (2b)	=	247.4250	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	98.9700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	247.4250	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent 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)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1212	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3712	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3434	(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	0.4378	0.4293	0.4207	0.3777	0.3692	0.3262	0.3262	0.3176	0.3434	0.3692	0.3863	0.4035	(22b)
Effective ac	0.5959	0.5921	0.5885	0.5713	0.5681	0.5532	0.5532	0.5505	0.5590	0.5681	0.5746	0.5814	(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	
TER Opaque door			2.1400	1.0000	2.1400			(26)
TER Opening Type (Uw = 1.40)			22.6000	1.3258	29.9621			(27)
Heat Loss Floor bike store			90.0000	0.1300	11.7000			(28b)
Heat Loss Floor over external			8.7300	0.1300	1.1349			(28b)
External Wall 1	68.9900	24.7400	44.2500	0.1800	7.9650			(29a)
Wall to Corridor	29.7800		29.7800	0.1800	5.3604			(29a)
Total net area of external elements Aum(A, m2)			197.5000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		58.2624			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							18.8437	(36)
Total fabric heat loss					(33) + (36) =		77.1061	(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	48.6515	48.3476	48.0497	46.6505	46.3888	45.1701	45.1701	44.9444	45.6395	46.3888	46.9183	47.4720	(38)
Heat transfer coeff	125.7576	125.4537	125.1558	123.7567	123.4949	122.2762	122.2762	122.0506	122.7456	123.4949	124.0245	124.5781	(39)
Average = Sum(39)m / 12 =												123.7554	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2707	1.2676	1.2646	1.2504	1.2478	1.2355	1.2355	1.2332	1.2402	1.2478	1.2532	1.2587	(40)
HLP (average)												1.2504	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.7298	(42)
Average daily hot water use (litres/day)												99.0324	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.9356	104.9743	101.0130	97.0517	93.0904	89.1291	89.1291	93.0904	97.0517	101.0130	104.9743	108.9356	(44)
Energy conte	161.5484	141.2912	145.7999	127.1119	121.9669	105.2481	97.5279	111.9147	113.2513	131.9834	144.0702	156.4510	(45)
Energy content (annual)										Total = Sum(45)m =		1558.1648	(45)
Distribution loss (46)m = 0.15 x (45)m	24.2323	21.1937	21.8700	19.0668	18.2950	15.7872	14.6292	16.7872	16.9877	19.7975	21.6105	23.4676	(46)
Water storage loss:													
Store volume												170.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.5003	(48)
Temperature factor from Table 2b												0.5400	(49)

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Enter (49) or (54) in (55)												0.8102	(55)
Total storage loss													
	25.1153	22.6848	25.1153	24.3051	25.1153	24.3051	25.1153	25.1153	24.3051	25.1153	24.3051	25.1153	(56)
If cylinder contains dedicated solar storage													
	25.1153	22.6848	25.1153	24.3051	25.1153	24.3051	25.1153	25.1153	24.3051	25.1153	24.3051	25.1153	(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)
Total heat required for water heating calculated for each month													
	209.9261	184.9872	194.1776	173.9290	170.3446	152.0653	145.9056	160.2924	160.0684	180.3611	190.8874	204.8287	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	209.9261	184.9872	194.1776	173.9290	170.3446	152.0653	145.9056	160.2924	160.0684	180.3611	190.8874	204.8287	(64)
								Total per year (kWh/year) = Sum(64)m =				2127.7733	(64)
Heat gains from water heating, kWh/month													
	92.4170	81.9361	87.1806	79.7184	79.2561	72.4487	71.1302	75.9138	75.1098	82.5867	85.3571	90.7221	(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	136.4892	136.4892	136.4892	136.4892	136.4892	136.4892	136.4892	136.4892	136.4892	136.4892	136.4892	136.4892	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	22.7024	20.1641	16.3985	12.4147	9.2802	7.8347	8.4657	11.0040	14.7695	18.7533	21.8879	23.3334	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	254.6518	257.2943	250.6353	236.4591	218.5642	201.7455	190.5096	187.8671	194.5261	208.7023	226.5972	243.4159	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.6489	36.6489	36.6489	36.6489	36.6489	36.6489	36.6489	36.6489	36.6489	36.6489	36.6489	36.6489	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-109.1914	-109.1914	-109.1914	-109.1914	-109.1914	-109.1914	-109.1914	-109.1914	-109.1914	-109.1914	-109.1914	-109.1914	(71)
Water heating gains (Table 5)													
	124.2164	121.9288	117.1783	110.7200	106.5271	100.6232	95.6051	102.0347	104.3191	111.0036	118.5515	121.9383	(72)
Total internal gains													
	468.5173	466.3339	451.1588	426.5406	401.3182	377.1502	361.5271	367.8525	380.5615	405.4060	433.9833	455.6343	(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	
Northeast	2.3900	11.2829	0.6300	0.7000	0.7700	8.2412	(75)
South	6.6500	46.7521	0.6300	0.7000	0.7700	95.0155	(78)
Southwest	5.5900	36.7938	0.6300	0.7000	0.7700	62.8577	(79)
Northwest	7.9700	11.2829	0.6300	0.7000	0.7700	27.4823	(81)

Solar gains	193.5967	335.3970	475.7299	620.7086	725.9859	734.8481	702.5556	621.4660	525.3305	375.0410	232.8642	165.0688	(83)
Total gains	662.1140	801.7309	926.8887	1047.2492	1127.3041	1111.9983	1064.0827	989.3185	905.8920	780.4469	666.8475	620.7031	(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	54.6521	54.7845	54.9149	55.5357	55.6535	56.2081	56.2081	56.3120	55.9932	55.6535	55.4158	55.1695	
alpha	4.6435	4.6523	4.6610	4.7024	4.7102	4.7472	4.7472	4.7541	4.7329	4.7102	4.6944	4.6780	
util living area													
	0.9968	0.9918	0.9782	0.9357	0.8325	0.6584	0.4956	0.5502	0.7967	0.9601	0.9929	0.9976	(86)
MIT	19.6628	19.8622	20.1559	20.5177	20.8042	20.9529	20.9900	20.9840	20.8831	20.5012	20.0110	19.6287	(87)
Th 2	19.8639	19.8663	19.8687	19.8799	19.8819	19.8917	19.8917	19.8935	19.8880	19.8819	19.8777	19.8733	(88)
util rest of house													
	0.9957	0.9890	0.9705	0.9129	0.7769	0.5624	0.3759	0.4265	0.7130	0.9413	0.9900	0.9968	(89)
MIT 2	18.0986	18.3904	18.8155	19.3301	19.6981	19.8621	19.8883	19.8874	19.7997	19.3198	18.6164	18.0555	(90)
Living area fraction										fLA = Living area / (4) =		0.3966	(91)
MIT	18.7189	18.9741	19.3471	19.8011	20.1368	20.2947	20.3252	20.3223	20.2293	19.7883	19.1694	18.6794	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7189	18.9741	19.3471	19.8011	20.1368	20.2947	20.3252	20.3223	20.2293	19.7883	19.1694	18.6794	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9941	0.9860	0.9660	0.9110	0.7909	0.5990	0.4237	0.4758	0.7413	0.9393	0.9874	0.9955	(94)
Useful gains	658.1929	790.4837	895.3729	954.0428	891.5680	666.0603	450.8321	470.7624	671.5375	733.0552	658.4570	617.9273	(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													
	1813.2908	1765.6462	1607.8845	1349.0806	1041.8978	696.3228	455.5085	478.7199	752.3504	1134.7110	1496.9061	1803.8154	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	859.3928	655.3092	530.1086	284.4272	111.8454	0.0000	0.0000	0.0000	0.0000	298.8319	603.6834	882.3007	(98)
Space heating												4225.8992	(98)
Space heating per m2											(98) / (4) =	42.6988	(99)

8c. Space cooling requirement

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Not applicable

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 %)												93.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4519.6783	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	859.3928	655.3092	530.1086	284.4272	111.8454	0.0000	0.0000	0.0000	0.0000	298.8319	603.6834	882.3007	(98)
Space heating efficiency (main heating system 1)													
	93.5000	93.5000	93.5000	93.5000	93.5000	0.0000	0.0000	0.0000	0.0000	93.5000	93.5000	93.5000	(210)
Space heating fuel (main heating system)													
	919.1367	700.8655	566.9611	304.2002	119.6207	0.0000	0.0000	0.0000	0.0000	319.6063	645.6506	943.6371	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	209.9261	184.9872	194.1776	173.9290	170.3446	152.0653	145.9056	160.2924	160.0684	180.3611	190.8874	204.8287	(64)
Efficiency of water heater												79.8000	(216)
(217)m	88.1788	87.9052	87.3596	86.1183	83.7234	79.8000	79.8000	79.8000	79.8000	86.1521	87.6757	88.2700	(217)
Fuel for water heating, kWh/month													
	238.0685	210.4395	222.2738	201.9653	203.4612	190.5580	182.8391	200.8676	200.5870	209.3520	217.7197	232.0479	(219)
Water heating fuel used												2510.1795	(219)
Annual totals kWh/year													
Space heating fuel - main system												4519.6783	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												400.9313	(232)
Total delivered energy for all uses												7505.7892	(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	4519.6783	0.2160	976.2505	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2510.1795	0.2160	542.1988	(264)
Space and water heating			1518.4493	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	400.9313	0.5190	208.0834	(268)
Total CO2, kg/m2/year			1765.4577	(272)
Emissions per m2 for space and water heating			15.3425	(272a)
Fuel factor (electricity)			1.5500	
Emissions per m2 for lighting			2.1025	(272b)
Emissions per m2 for pumps and fans			0.3933	(272c)
Target Carbon Dioxide Emission Rate (TER) = (15.3425 * 1.55) + 2.1025 + 0.3933, rounded to 2 d.p.			26.2800	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	98.9700 (1b)	x	2.5000 (2b)	=	247.4250	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	98.9700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	247.4250	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent 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)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1212	(8)
Pressure test		Yes	
Measured/design AP50		3.5000	
Infiltration rate		0.2962	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2740	(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	0.3494	0.3425	0.3357	0.3014	0.2946	0.2603	0.2603	0.2535	0.2740	0.2946	0.3083	0.3220	(22b)
Effective ac	0.5610	0.5587	0.5563	0.5454	0.5434	0.5339	0.5339	0.5321	0.5375	0.5434	0.5475	0.5518	(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	
Window (Uw = 1.30)			28.3200	1.2357	34.9962			(27)
Front Door			2.1400	1.0000	2.1400			(26)
Heat Loss Floor bike store			90.0000	0.1500	13.5000			(28b)
Heat Loss Floor over external			8.7300	0.1500	1.3095			(28b)
External Wall 1	68.9900	30.4600	38.5300	0.1800	6.9354			(29a)
Wall to Corridor	29.7800		29.7800	0.1800	5.3604			(29a)
Total net area of external elements Aum(A, m2)			197.5000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		64.2415			(33)
Party Wall 1			5.0000	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	19.4712	(36)
Total fabric heat loss (33) + (36) =	83.7127	(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	45.8087	45.6152	45.4255	44.5346	44.3679	43.5919	43.5919	43.4482	43.8908	44.3679	44.7051	45.0577	(38)
Heat transfer coeff	129.5214	129.3279	129.1382	128.2473	128.0806	127.3046	127.3046	127.1609	127.6035	128.0806	128.4178	128.7704	(39)
Average = Sum(39)m / 12 =												128.2465	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3087	1.3067	1.3048	1.2958	1.2941	1.2863	1.2863	1.2848	1.2893	1.2941	1.2975	1.3011	(40)
HLP (average)												1.2958	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7298 (42)
Average daily hot water use (litres/day)	99.0324 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.9356	104.9743	101.0130	97.0517	93.0904	89.1291	89.1291	93.0904	97.0517	101.0130	104.9743	108.9356	(44)
Energy conte	161.5484	141.2912	145.7999	127.1119	121.9669	105.2481	97.5279	111.9147	113.2513	131.9834	144.0702	156.4510	(45)
Energy content (annual)										Total = Sum(45)m =		1558.1648	(45)
Distribution loss (46)m = 0.15 x (45)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	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(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	(59)

Heat gains from water heating, kWh/month

	34.3290	30.0244	30.9825	27.0113	25.9180	22.3652	20.7247	23.7819	24.0659	28.0465	30.6149	33.2458 (65)

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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	136.4892	136.4892	136.4892	136.4892	136.4892	136.4892	136.4892	136.4892	136.4892	136.4892	136.4892	136.4892	(66)

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

	22.7024	20.1641	16.3985	12.4147	9.2802	7.8347	8.4657	11.0040	14.7695	18.7533	21.8879	23.3334 (67)

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

	254.6518	257.2943	250.6353	236.4591	218.5642	201.7455	190.5096	187.8671	194.5261	208.7023	226.5972	243.4159 (68)

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

	36.6489	36.6489	36.6489	36.6489	36.6489	36.6489	36.6489	36.6489	36.6489	36.6489	36.6489	36.6489 (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)

	-109.1914	-109.1914	-109.1914	-109.1914	-109.1914	-109.1914	-109.1914	-109.1914	-109.1914	-109.1914	-109.1914	-109.1914 (71)

Water heating gains (Table 5)

	46.1412	44.6791	41.6431	37.5157	34.8360	31.0628	27.8557	31.9649	33.4249	37.6969	42.5207	44.6853 (72)

Total internal gains

	387.4421	386.0843	372.6237	350.3363	326.6271	304.5898	290.7778	294.7828	306.6673	329.0993	354.9526	375.3813 (73)

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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	
Northeast	3.0000	11.2829	0.4500	0.8000	0.7700	8.4446	(75)
South	8.3300	46.7521	0.4500	0.8000	0.7700	97.1587	(78)
Southwest	7.0000	36.7938	0.4500	0.8000	0.7700	64.2553	(79)
Northwest	9.9900	11.2829	0.4500	0.8000	0.7700	28.1205	(81)

Solar gains	197.9791	343.0008	486.5448	634.8669	742.5861	751.6679	718.6294	635.6572	537.2890	383.5515	238.1376	168.8041 (83)
Total gains	585.4212	729.0850	859.1685	985.2032	1069.2132	1056.2577	1009.4072	930.4400	843.9563	712.6508	593.0902	544.1853 (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, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	53.0639	53.1433	53.2214	53.5911	53.6609	53.9880	53.9880	54.0490	53.8615	53.6609	53.5200	53.3734	
alpha	4.5376	4.5429	4.5481	4.5727	4.5774	4.5992	4.5992	4.6033	4.5908	4.5774	4.5680	4.5582	
util living area	0.9981	0.9945	0.9841	0.9503	0.8620	0.7016	0.5378	0.5989	0.8381	0.9726	0.9956	0.9986	(86)
MIT	19.5440	19.7479	20.0522	20.4310	20.7508	20.9318	20.9840	20.9743	20.8397	20.4092	19.8962	19.5040	(87)
Th 2	19.8340	19.8356	19.8371	19.8441	19.8454	19.8516	19.8516	19.8527	19.8492	19.8454	19.8428	19.8400	(88)
util rest of house	0.9974	0.9925	0.9783	0.9314	0.8105	0.6022	0.4060	0.4639	0.7593	0.9586	0.9938	0.9981	(89)
MIT 2	18.5169	18.7211	19.0233	19.3949	19.6820	19.8215	19.8478	19.8459	19.7633	19.3822	18.8752	18.4817	(90)
Living area fraction									fLA = Living area / (4) =			0.3966	(91)
MIT	18.9242	19.1283	19.4313	19.8058	20.1059	20.2618	20.2984	20.2934	20.1902	19.7895	19.2801	18.8871	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9242	19.1283	19.4313	19.8058	20.1059	20.2618	20.2984	20.2934	20.1902	19.7895	19.2801	18.8871	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9966	0.9909	0.9758	0.9306	0.8235	0.6400	0.4589	0.5181	0.7857	0.9577	0.9926	0.9976	(94)
Useful gains	583.4550	722.4829	838.3419	916.8428	880.5300	676.0331	463.1893	482.0153	663.0880	682.5324	588.6824	542.8586	(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	1894.1526	1840.1193	1669.9295	1398.6391	1076.6330	720.7791	470.8255	495.0879	777.1317	1176.9945	1564.1442	1891.2628	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	975.1590	751.0517	618.7012	346.8933	145.9006	0.0000	0.0000	0.0000	0.0000	367.8799	702.3325	1003.2128	(98)
Space heating												4911.1309	(98)
Space heating per m2											(98) / (4) =	49.6224	(99)

8c. Space cooling requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	1196.6631	942.0539	966.4227	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8643	0.9218	0.8957	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1034.2357	868.3745	865.5999	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1339.0393	1282.0232	1191.5537	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)

Space cooling kWh

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	219.4586	307.7546	242.5096	0.0000	0.0000	0.0000	0.0000 (104)
Space cooling												769.7228 (104)
Cooled fraction										fC = cooled area / (4) =		1.0000 (105)
Intermittency factor (Table 10b)												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000 (106)
Space cooling kWh												
	0.0000	0.0000	0.0000	0.0000	0.0000	54.8646	76.9387	60.6274	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												192.4307 (107)
Space cooling per m2												1.9443 (108)
Energy for space heating												49.6224 (99)
Energy for space cooling												1.9443 (108)
Total												51.5668 (109)
Dwelling Fabric Energy Efficiency (DFEE)												51.6 (109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	98.9700 (1b)	x	2.5000 (2b)	=	247.4250	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	98.9700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	247.4250	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent 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)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1212	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3712	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3434	(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	0.4378	0.4293	0.4207	0.3777	0.3692	0.3262	0.3262	0.3176	0.3434	0.3692	0.3863	0.4035	(22b)
Effective ac	0.5959	0.5921	0.5885	0.5713	0.5681	0.5532	0.5532	0.5505	0.5590	0.5681	0.5746	0.5814	(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	
TER Opaque door			2.1400	1.0000	2.1400			(26)
TER Opening Type (Uw = 1.40)			22.6000	1.3258	29.9621			(27)
Heat Loss Floor bike store			90.0000	0.1300	11.7000			(28b)
Heat Loss Floor over external			8.7300	0.1300	1.1349			(28b)
External Wall 1	68.9900	24.7400	44.2500	0.1800	7.9650			(29a)
Wall to Corridor	29.7800		29.7800	0.1800	5.3604			(29a)
Total net area of external elements Aum(A, m2)			197.5000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		58.2624			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							18.8437	(36)
Total fabric heat loss					(33) + (36) =		77.1061	(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	48.6515	48.3476	48.0497	46.6505	46.3888	45.1701	45.1701	44.9444	45.6395	46.3888	46.9183	47.4720	(38)
Heat transfer coeff	125.7576	125.4537	125.1558	123.7567	123.4949	122.2762	122.2762	122.0506	122.7456	123.4949	124.0245	124.5781	(39)
Average = Sum(39)m / 12 =												123.7554	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2707	1.2676	1.2646	1.2504	1.2478	1.2355	1.2355	1.2332	1.2402	1.2478	1.2532	1.2587	(40)
HLP (average)												1.2504	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.7298	(42)
Average daily hot water use (litres/day)												99.0324	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.9356	104.9743	101.0130	97.0517	93.0904	89.1291	89.1291	93.0904	97.0517	101.0130	104.9743	108.9356	(44)
Energy conte	161.5484	141.2912	145.7999	127.1119	121.9669	105.2481	97.5279	111.9147	113.2513	131.9834	144.0702	156.4510	(45)
Energy content (annual)										Total = Sum(45)m =		1558.1648	(45)
Distribution loss (46)m = 0.15 x (45)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	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

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	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
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)
Heat gains from water heating, kWh/month													
	34.3290	30.0244	30.9825	27.0113	25.9180	22.3652	20.7247	23.7819	24.0659	28.0465	30.6149	33.2458	(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	136.4892	136.4892	136.4892	136.4892	136.4892	136.4892	136.4892	136.4892	136.4892	136.4892	136.4892	136.4892	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	22.7024	20.1641	16.3985	12.4147	9.2802	7.8347	8.4657	11.0040	14.7695	18.7533	21.8879	23.3334	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	254.6518	257.2943	250.6353	236.4591	218.5642	201.7455	190.5096	187.8671	194.5261	208.7023	226.5972	243.4159	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.6489	36.6489	36.6489	36.6489	36.6489	36.6489	36.6489	36.6489	36.6489	36.6489	36.6489	36.6489	(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)													
	-109.1914	-109.1914	-109.1914	-109.1914	-109.1914	-109.1914	-109.1914	-109.1914	-109.1914	-109.1914	-109.1914	-109.1914	(71)
Water heating gains (Table 5)													
	46.1412	44.6791	41.6431	37.5157	34.8360	31.0628	27.8557	31.9649	33.4249	37.6969	42.5207	44.6853	(72)
Total internal gains													
	387.4421	386.0843	372.6237	350.3363	326.6271	304.5898	290.7778	294.7828	306.6673	329.0993	354.9526	375.3813	(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	
Northeast	2.3900	11.2829	0.6300	0.7000	0.7700	8.2412	(75)
South	6.6500	46.7521	0.6300	0.7000	0.7700	95.0155	(78)
Southwest	5.5900	36.7938	0.6300	0.7000	0.7700	62.8577	(79)
Northwest	7.9700	11.2829	0.6300	0.7000	0.7700	27.4823	(81)

Solar gains	193.5967	335.3970	475.7299	620.7086	725.9859	734.8481	702.5556	621.4660	525.3305	375.0410	232.8642	165.0688	(83)
Total gains	581.0388	721.4813	848.3536	971.0449	1052.6129	1039.4379	993.3334	916.2488	831.9977	704.1402	587.8168	540.4501	(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	54.6521	54.7845	54.9149	55.5357	55.6535	56.2081	56.2081	56.3120	55.9932	55.6535	55.4158	55.1695	
alpha	4.6435	4.6523	4.6610	4.7024	4.7102	4.7472	4.7472	4.7541	4.7329	4.7102	4.6944	4.6780	
util living area													
	0.9981	0.9946	0.9844	0.9499	0.8588	0.6928	0.5277	0.5882	0.8328	0.9725	0.9958	0.9987	(86)
MIT	19.5885	19.7902	20.0894	20.4641	20.7720	20.9416	20.9871	20.9789	20.8562	20.4410	19.9395	19.5548	(87)
Th 2	19.8639	19.8663	19.8687	19.8799	19.8819	19.8917	19.8917	19.8935	19.8880	19.8819	19.8777	19.8733	(88)
util rest of house													
	0.9975	0.9928	0.9787	0.9311	0.8076	0.5960	0.4019	0.4587	0.7547	0.9586	0.9940	0.9982	(89)
MIT 2	18.5847	18.7874	19.0852	19.4561	19.7325	19.8660	19.8886	19.8878	19.8109	19.4425	18.9459	18.5584	(90)
Living area fraction										fLA = Living area / (4) =		0.3966	(91)
MIT	18.9828	19.1851	19.4835	19.8559	20.1447	20.2926	20.3243	20.3206	20.2255	19.8385	19.3399	18.9536	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9828	19.1851	19.4835	19.8559	20.1447	20.2926	20.3243	20.3206	20.2255	19.8385	19.3399	18.9536	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9968	0.9913	0.9763	0.9306	0.8210	0.6330	0.4523	0.5106	0.7813	0.9579	0.9928	0.9977	(94)
Useful gains	579.1806	715.1901	828.2440	903.6490	864.2195	657.9968	449.2359	467.8330	650.0595	674.4951	583.6074	539.2049	(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													
	1846.4682	1792.1198	1624.9565	1355.8622	1042.8813	696.0645	455.3880	478.5060	751.8731	1140.9092	1518.0471	1837.9711	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	942.8620	723.6967	592.7541	325.5935	132.9244	0.0000	0.0000	0.0000	0.0000	347.0121	672.7966	966.2820	(98)
Space heating												4703.9214	(98)
Space heating per m2											(98) / (4) =	47.5288	(99)

8c. Space cooling requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1149.3966	904.8441	927.5842	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8777	0.9318	0.9080	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1008.8348	843.1062	842.2073	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1319.3798	1263.2357	1174.9666	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	223.5924	312.5763	247.5729	0.0000	0.0000	0.0000	0.0000	(104)

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Space cooling											783.7416	(104)
Cooled fraction									fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)												
0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh												
0.0000	0.0000	0.0000	0.0000	0.0000	55.8981	78.1441	61.8932	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling											195.9354	(107)
Space cooling per m2											1.9797	(108)
Energy for space heating											47.5288	(99)
Energy for space cooling											1.9797	(108)
Total											49.5085	(109)
Target Fabric Energy Efficiency (TFEE)											56.9	(109)

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

HODKINSON

Property Reference	A.03.02 Wootton	**Issued on Date**	26/11/2020
Assessment Reference	A.03.02 Wootton HP	**Prop Type Ref**	Blk A 1B2P (Mid floor)
Property			

SAP Rating	88 B	**DER**	15.40	**TER**	22.94
Environmental	90 B	**% DER<TER**	32.86		
CO_2 Emissions (t/year)	0.71	**DFEE**	30.52	**TFEE**	31.17
General Requirements Compliance	Pass	**% DFEE<TFEE**	2.07		

Assessor Details	Mr. Jonathan Peck, Jonathan Peck, Tel: 02036031622, Jonathan@hodkinsonconsultancy.com	**Assessor ID**	M976-0001
Client			

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DWELLING AS DESIGNED

Mid-floor flat, total floor area 56 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Electricity
Fuel factor:1.55 (electricity)
Target Carbon Dioxide Emission Rate (TER) 22.94 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 15.40 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)31.2 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)30.5 kWh/m²/yrOK

---
2 Fabric U-values

Element	Average	Highest	
External wall	0.18 (max. 0.30)	0.18 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	(no floor)		
Roof	(no roof)		
Openings	1.26 (max. 2.00)	1.30 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

---
3 Air permeability
Air permeability at 50 pascals: 3.50 (design value)
Maximum 10.0 OK

---
4 Heating efficiency
Main heating system: Heat pump with radiators or underfloor - Electric
Mitsubishi ECODAN 5kW PUHZ-W50VHA-BS

Secondary heating system: None

---
5 Cylinder insulation
Hot water storage Measured cylinder loss: 1.20 kWh/day
Permitted by DBSCG 2.03 OK
Primary pipework insulated: Yes OK

---
6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: Cylinderstat OK
Independent timer for DHW OK

---
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK

---
8 Mechanical ventilation
Continuous supply and extract system
Specific fan power: 0.48
Maximum 1.5 OK
MVHR efficiency: 92%
Minimum: 70% OK

---
9 Summertime temperature
Overheating risk (Thames Valley): Medium OK
Based on:
Overshading: Average
Windows facing South: 7.86 m², No overhang
Windows facing South West: 4.68 m², No overhang
Air change rate: 3.00 ach
Blinds/curtains: None

---
10 Key features
Party wall U-value 0.00 W/m²K
Door U-value 1.00 W/m²K
Air permeability 3.5 m³/m²h
Photovoltaic array 0.14 kW

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	55.9100 (1b)	x	2.5000 (2b)	=	139.7750	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	55.9100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	139.7750	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent 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)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Measured/design AP50		3.5000	
Infiltration rate		0.1750	(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) =	0.1356	(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	0.1729	0.1695	0.1661	0.1492	0.1458	0.1288	0.1288	0.1255	0.1356	0.1458	0.1526	0.1594	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation:	0.5000	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	78.2000	(23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.2819	0.2785	0.2751	0.2582	0.2548	0.2378	0.2378	0.2345	0.2446	0.2548	0.2616	0.2684	(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	
Window (Uw = 1.30)			12.5400	1.2357	15.4962			(27)
Front Door			2.1400	1.0000	2.1400			(26)
External Wall 1	32.7500	14.6800	18.0700	0.1800	3.2526			(29a)
Wall to Corridor	14.5500		14.5500	0.1800	2.6190			(29a)
Total net area of external elements Aum(A, m2)			47.3000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		23.5078			(33)
Party Wall 1			39.2800	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	7.0548	(36)
Total fabric heat loss (33) + (36) =	30.5626	(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	13.0039	12.8475	12.6911	11.9091	11.7527	10.9707	10.9707	10.8143	11.2835	11.7527	12.0655	12.3783	(38)
Heat transfer coeff	43.5665	43.4101	43.2537	42.4717	42.3153	41.5333	41.5333	41.3769	41.8461	42.3153	42.6281	42.9409	(39)
Average = Sum(39)m / 12 =												42.4326	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.7792	0.7764	0.7736	0.7596	0.7568	0.7429	0.7429	0.7401	0.7485	0.7568	0.7624	0.7680	(40)
HLP (average)												0.7589	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.8640 (42)
Average daily hot water use (litres/day)	78.4693 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	86.3162	83.1774	80.0386	76.8999	73.7611	70.6223	70.6223	73.7611	76.8999	80.0386	83.1774	86.3162	(44)
Energy conte	128.0044	111.9535	115.5260	100.7183	96.6416	83.3944	77.2772	88.6767	89.7357	104.5784	114.1555	123.9654	(45)
Energy content (annual)										Total = Sum(45)m =		1234.6270	(45)
Distribution loss (46)m = 0.15 x (45)m	19.2007	16.7930	17.3289	15.1077	14.4962	12.5092	11.5916	13.3015	13.4604	15.6868	17.1233	18.5948	(46)

Water storage loss:

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Store volume												170.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.2000	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.6480	(55)
Total storage loss													
	20.0880	18.1440	20.0880	19.4400	20.0880	19.4400	20.0880	20.0880	19.4400	20.0880	19.4400	20.0880	(56)
If cylinder contains dedicated solar storage													
	20.0880	18.1440	20.0880	19.4400	20.0880	19.4400	20.0880	20.0880	19.4400	20.0880	19.4400	20.0880	(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)
Total heat required for water heating calculated for each month													
	171.3548	151.1087	158.8764	142.6703	139.9920	125.3464	120.6276	132.0271	131.6877	147.9288	156.1075	167.3158	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	171.3548	151.1087	158.8764	142.6703	139.9920	125.3464	120.6276	132.0271	131.6877	147.9288	156.1075	167.3158	(64)
								Total per year (kWh/year) = Sum(64)m =				1745.0430	(64)
Heat gains from water heating, kWh/month													
	77.2418	68.5487	73.0927	67.0504	66.8137	61.2902	60.3750	64.1653	63.3987	69.4526	71.5183	75.8988	(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	93.1984	93.1984	93.1984	93.1984	93.1984	93.1984	93.1984	93.1984	93.1984	93.1984	93.1984	93.1984	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	14.4894	12.8694	10.4661	7.9235	5.9229	5.0004	5.4031	7.0231	9.4264	11.9690	13.9696	14.8921	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	162.5275	164.2140	159.9640	150.9163	139.4951	128.7609	121.5897	119.9032	124.1532	133.2009	144.6221	155.3563	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	32.3198	32.3198	32.3198	32.3198	32.3198	32.3198	32.3198	32.3198	32.3198	32.3198	32.3198	32.3198	(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)													
	-74.5588	-74.5588	-74.5588	-74.5588	-74.5588	-74.5588	-74.5588	-74.5588	-74.5588	-74.5588	-74.5588	-74.5588	(71)
Water heating gains (Table 5)													
	103.8196	102.0070	98.2429	93.1256	89.8033	85.1253	81.1492	86.2437	88.0538	93.3503	99.3310	102.0146	(72)
Total internal gains													
	331.7961	330.0499	319.6325	302.9249	286.1809	269.8461	259.1015	264.1296	272.5930	289.4798	308.8822	323.2226	(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	
South	7.8600	46.7521	0.4500	0.8000	0.7700	91.6767	(78)
Southwest	4.6800	36.7938	0.4500	0.8000	0.7700	42.9592	(79)

Solar gains	134.6360	223.3183	291.3772	340.2159	364.2051	354.7226	344.7986	327.5718	308.1996	242.8176	160.1235	115.9813	(83)
Total gains	466.4320	553.3682	611.0098	643.1409	650.3860	624.5688	603.9001	591.7014	580.7926	532.2974	469.0056	439.2039	(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	89.1199	89.4410	89.7644	91.4171	91.7550	93.4825	93.4825	93.8359	92.7837	91.7550	91.0817	90.4183	
alpha	6.9413	6.9627	6.9843	7.0945	7.1170	7.2322	7.2322	7.2557	7.1856	7.1170	7.0721	7.0279	
util living area													
	0.9831	0.9515	0.8859	0.7600	0.5983	0.4251	0.3026	0.3216	0.4955	0.7797	0.9530	0.9878	(86)
Tweekday	19.6398	19.8855	20.0960	20.2417	20.2841	20.3028	20.3031	20.3056	20.2971	20.2466	19.9652	19.5985	
Tweekend	20.6867	20.7991	20.8999	20.9706	20.9948	20.9996	21.0000	21.0000	20.9989	20.9707	20.8299	20.6644	
24 / 16	9	8	9	8	9	9	9	9	8	9	8	9	
24 / 9	22	20	22	22	22	21	22	22	22	22	22	22	
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	20.2714	20.2738	20.2762	20.2884	20.2909	20.3031	20.3031	20.3056	20.2982	20.2909	20.2860	20.2811	(88)
util rest of house													
	0.9786	0.9402	0.8635	0.7246	0.5550	0.3790	0.2547	0.2731	0.4458	0.7390	0.9401	0.9845	(89)
Tweekday	19.6398	19.8855	20.0960	20.2417	20.2841	20.3028	20.3031	20.3056	20.2971	20.2466	19.9652	19.5985	
Tweekend	19.6398	19.8855	20.0960	20.2417	20.2841	20.3028	20.3031	20.3056	20.2971	20.2466	19.9652	19.5985	
MIT 2	20.2714	20.2738	20.2762	20.2884	20.2909	20.3031	20.3031	20.3056	20.2982	20.2909	20.2860	20.2811	(90)
Living area fraction									fLA = Living area / (4) =			0.5139	(91)
MIT	20.6458	20.6470	20.6482	20.6541	20.6553	20.6612	20.6612	20.6624	20.6588	20.6553	20.6529	20.6505	(92)
Temperature adjustment												0.0000	
adjusted MIT	20.6458	20.6470	20.6482	20.6541	20.6553	20.6612	20.6612	20.6624	20.6588	20.6553	20.6529	20.6505	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9811	0.9463	0.8754	0.7432	0.5774	0.4027	0.2793	0.2980	0.4714	0.7605	0.9471	0.9863	(94)
Useful gains	457.5937	523.6388	534.8977	477.9631	375.5180	251.5323	168.6641	176.3466	273.7976	404.7876	444.1921	433.1827	(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													
	712.1280	683.5770	611.9596	499.2159	378.9450	251.7427	168.6761	176.3656	274.4620	425.4919	577.7341	706.4000	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	189.3735	107.4784	57.3340	15.3020	2.5497	0.0000	0.0000	0.0000	0.0000	15.4039	96.1502	203.2736	(98)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Space heating		686.8655 (98)
Space heating per m2	(98) / (4) =	12.2852 (99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000 (201)
Fraction of space heat from main system(s)	1.0000 (202)
Efficiency of main space heating system 1 (in %)	160.5007 (206)
Efficiency of secondary/supplementary heating system, %	100.0000 (208)
Space heating requirement	427.9517 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	189.3735	107.4784	57.3340	15.3020	2.5497	0.0000	0.0000	0.0000	0.0000	15.4039	96.1502	203.2736	(98)
Space heating efficiency (main heating system 1)													
	160.5007	160.5007	160.5007	160.5007	160.5007	0.0000	0.0000	0.0000	0.0000	160.5007	160.5007	160.5007	(210)
Space heating fuel (main heating system)													
	117.9892	66.9645	35.7220	9.5339	1.5886	0.0000	0.0000	0.0000	0.0000	9.5974	59.9064	126.6497	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	171.3548	151.1087	158.8764	142.6703	139.9920	125.3464	120.6276	132.0271	131.6877	147.9288	156.1075	167.3158	(64)
Efficiency of water heater													
(217)m	178.1250	178.1250	178.1250	178.1250	178.1250	178.1250	178.1250	178.1250	178.1250	178.1250	178.1250	178.1250	(217)
Fuel for water heating, kWh/month													
	96.1992	84.8329	89.1937	80.0956	78.5920	70.3699	67.7207	74.1205	73.9300	83.0477	87.6393	93.9317	(219)
Water heating fuel used												979.6733	(219)
Annual totals kWh/year													
Space heating fuel - main system												427.9517	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.6000)													
mechanical ventilation fans (SFP = 0.6000)												102.3153	(230a)
Total electricity for the above, kWh/year												102.3153	(231)
Electricity for lighting (calculated in Appendix L)												255.8881	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 0.14 * 951 * 1.00) =												-106.4690	(233)
Total delivered energy for all uses												1659.3594	(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	427.9517	0.5190	222.1069	(261)
Space heating - secondary	0.0000	0.5190	0.0000	(263)
Water heating (other fuel)	979.6733	0.5190	508.4504	(264)
Space and water heating			730.5574	(265)
Pumps and fans	102.3153	0.5190	53.1016	(267)
Energy for lighting	255.8881	0.5190	132.8059	(268)
Energy saving/generation technologies				
PV Unit	-106.4690	0.5190	-55.2574	(269)
Total CO2, kg/year			861.2075	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			15.4000	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		15.4000	ZC1
Total Floor Area	TFA	55.9100	
Assumed number of occupants	N	1.8640	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		17.2260	ZC2
CO2 emissions from cooking, equation (L16)		2.9286	ZC3
Total CO2 emissions		35.5545	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		35.5545	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	55.9100 (1b)	x	2.5000 (2b)	=	139.7750	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	55.9100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	139.7750	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent 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)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1431	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3931	(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) =	0.3046	(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	0.3884	0.3808	0.3732	0.3351	0.3275	0.2894	0.2894	0.2818	0.3046	0.3275	0.3427	0.3580	(22b)
Effective ac	0.5754	0.5725	0.5696	0.5561	0.5536	0.5419	0.5419	0.5397	0.5464	0.5536	0.5587	0.5641	(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	
TER Opaque door			2.1400	1.0000	2.1400			(26)
TER Opening Type (Uw = 1.40)			11.8400	1.3258	15.6970			(27)
External Wall 1	32.7500	13.9800	18.7700	0.1800	3.3786			(29a)
Wall to Corridor	14.5500		14.5500	0.1800	2.6190			(29a)
Total net area of external elements Aum(A, m2)			47.3000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	23.8346			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							3.7238	(36)
Total fabric heat loss					(33) + (36) =		27.5584	(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	26.5424	26.4072	26.2748	25.6528	25.5364	24.9946	24.9946	24.8943	25.2033	25.5364	25.7718	26.0180	(38)
Heat transfer coeff	54.1007	53.9656	53.8332	53.2111	53.0947	52.5530	52.5530	52.4526	52.7616	53.0947	53.3302	53.5763	(39)
Average = Sum(39)m / 12 =												53.2106	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9676	0.9652	0.9629	0.9517	0.9496	0.9400	0.9400	0.9382	0.9437	0.9496	0.9539	0.9583	(40)
HLP (average)												0.9517	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		1.8640 (42)
Average daily hot water use (litres/day)		78.4693 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	86.3162	83.1774	80.0386	76.8999	73.7611	70.6223	70.6223	73.7611	76.8999	80.0386	83.1774	86.3162	(44)
Energy conte	128.0044	111.9535	115.5260	100.7183	96.6416	83.3944	77.2772	88.6767	89.7357	104.5784	114.1555	123.9654	(45)
Energy content (annual)										Total = Sum(45)m =		1234.6270	(45)
Distribution loss (46)m = 0.15 x (45)m	19.2007	16.7930	17.3289	15.1077	14.4962	12.5092	11.5916	13.3015	13.4604	15.6868	17.1233	18.5948	(46)

Water storage loss:		
Store volume		170.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):		1.5003 (48)
Temperature factor from Table 2b		0.5400 (49)
Enter (49) or (54) in (55)		0.8102 (55)
Total storage loss		

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	25.1153	22.6848	25.1153	24.3051	25.1153	24.3051	25.1153	25.1153	24.3051	25.1153	24.3051	25.1153	(56)
If cylinder contains dedicated solar storage													
	25.1153	22.6848	25.1153	24.3051	25.1153	24.3051	25.1153	25.1153	24.3051	25.1153	24.3051	25.1153	(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)
Total heat required for water heating calculated for each month													
	176.3821	155.6495	163.9037	147.5355	145.0193	130.2115	125.6549	137.0544	136.5529	152.9561	160.9726	172.3431	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	176.3821	155.6495	163.9037	147.5355	145.0193	130.2115	125.6549	137.0544	136.5529	152.9561	160.9726	172.3431	(64)
								Total per year (kWh/year) = Sum(64)m =				1804.2354	(64)
Heat gains from water heating, kWh/month													
	81.2636	72.1813	77.1145	70.9425	70.8355	65.1823	64.3968	68.1872	67.2908	73.4745	75.4104	79.9207	(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	93.1984	93.1984	93.1984	93.1984	93.1984	93.1984	93.1984	93.1984	93.1984	93.1984	93.1984	93.1984	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	14.5210	12.8974	10.4889	7.9408	5.9358	5.0113	5.4149	7.0384	9.4470	11.9951	14.0001	14.9246	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	162.5275	164.2140	159.9640	150.9163	139.4951	128.7609	121.5897	119.9032	124.1532	133.2009	144.6221	155.3563	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	32.3198	32.3198	32.3198	32.3198	32.3198	32.3198	32.3198	32.3198	32.3198	32.3198	32.3198	32.3198	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-74.5588	-74.5588	-74.5588	-74.5588	-74.5588	-74.5588	-74.5588	-74.5588	-74.5588	-74.5588	-74.5588	-74.5588	(71)
Water heating gains (Table 5)													
	109.2253	107.4127	103.6486	98.5313	95.2090	90.5310	86.5549	91.6494	93.4595	98.7560	104.7367	107.4203	(72)
Total internal gains													
	340.2333	338.4837	328.0610	311.3479	294.5995	278.2627	267.5190	272.5506	281.0192	297.9116	317.3183	331.6607	(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	
South	7.4200	46.7521	0.6300	0.7000	0.7700	106.0172	(78)
Southwest	4.4200	36.7938	0.6300	0.7000	0.7700	49.7015	(79)

Solar gains	155.7187	258.2889	337.0079	393.4986	421.2480	410.2818	398.8028	378.8756	356.4661	280.8424	185.1975	134.1428	(83)
Total gains	495.9520	596.7726	665.0690	704.8466	715.8475	688.5445	666.3218	651.4261	637.4853	578.7540	502.5158	465.8035	(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	71.7669	71.9465	72.1235	72.9667	73.1266	73.8805	73.8805	74.0218	73.5883	73.1266	72.8038	72.4693	
alpha	5.7845	5.7964	5.8082	5.8644	5.8751	5.9254	5.9254	5.9348	5.9059	5.8751	5.8536	5.8313	
util living area													
	0.9857	0.9615	0.9121	0.8130	0.6636	0.4849	0.3466	0.3697	0.5619	0.8337	0.9644	0.9895	(86)
MIT	20.2796	20.4871	20.6974	20.8766	20.9673	20.9957	20.9995	20.9993	20.9898	20.8785	20.5529	20.2356	(87)
Th 2	20.1104	20.1124	20.1144	20.1238	20.1255	20.1337	20.1337	20.1352	20.1305	20.1255	20.1220	20.1183	(88)
util rest of house													
	0.9816	0.9514	0.8912	0.7752	0.6095	0.4209	0.2786	0.3006	0.4950	0.7913	0.9533	0.9864	(89)
MIT 2	19.1725	19.4679	19.7573	19.9941	20.0973	20.1311	20.1335	20.1349	20.1237	20.0034	19.5724	19.1155	(90)
Living area fraction									fLA = Living area / (4) =			0.5139	(91)
MIT	19.7414	19.9916	20.2404	20.4476	20.5444	20.5753	20.5785	20.5791	20.5688	20.4531	20.0762	19.6911	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.7414	19.9916	20.2404	20.4476	20.5444	20.5753	20.5785	20.5791	20.5688	20.4531	20.0762	19.6911	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9795	0.9499	0.8944	0.7898	0.6359	0.4537	0.3136	0.3361	0.5291	0.8081	0.9526	0.9846	(94)
Useful gains	485.7840	566.8584	594.8465	556.7133	455.2302	312.3853	208.9326	218.9762	337.2893	467.6898	478.7173	458.6235	(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													
	835.3923	814.4301	739.6878	614.4593	469.5905	314.0222	209.0820	219.2030	341.3039	523.1486	692.0250	829.9551	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	260.1085	166.3682	107.7619	41.5771	10.6840	0.0000	0.0000	0.0000	0.0000	41.2613	153.5816	276.2707	(98)
Space heating												1057.6133	(98)
Space heating per m2											(98) / (4) =	18.9164	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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 %)												93.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												1131.1372	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	260.1085	166.3682	107.7619	41.5771	10.6840	0.0000	0.0000	0.0000	0.0000	41.2613	153.5816	276.2707	(98)
Space heating efficiency (main heating system 1)													
	93.5000	93.5000	93.5000	93.5000	93.5000	0.0000	0.0000	0.0000	0.0000	93.5000	93.5000	93.5000	(210)
Space heating fuel (main heating system)													
	278.1910	177.9339	115.2534	44.4674	11.4268	0.0000	0.0000	0.0000	0.0000	44.1298	164.2583	295.4767	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	176.3821	155.6495	163.9037	147.5355	145.0193	130.2115	125.6549	137.0544	136.5529	152.9561	160.9726	172.3431	(64)
Efficiency of water heater												79.8000	(216)
(217)m	85.8485	84.9916	83.7267	81.9297	80.4527	79.8000	79.8000	79.8000	79.8000	81.8561	84.6888	86.0666	(217)
Fuel for water heating, kWh/month													
	205.4574	183.1351	195.7603	180.0758	180.2542	163.1723	157.4622	171.7473	171.1189	186.8597	190.0753	200.2439	(219)
Water heating fuel used												2185.3625	(219)
Annual totals kWh/year													
Space heating fuel - main system												1131.1372	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												256.4459	(232)
Total delivered energy for all uses												3647.9456	(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	1131.1372	0.2160	244.3256	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2185.3625	0.2160	472.0383	(264)
Space and water heating			716.3639	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	256.4459	0.5190	133.0954	(268)
Total CO2, kg/m2/year			888.3844	(272)
Emissions per m2 for space and water heating			12.8128	(272a)
Fuel factor (electricity)			1.5500	
Emissions per m2 for lighting			2.3805	(272b)
Emissions per m2 for pumps and fans			0.6962	(272c)
Target Carbon Dioxide Emission Rate (TER) = (12.8128 * 1.55) + 2.3805 + 0.6962, rounded to 2 d.p.			22.9400	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	55.9100 (1b)	x	2.5000 (2b)	=	139.7750	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	55.9100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	139.7750	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent 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)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1431	(8)
Pressure test		Yes	
Measured/design AP50		3.5000	
Infiltration rate		0.3181	(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) =	0.2465	(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	0.3143	0.3081	0.3020	0.2712	0.2650	0.2342	0.2342	0.2280	0.2465	0.2650	0.2773	0.2897	(22b)
Effective ac	0.5494	0.5475	0.5456	0.5368	0.5351	0.5274	0.5274	0.5260	0.5304	0.5351	0.5385	0.5420	(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	
Window (Uw = 1.30)			12.5400	1.2357	15.4962			(27)
Front Door			2.1400	1.0000	2.1400			(26)
External Wall 1	32.7500	14.6800	18.0700	0.1800	3.2526			(29a)
Wall to Corridor	14.5500		14.5500	0.1800	2.6190			(29a)
Total net area of external elements Aum(A, m2)			47.3000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		23.5078			(33)
Party Wall 1			39.2800	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	7.0548	(36)
Total fabric heat loss (33) + (36) =	30.5626	(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	25.3413	25.2528	25.1661	24.7588	24.6825	24.3278	24.3278	24.2621	24.4644	24.6825	24.8367	24.9979	(38)
Heat transfer coeff	55.9039	55.8154	55.7287	55.3213	55.2451	54.8904	54.8904	54.8247	55.0270	55.2451	55.3993	55.5605	(39)
Average = Sum(39)m / 12 =												55.3210	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9999	0.9983	0.9968	0.9895	0.9881	0.9818	0.9818	0.9806	0.9842	0.9881	0.9909	0.9937	(40)
HLP (average)												0.9895	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.8640	(42)
Average daily hot water use (litres/day)	78.4693	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	86.3162	83.1774	80.0386	76.8999	73.7611	70.6223	70.6223	73.7611	76.8999	80.0386	83.1774	86.3162	(44)
Energy conte	128.0044	111.9535	115.5260	100.7183	96.6416	83.3944	77.2772	88.6767	89.7357	104.5784	114.1555	123.9654	(45)
Energy content (annual)										Total = Sum(45)m =		1234.6270	(45)
Distribution loss (46)m = 0.15 x (45)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	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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)
Heat gains from water heating, kWh/month													
	27.2009	23.7901	24.5493	21.4026	20.5363	17.7213	16.4214	18.8438	19.0688	22.2229	24.2580	26.3427	(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	93.1984	93.1984	93.1984	93.1984	93.1984	93.1984	93.1984	93.1984	93.1984	93.1984	93.1984	93.1984	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	14.4894	12.8694	10.4661	7.9235	5.9229	5.0004	5.4031	7.0231	9.4264	11.9690	13.9696	14.8921	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	162.5275	164.2140	159.9640	150.9163	139.4951	128.7609	121.5897	119.9032	124.1532	133.2009	144.6221	155.3563	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	32.3198	32.3198	32.3198	32.3198	32.3198	32.3198	32.3198	32.3198	32.3198	32.3198	32.3198	32.3198	(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)													
	-74.5588	-74.5588	-74.5588	-74.5588	-74.5588	-74.5588	-74.5588	-74.5588	-74.5588	-74.5588	-74.5588	-74.5588	(71)
Water heating gains (Table 5)													
	36.5604	35.4020	32.9963	29.7259	27.6026	24.6129	22.0718	25.3277	26.4845	29.8695	33.6917	35.4068	(72)
Total internal gains													
	264.5368	263.4449	254.3860	239.5252	223.9802	209.3337	200.0241	203.2136	211.0237	225.9990	243.2429	256.6148	(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	
South	7.8600	46.7521	0.4500	0.8000	0.7700	91.6767	(78)
Southwest	4.6800	36.7938	0.4500	0.8000	0.7700	42.9592	(79)

Solar gains	134.6360	223.3183	291.3772	340.2159	364.2051	354.7226	344.7986	327.5718	308.1996	242.8176	160.1235	115.9813	(83)
Total gains	399.1728	486.7632	545.7632	579.7412	588.1853	564.0564	544.8227	530.7854	519.2233	468.8166	403.3664	372.5961	(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	69.4521	69.5621	69.6704	70.1834	70.2802	70.7344	70.7344	70.8192	70.5588	70.2802	70.0846	69.8813	
alpha	5.6301	5.6375	5.6447	5.6789	5.6853	5.7156	5.7156	5.7213	5.7039	5.6853	5.6723	5.6588	
util living area													
	0.9952	0.9853	0.9618	0.9041	0.7874	0.6064	0.4409	0.4716	0.6937	0.9221	0.9877	0.9967	(86)
MIT	20.0737	20.2761	20.5107	20.7487	20.9124	20.9840	20.9978	20.9967	20.9662	20.7538	20.3571	20.0282	(87)
Th 2	20.0834	20.0847	20.0860	20.0921	20.0933	20.0986	20.0986	20.0995	20.0965	20.0933	20.0910	20.0885	(88)
util rest of house													
	0.9937	0.9808	0.9504	0.8768	0.7341	0.5280	0.3519	0.3812	0.6172	0.8937	0.9832	0.9956	(89)
MIT 2	19.2446	19.4454	19.6740	19.9003	20.0381	20.0916	20.0980	20.0987	20.0800	19.9107	19.5320	19.2036	(90)
Living area fraction									fLA = Living area / (4) =			0.5139	(91)
MIT	19.6707	19.8723	20.1039	20.3362	20.4873	20.5502	20.5604	20.5601	20.5354	20.3439	19.9560	19.6273	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.6707	19.8723	20.1039	20.3362	20.4873	20.5502	20.5604	20.5601	20.5354	20.3439	19.9560	19.6273	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9928	0.9796	0.9506	0.8848	0.7584	0.5680	0.3977	0.4277	0.6555	0.9024	0.9824	0.9949	(94)
Useful gains	396.3027	476.8335	518.8162	512.9389	446.0737	320.3966	216.6993	227.0387	340.3716	423.0813	396.2514	370.7004	(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													
	859.2801	835.6835	758.1290	632.6679	485.4579	326.6081	217.3853	228.0784	354.1210	538.3045	712.2120	857.1509	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	344.4552	241.1472	178.0487	86.2049	29.3018	0.0000	0.0000	0.0000	0.0000	85.7261	227.4917	361.9192	(98)
Space heating												1554.2947	(98)
Space heating per m2											(98) / (4) =	27.7999	(99)

8c. Space cooling requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	515.9695	406.1888	416.6675	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9551	0.9815	0.9771	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	492.8106	398.6551	407.1377	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	729.2323	705.3952	690.0488	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	170.2237	228.2146	210.4859	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												608.9242	(104)
Cooled fraction									fC = cooled area / (4) =			1.0000	(105)
Intermittency factor (Table 10b)													

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000 (106)
Space cooling kWh												
	0.0000	0.0000	0.0000	0.0000	0.0000	42.5559	57.0537	52.6215	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												152.2310 (107)
Space cooling per m2												2.7228 (108)
Energy for space heating												27.7999 (99)
Energy for space cooling												2.7228 (108)
Total												30.5227 (109)
Dwelling Fabric Energy Efficiency (DFEE)												30.5 (109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	55.9100 (1b)	x	2.5000 (2b)	=	139.7750	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	55.9100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	139.7750	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent 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)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1431	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3931	(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) =	0.3046	(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	0.3884	0.3808	0.3732	0.3351	0.3275	0.2894	0.2894	0.2818	0.3046	0.3275	0.3427	0.3580	(22b)
Effective ac	0.5754	0.5725	0.5696	0.5561	0.5536	0.5419	0.5419	0.5397	0.5464	0.5536	0.5587	0.5641	(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	
TER Opaque door			2.1400	1.0000	2.1400			(26)
TER Opening Type (Uw = 1.40)			11.8400	1.3258	15.6970			(27)
External Wall 1	32.7500	13.9800	18.7700	0.1800	3.3786			(29a)
Wall to Corridor	14.5500		14.5500	0.1800	2.6190			(29a)
Total net area of external elements Aum(A, m2)			47.3000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	23.8346			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		3.7238 (36)
Total fabric heat loss	(33) + (36) =	27.5584 (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	26.5424	26.4072	26.2748	25.6528	25.5364	24.9946	24.9946	24.8943	25.2033	25.5364	25.7718	26.0180	(38)
Heat transfer coeff	54.1007	53.9656	53.8332	53.2111	53.0947	52.5530	52.5530	52.4526	52.7616	53.0947	53.3302	53.5763	(39)
Average = Sum(39)m / 12 =												53.2106	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9676	0.9652	0.9629	0.9517	0.9496	0.9400	0.9400	0.9382	0.9437	0.9496	0.9539	0.9583	(40)
HLP (average)												0.9517	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.8640 (42)
Average daily hot water use (litres/day)	78.4693 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	86.3162	83.1774	80.0386	76.8999	73.7611	70.6223	70.6223	73.7611	76.8999	80.0386	83.1774	86.3162	(44)
Energy conte	128.0044	111.9535	115.5260	100.7183	96.6416	83.3944	77.2772	88.6767	89.7357	104.5784	114.1555	123.9654	(45)
Energy content (annual)											Total = Sum(45)m =	1234.6270	(45)
Distribution loss (46)m = 0.15 x (45)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	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
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)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Heat gains from water heating, kWh/month

	27.2009	23.7901	24.5493	21.4026	20.5363	17.7213	16.4214	18.8438	19.0688	22.2229	24.2580	26.3427 (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	93.1984	93.1984	93.1984	93.1984	93.1984	93.1984	93.1984	93.1984	93.1984	93.1984	93.1984	93.1984	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	14.5210	12.8974	10.4889	7.9408	5.9358	5.0113	5.4149	7.0384	9.4470	11.9951	14.0001	14.9246	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	162.5275	164.2140	159.9640	150.9163	139.4951	128.7609	121.5897	119.9032	124.1532	133.2009	144.6221	155.3563	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	32.3198	32.3198	32.3198	32.3198	32.3198	32.3198	32.3198	32.3198	32.3198	32.3198	32.3198	32.3198	(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)													
	-74.5588	-74.5588	-74.5588	-74.5588	-74.5588	-74.5588	-74.5588	-74.5588	-74.5588	-74.5588	-74.5588	-74.5588	(71)
Water heating gains (Table 5)													
	36.5604	35.4020	32.9963	29.7259	27.6026	24.6129	22.0718	25.3277	26.4845	29.8695	33.6917	35.4068	(72)
Total internal gains													
	264.5684	263.4729	254.4088	239.5425	223.9931	209.3446	200.0359	203.2289	211.0442	226.0251	243.2734	256.6473	(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	
South	7.4200	46.7521	0.6300	0.7000	0.7700	106.0172	(78)
Southwest	4.4200	36.7938	0.6300	0.7000	0.7700	49.7015	(79)

Solar gains	155.7187	258.2889	337.0079	393.4986	421.2480	410.2818	398.8028	378.8756	356.4661	280.8424	185.1975	134.1428	(83)
Total gains	420.2871	521.7618	591.4167	633.0411	645.2411	619.6264	598.8387	582.1044	567.5103	506.8675	428.4709	390.7900	(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	71.7669	71.9465	72.1235	72.9667	73.1266	73.8805	73.8805	74.0218	73.5883	73.1266	72.8038	72.4693	
alpha	5.7845	5.7964	5.8082	5.8644	5.8751	5.9254	5.9254	5.9348	5.9059	5.8751	5.8536	5.8313	
util living area	0.9936	0.9785	0.9430	0.8615	0.7209	0.5361	0.3853	0.4132	0.6240	0.8885	0.9825	0.9956	(86)
MIT	20.1558	20.3772	20.6125	20.8283	20.9501	20.9927	20.9991	20.9987	20.9826	20.8224	20.4420	20.1106	(87)
Th 2	20.1104	20.1124	20.1144	20.1238	20.1255	20.1337	20.1337	20.1352	20.1305	20.1255	20.1220	20.1183	(88)
util rest of house	0.9916	0.9724	0.9277	0.8283	0.6664	0.4665	0.3099	0.3362	0.5524	0.8536	0.9765	0.9943	(89)
MIT 2	19.3483	19.5673	19.7940	19.9968	20.0953	20.1306	20.1335	20.1348	20.1224	19.9981	19.6410	19.3101	(90)
Living area fraction										fLA = Living area / (4) =		0.5139	(91)
MIT	19.7632	19.9835	20.2145	20.4241	20.5345	20.5736	20.5783	20.5787	20.5644	20.4217	20.0526	19.7214	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.7632	19.9835	20.2145	20.4241	20.5345	20.5736	20.5783	20.5787	20.5644	20.4217	20.0526	19.7214	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9906	0.9713	0.9296	0.8404	0.6926	0.5022	0.3487	0.3758	0.5888	0.8664	0.9759	0.9935	(94)
Useful gains	416.3497	506.8104	549.7819	531.9959	446.9236	311.1497	208.8038	218.7695	334.1400	439.1533	418.1418	388.2412	(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	836.5724	813.9897	738.2976	613.2085	469.0672	313.9306	209.0706	219.1851	341.0739	521.4802	690.7666	831.5819	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	312.6457	206.4245	140.2557	58.4730	16.4748	0.0000	0.0000	0.0000	0.0000	61.2512	196.2899	329.8455	(98)
Space heating												1321.6603	(98)
Space heating per m2											(98) / (4) =	23.6391	(99)

8c. Space cooling requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	493.9978	388.8919	398.6399	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9764	0.9912	0.9889	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	482.3594	385.4683	394.1977	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	794.1988	768.5464	750.0525	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	224.5244	285.0101	264.7560	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												774.2905	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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Space cooling kWh
                0.0000     0.0000     0.0000     0.0000     0.0000    56.1311    71.2525    66.1890     0.0000     0.0000     0.0000     0.0000 (107)
Space cooling                                                                                                                    193.5726 (107)
Space cooling per m2                                                                                                               3.4622 (108)
Energy for space heating                                                                                                          23.6391 (99)
Energy for space cooling                                                                                                           3.4622 (108)
Total                                                                                                                             27.1013 (109)
Target Fabric Energy Efficiency (TFEE)                                                                                               31.2 (109)
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FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

HODKINSON

Property Reference	B.04.05 Wootton	**Issued on Date**	26/11/2020
Assessment Reference	B.04.05 Wootton HP	**Prop Type Ref**	Blk B 3B5P (exposed roof)
Property			

SAP Rating	86 B	**DER**	14.45	**TER**	26.91
Environmental	88 B	**% DER<TER**	46.30		
CO_2 Emissions (t/year)	1.20	**DFEE**	49.03	**TFEE**	59.04
General Requirements Compliance	Pass	**% DFEE<TFEE**	16.95		

Assessor Details	Mr. Jonathan Peck, Jonathan Peck, Tel: 02036031622, Jonathan@hodkinsonconsultancy.com	**Assessor ID**	M976-0001
Client			

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

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

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DWELLING AS DESIGNED

Top-floor flat, total floor area 99 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Electricity
Fuel factor:1.55 (electricity)
Target Carbon Dioxide Emission Rate (TER) 26.91 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 14.45 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)59.0 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)49.0 kWh/m²/yrOK

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2 Fabric U-values

Element	Average	Highest	
External wall	0.18 (max. 0.30)	0.18 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	(no floor)		
Roof	0.10 (max. 0.20)	0.10 (max. 0.35)	OK
Openings	1.28 (max. 2.00)	1.30 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

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3 Air permeability
Air permeability at 50 pascals: 3.50 (design value)
Maximum 10.0 OK

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4 Heating efficiency
Main heating system: Heat pump with radiators or underfloor - Electric
Mitsubishi ECODAN 5kW PUHZ-W50VHA-BS

Secondary heating system: None

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5 Cylinder insulation
Hot water storage: Measured cylinder loss: 1.20 kWh/day
Permitted by DBSCG 2.03 OK
Primary pipework insulated: Yes OK

---

6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: Cylinderstat OK
Independent timer for DHW OK

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7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK

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8 Mechanical ventilation
Continuous supply and extract system
Specific fan power: 0.52
Maximum 1.5 OK
MVHR efficiency: 92%
Minimum: 70% OK

---

9 Summertime temperature
Overheating risk (Thames Valley): Medium OK
Based on:
Overshading: Average
Windows facing North East: 3.00 m², No overhang
Windows facing South: 8.33 m², No overhang
Windows facing South West: 7.00 m², No overhang
Windows facing North West: 9.99 m², No overhang
Air change rate: 3.00 ach
Blinds/curtains: None

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10 Key features
Party wall U-value 0.00 W/m²K
Roof U-value 0.10 W/m²K
Door U-value 1.00 W/m²K
Air permeability 3.5 m³/m²h
Photovoltaic array 0.14 kW

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	98.9700 (1b)	x	2.5000 (2b)	=	247.4250	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	98.9700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	247.4250	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent 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)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Measured/design AP50		3.5000	
Infiltration rate		0.1750	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1619	(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	0.2064	0.2023	0.1983	0.1781	0.1740	0.1538	0.1538	0.1497	0.1619	0.1740	0.1821	0.1902	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation:	0.5000	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	78.2000	(23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.3154	0.3113	0.3073	0.2871	0.2830	0.2628	0.2628	0.2587	0.2709	0.2830	0.2911	0.2992	(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	
Window (Uw = 1.30)			28.3200	1.2357	34.9962			(27)
Front Door			2.1400	1.0000	2.1400			(26)
External Wall 1	68.9900	30.4600	38.5300	0.1800	6.9354			(29a)
Wall to Corridor	29.7800		29.7800	0.1800	5.3604			(29a)
External Roof 1	98.9700		98.9700	0.1000	9.8970			(30)
Total net area of external elements Aum(A, m2)			197.7400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		59.3290			(33)
Party Wall 1			5.0000	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	19.8866 (36)
Total fabric heat loss (33) + (36) =	79.2156 (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	25.7517	25.4213	25.0909	23.4387	23.1083	21.4562	21.4562	21.1257	22.1170	23.1083	23.7692	24.4300	(38)
Heat transfer coeff	104.9673	104.6369	104.3065	102.6543	102.3239	100.6718	100.6718	100.3413	101.3326	102.3239	102.9848	103.6456	(39)

Average = Sum(39)m / 12 =	102.5717 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0606	1.0573	1.0539	1.0372	1.0339	1.0172	1.0172	1.0139	1.0239	1.0339	1.0406	1.0472	(40)
HLP (average)												1.0364	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.7298 (42)
Average daily hot water use (litres/day)	99.0324 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.9356	104.9743	101.0130	97.0517	93.0904	89.1291	89.1291	93.0904	97.0517	101.0130	104.9743	108.9356	(44)
Energy conte	161.5484	141.2912	145.7999	127.1119	121.9669	105.2481	97.5279	111.9147	113.2513	131.9834	144.0702	156.4510	(45)
Energy content (annual)										Total = Sum(45)m =		1558.1648	(45)
Distribution loss (46)m = 0.15 x (45)m	24.2323	21.1937	21.8700	19.0668	18.2950	15.7872	14.6292	16.7872	16.9877	19.7975	21.6105	23.4676	(46)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Water storage loss:
Store volume 170.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): 1.2000 (48)
Temperature factor from Table 2b 0.5400 (49)
Enter (49) or (54) in (55) 0.6480 (55)
Total storage loss

	20.0880	18.1440	20.0880	19.4400	20.0880	19.4400	20.0880	20.0880	19.4400	20.0880	19.4400	20.0880 (56)

If cylinder contains dedicated solar storage

	20.0880	18.1440	20.0880	19.4400	20.0880	19.4400	20.0880	20.0880	19.4400	20.0880	19.4400	20.0880 (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)

Total heat required for water heating calculated for each month

	204.8988	180.4464	189.1503	169.0639	165.3173	147.2001	140.8783	155.2651	155.2033	175.3338	186.0222	199.8014 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)

Solar input (sum of months) = Sum(63)m = 0.0000 (63)

Output from w/h

	204.8988	180.4464	189.1503	169.0639	165.3173	147.2001	140.8783	155.2651	155.2033	175.3338	186.0222	199.8014 (64)

Total per year (kWh/year) = Sum(64)m = 2068.5808 (64)

Heat gains from water heating, kWh/month

	88.3952	78.3035	83.1588	75.8263	75.2343	68.5566	67.1083	71.8919	71.2176	78.5648	81.4650	86.7003 (65)

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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	136.4892	136.4892	136.4892	136.4892	136.4892	136.4892	136.4892	136.4892	136.4892	136.4892	136.4892	136.4892	(66)

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

	22.7024	20.1641	16.3985	12.4147	9.2802	7.8347	8.4657	11.0040	14.7695	18.7533	21.8879	23.3334	(67)

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

	254.6518	257.2943	250.6353	236.4591	218.5642	201.7455	190.5096	187.8671	194.5261	208.7023	226.5972	243.4159	(68)

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

	36.6489	36.6489	36.6489	36.6489	36.6489	36.6489	36.6489	36.6489	36.6489	36.6489	36.6489	36.6489	(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)

	-109.1914	-109.1914	-109.1914	-109.1914	-109.1914	-109.1914	-109.1914	-109.1914	-109.1914	-109.1914	-109.1914	-109.1914	(71)

Water heating gains (Table 5)

	118.8107	116.5231	111.7726	105.3143	101.1214	95.2175	90.1994	96.6290	98.9134	105.5979	113.1458	116.5326	(72)

Total internal gains

	460.1116	457.9282	442.7531	418.1349	392.9125	368.7445	353.1214	359.4468	372.1558	397.0003	425.5776	447.2286	(73)

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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	
Northeast	3.0000	11.2829	0.4500	0.8000	0.7700	8.4446	(75)
South	8.3300	46.7521	0.4500	0.8000	0.7700	97.1587	(78)
Southwest	7.0000	36.7938	0.4500	0.8000	0.7700	64.2553	(79)
Northwest	9.9900	11.2829	0.4500	0.8000	0.7700	28.1205	(81)

Solar gains	197.9791	343.0008	486.5448	634.8669	742.5861	751.6679	718.6294	635.6572	537.2890	383.5515	238.1376	168.8041	(83)
Total gains	658.0907	800.9289	929.2979	1053.0018	1135.4986	1120.4124	1071.7508	995.1041	909.4449	780.5518	663.7152	616.0327	(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, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	65.4767	65.6835	65.8916	66.9520	67.1682	68.2706	68.2706	68.4954	67.8253	67.1682	66.7372	66.3117	
alpha	5.3651	5.3789	5.3928	5.4635	5.4779	5.5514	5.5514	5.5664	5.5217	5.4779	5.4491	5.4208	
util living area	0.9967	0.9903	0.9708	0.9059	0.7624	0.5634	0.4115	0.4604	0.7181	0.9436	0.9918	0.9977	(86)
Tweekday	18.6256	18.9147	19.3050	19.7403	19.9798	20.0612	20.0684	20.0705	20.0310	19.7018	19.0890	18.5881	
Tweekend	20.3159	20.4437	20.6190	20.8195	20.9462	20.9918	20.9988	20.9978	20.9710	20.7947	20.5160	20.2957	
24 / 16	9	8	9	8	9	9	9	9	8	9	8	9	
24 / 9	22	20	22	22	22	21	22	22	22	22	22	22	
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	20.0331	20.0359	20.0386	20.0524	20.0552	20.0690	20.0690	20.0718	20.0635	20.0552	20.0497	20.0442	(88)
util rest of house	0.9957	0.9872	0.9615	0.8783	0.7062	0.4865	0.3254	0.3693	0.6394	0.9206	0.9887	0.9969	(89)
Tweekday	18.6256	18.9147	19.3050	19.7403	19.9798	20.0612	20.0684	20.0705	20.0310	19.7018	19.0890	18.5881	
Tweekend	18.6256	18.9147	19.3050	19.7403	19.9798	20.0612	20.0684	20.0705	20.0310	19.7018	19.0890	18.5881	
MIT 2	20.0331	20.0359	20.0386	20.0524	20.0552	20.0690	20.0690	20.0718	20.0635	20.0552	20.0497	20.0442	(90)

Living area fraction fLA = Living area / (4) = 0.3966 (91)

MIT	20.4166	20.4182	20.4199	20.4282	20.4299	20.4382	20.4382	20.4399	20.4349	20.4299	20.4266	20.4232	(92)

Temperature adjustment 0.0000

adjusted MIT	20.4166	20.4182	20.4199	20.4282	20.4299	20.4382	20.4382	20.4399	20.4349	20.4299	20.4266	20.4232	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9961	0.9886	0.9656	0.8901	0.7295	0.5175	0.3597	0.4057	0.6720	0.9308	0.9901	0.9973	(94)
Useful gains	655.5470	791.7617	897.2988	937.2776	828.3636	579.8530	385.5434	403.7451	611.1732	726.5090	657.1123	614.3414	(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	1691.7145	1623.7806	1451.9358	1183.4216	893.2760	587.7457	386.4021	405.3701	641.9314	1005.8323	1372.4319	1681.4661	(97)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	770.9087	559.1167	412.6499	177.2237	48.2948	0.0000	0.0000	0.0000	0.0000	207.8165	515.0301	793.9408	(98)
Space heating												3484.9811	(98)
Space heating per m2											(98) / (4) =	35.2125	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												316.0234	(206)
Efficiency of secondary/supplementary heating system, %												100.0000	(208)
Space heating requirement												1102.7605	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	770.9087	559.1167	412.6499	177.2237	48.2948	0.0000	0.0000	0.0000	0.0000	207.8165	515.0301	793.9408	(98)
Space heating efficiency (main heating system 1)													
	316.0234	316.0234	316.0234	316.0234	316.0234	0.0000	0.0000	0.0000	0.0000	316.0234	316.0234	316.0234	(210)
Space heating fuel (main heating system)													
	243.9404	176.9226	130.5757	56.0793	15.2820	0.0000	0.0000	0.0000	0.0000	65.7599	162.9721	251.2285	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	204.8988	180.4464	189.1503	169.0639	165.3173	147.2001	140.8783	155.2651	155.2033	175.3338	186.0222	199.8014	(64)
Efficiency of water heater												178.1250	(216)
(217)m	178.1250	178.1250	178.1250	178.1250	178.1250	178.1250	178.1250	178.1250	178.1250	178.1250	178.1250	178.1250	(217)
Fuel for water heating, kWh/month													
	115.0309	101.3033	106.1896	94.9131	92.8097	82.6387	79.0896	87.1663	87.1317	98.4330	104.4335	112.1692	(219)
Water heating fuel used												1161.3085	(219)
Annual totals kWh/year													
Space heating fuel - main system												1102.7605	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.6500)													
mechanical ventilation fans (SFP = 0.6500)												196.2080	(230a)
Total electricity for the above, kWh/year												196.2080	(231)
Electricity for lighting (calculated in Appendix L)												400.9313	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 0.14 * 951 * 1.00) =												-106.4690	(233)
Total delivered energy for all uses												2754.7395	(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	1102.7605	0.5190	572.3327	(261)
Space heating - secondary	0.0000	0.5190	0.0000	(263)
Water heating (other fuel)	1161.3085	0.5190	602.7191	(264)
Space and water heating			1175.0518	(265)
Pumps and fans	196.2080	0.5190	101.8320	(267)
Energy for lighting	400.9313	0.5190	208.0834	(268)
Energy saving/generation technologies				
PV Unit	-106.4690	0.5190	-55.2574	(269)
Total CO2, kg/year			1429.7098	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			14.4500	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		14.4500	ZC1
Total Floor Area	TFA	98.9700	
Assumed number of occupants	N	2.7298	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		15.2472	ZC2
CO2 emissions from cooking, equation (L16)		1.8644	ZC3
Total CO2 emissions		31.5615	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		31.5615	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	98.9700 (1b)	x	2.5000 (2b)	=	247.4250	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	98.9700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	247.4250	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent 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)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1212	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3712	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3434	(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	0.4378	0.4293	0.4207	0.3777	0.3692	0.3262	0.3262	0.3176	0.3434	0.3692	0.3863	0.4035	(22b)
Effective ac	0.5959	0.5921	0.5885	0.5713	0.5681	0.5532	0.5532	0.5505	0.5590	0.5681	0.5746	0.5814	(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	
TER Opaque door			2.1400	1.0000	2.1400			(26)
TER Opening Type (Uw = 1.40)			22.6000	1.3258	29.9621			(27)
External Wall 1	68.9900	24.7400	44.2500	0.1800	7.9650			(29a)
Wall to Corridor	29.7800		29.7800	0.1800	5.3604			(29a)
External Roof 1	98.9700		98.9700	0.1300	12.8661			(30)
Total net area of external elements Aum(A, m2)			197.7400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		58.2936			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							22.0531	(36)
Total fabric heat loss					(33) + (36) =		80.3467	(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	48.6515	48.3476	48.0497	46.6505	46.3888	45.1701	45.1701	44.9444	45.6395	46.3888	46.9183	47.4720	(38)
Heat transfer coeff	128.9982	128.6943	128.3964	126.9973	126.7355	125.5168	125.5168	125.2912	125.9862	126.7355	127.2651	127.8187	(39)
Average = Sum(39)m / 12 =												126.9960	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3034	1.3003	1.2973	1.2832	1.2805	1.2682	1.2682	1.2660	1.2730	1.2805	1.2859	1.2915	(40)
HLP (average)												1.2832	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.7298 (42)
Average daily hot water use (litres/day)		99.0324 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.9356	104.9743	101.0130	97.0517	93.0904	89.1291	89.1291	93.0904	97.0517	101.0130	104.9743	108.9356	(44)
Energy conte	161.5484	141.2912	145.7999	127.1119	121.9669	105.2481	97.5279	111.9147	113.2513	131.9834	144.0702	156.4510	(45)
Energy content (annual)										Total = Sum(45)m =		1558.1648	(45)
Distribution loss (46)m = 0.15 x (45)m	24.2323	21.1937	21.8700	19.0668	18.2950	15.7872	14.6292	16.7872	16.9877	19.7975	21.6105	23.4676	(46)

Water storage loss:		
Store volume		170.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):		1.5003 (48)
Temperature factor from Table 2b		0.5400 (49)
Enter (49) or (54) in (55)		0.8102 (55)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Total storage loss
25.1153 22.6848 25.1153 24.3051 25.1153 24.3051 25.1153 25.1153 24.3051 25.1153 24.3051 25.1153 (56)
If cylinder contains dedicated solar storage
25.1153 22.6848 25.1153 24.3051 25.1153 24.3051 25.1153 25.1153 24.3051 25.1153 24.3051 25.1153 (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)
Total heat required for water heating calculated for each month
209.9261 184.9872 194.1776 173.9290 170.3446 152.0653 145.9056 160.2924 160.0684 180.3611 190.8874 204.8287 (62)
Solar input 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (63)
Solar input (sum of months) = Sum(63)m = 0.0000 (63)
Output from w/h
209.9261 184.9872 194.1776 173.9290 170.3446 152.0653 145.9056 160.2924 160.0684 180.3611 190.8874 204.8287 (64)
Total per year (kWh/year) = Sum(64)m = 2127.7733 (64)
Heat gains from water heating, kWh/month
92.4170 81.9361 87.1806 79.7184 79.2561 72.4487 71.1302 75.9138 75.1098 82.5867 85.3571 90.7221 (65)

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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	136.4892	136.4892	136.4892	136.4892	136.4892	136.4892	136.4892	136.4892	136.4892	136.4892	136.4892	136.4892	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
22.7024 20.1641 16.3985 12.4147 9.2802 7.8347 8.4657 11.0040 14.7695 18.7533 21.8879 23.3334 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
254.6518 257.2943 250.6353 236.4591 218.5642 201.7455 190.5096 187.8671 194.5261 208.7023 226.5972 243.4159 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
36.6489 36.6489 36.6489 36.6489 36.6489 36.6489 36.6489 36.6489 36.6489 36.6489 36.6489 36.6489 (69)
Pumps, fans 3.0000 3.0000 3.0000 3.0000 3.0000 3.0000 3.0000 3.0000 3.0000 3.0000 3.0000 3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
-109.1914 -109.1914 -109.1914 -109.1914 -109.1914 -109.1914 -109.1914 -109.1914 -109.1914 -109.1914 -109.1914 -109.1914 (71)
Water heating gains (Table 5)
124.2164 121.9288 117.1783 110.7200 106.5271 100.6232 95.6051 102.0347 104.3191 111.0036 118.5515 121.9383 (72)
Total internal gains
468.5173 466.3339 451.1588 426.5406 401.3182 377.1502 361.5271 367.8525 380.5615 405.4060 433.9833 455.6343 (73)

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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	
Northeast	2.3900	11.2829	0.6300	0.7000	0.7700	8.2412	(75)
South	6.6500	46.7521	0.6300	0.7000	0.7700	95.0155	(78)
Southwest	5.5900	36.7938	0.6300	0.7000	0.7700	62.8577	(79)
Northwest	7.9700	11.2829	0.6300	0.7000	0.7700	27.4823	(81)

Solar gains 193.5967 335.3970 475.7299 620.7086 725.9859 734.8481 702.5556 621.4660 525.3305 375.0410 232.8642 165.0688 (83)
Total gains 662.1140 801.7309 926.8887 1047.2492 1127.3041 1111.9983 1064.0827 989.3185 905.8920 780.4469 666.8475 620.7031 (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, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	53.2792	53.4050	53.5289	54.1186	54.2304	54.7569	54.7569	54.8556	54.5529	54.2304	54.0047	53.7708	
alpha	4.5519	4.5603	4.5686	4.6079	4.6154	4.6505	4.6505	4.6570	4.6369	4.6154	4.6003	4.5847	
util living area	0.9968	0.9919	0.9788	0.9384	0.8397	0.6698	0.5069	0.5620	0.8052	0.9617	0.9930	0.9976	(86)
MIT	19.6206	19.8207	20.1179	20.4868	20.7849	20.9457	20.9880	20.9811	20.8702	20.4740	19.9751	19.5863	(87)
Th 2	19.8382	19.8406	19.8429	19.8540	19.8561	19.8658	19.8658	19.8676	19.8621	19.8561	19.8519	19.8475	(88)
util rest of house	0.9957	0.9891	0.9713	0.9161	0.7845	0.5717	0.3824	0.4338	0.7214	0.9432	0.9901	0.9968	(89)
MIT 2	18.0194	18.3122	18.7427	19.2682	19.6535	19.8315	19.8617	19.8603	19.7636	19.2629	18.5463	17.9759	(90)
Living area fraction									fLA = Living area / (4) =			0.3966	(91)
MIT	18.6544	18.9105	19.2881	19.7515	20.1022	20.2734	20.3084	20.3048	20.2025	19.7432	19.1129	18.6146	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6544	18.9105	19.2881	19.7515	20.1022	20.2734	20.3084	20.3048	20.2025	19.7432	19.1129	18.6146	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9940	0.9861	0.9667	0.9137	0.7977	0.6089	0.4321	0.4849	0.7492	0.9409	0.9875	0.9955	(94)
Useful gains	658.1591	790.5557	895.9960	956.9208	899.2771	677.0525	459.8138	479.7490	678.7253	734.3228	658.4970	617.8904	(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	1851.6932	1803.0688	1641.9438	1378.1106	1064.8558	712.1063	465.4661	489.2373	768.8257	1158.7674	1528.8252	1842.4494	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	887.9893	680.4088	554.9852	303.2566	123.1906	0.0000	0.0000	0.0000	0.0000	315.7868	626.6363	911.0720	(98)
Space heating												4403.3256	(98)
Space heating per m2											(98) / (4) =	44.4915	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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 %)												93.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4709.4392	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	887.9893	680.4088	554.9852	303.2566	123.1906	0.0000	0.0000	0.0000	0.0000	315.7868	626.6363	911.0720	(98)
Space heating efficiency (main heating system 1)													
	93.5000	93.5000	93.5000	93.5000	93.5000	0.0000	0.0000	0.0000	0.0000	93.5000	93.5000	93.5000	(210)
Space heating fuel (main heating system)													
	949.7212	727.7100	593.5671	324.3386	131.7547	0.0000	0.0000	0.0000	0.0000	337.7399	670.1993	974.4085	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	209.9261	184.9872	194.1776	173.9290	170.3446	152.0653	145.9056	160.2924	160.0684	180.3611	190.8874	204.8287	(64)
Efficiency of water heater												79.8000	(216)
(217)m	88.2378	87.9784	87.4604	86.2831	83.9664	79.8000	79.8000	79.8000	79.8000	86.2938	87.7526	88.3261	(217)
Fuel for water heating, kWh/month													
	237.9095	210.2645	222.0177	201.5794	202.8724	190.5580	182.8391	200.8676	200.5870	209.0083	217.5290	231.9004	(219)
Water heating fuel used												2507.9328	(219)
Annual totals kWh/year													
Space heating fuel - main system												4709.4392	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												400.9313	(232)
Total delivered energy for all uses												7693.3033	(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	4709.4392	0.2160	1017.2389	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2507.9328	0.2160	541.7135	(264)
Space and water heating			1558.9523	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	400.9313	0.5190	208.0834	(268)
Total CO2, kg/m2/year			1805.9607	(272)
Emissions per m2 for space and water heating			15.7518	(272a)
Fuel factor (electricity)			1.5500	
Emissions per m2 for lighting			2.1025	(272b)
Emissions per m2 for pumps and fans			0.3933	(272c)
Target Carbon Dioxide Emission Rate (TER) = (15.7518 * 1.55) + 2.1025 + 0.3933, rounded to 2 d.p.			26.9100	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	98.9700 (1b)	x	2.5000 (2b)	=	247.4250	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	98.9700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	247.4250	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent 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)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1212	(8)
Pressure test		Yes	
Measured/design AP50		3.5000	
Infiltration rate		0.2962	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2740	(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	0.3494	0.3425	0.3357	0.3014	0.2946	0.2603	0.2603	0.2535	0.2740	0.2946	0.3083	0.3220	(22b)
Effective ac	0.5610	0.5587	0.5563	0.5454	0.5434	0.5339	0.5339	0.5321	0.5375	0.5434	0.5475	0.5518	(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	
Window (Uw = 1.30)			28.3200	1.2357	34.9962			(27)
Front Door			2.1400	1.0000	2.1400			(26)
External Wall 1	68.9900	30.4600	38.5300	0.1800	6.9354			(29a)
Wall to Corridor	29.7800		29.7800	0.1800	5.3604			(29a)
External Roof 1	98.9700		98.9700	0.1000	9.8970			(30)
Total net area of external elements Aum(A, m2)			197.7400					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	59.3290			(33)
Party Wall 1			5.0000	0.0000	0.0000			(32)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							19.8866	(36)
Total fabric heat loss						(33) + (36) =	79.2156	(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	45.8087	45.6152	45.4255	44.5346	44.3679	43.5919	43.5919	43.4482	43.8908	44.3679	44.7051	45.0577	(38)
Heat transfer coeff	125.0243	124.8308	124.6411	123.7502	123.5835	122.8075	122.8075	122.6638	123.1064	123.5835	123.9207	124.2733	(39)
Average = Sum(39)m / 12 =												123.7494	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2633	1.2613	1.2594	1.2504	1.2487	1.2409	1.2409	1.2394	1.2439	1.2487	1.2521	1.2557	(40)
HLP (average)												1.2504	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.7298	(42)
Average daily hot water use (litres/day)												99.0324	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.9356	104.9743	101.0130	97.0517	93.0904	89.1291	89.1291	93.0904	97.0517	101.0130	104.9743	108.9356	(44)
Energy conte	161.5484	141.2912	145.7999	127.1119	121.9669	105.2481	97.5279	111.9147	113.2513	131.9834	144.0702	156.4510	(45)
Energy content (annual)										Total = Sum(45)m =		1558.1648	(45)
Distribution loss (46)m = 0.15 x (45)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	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
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)
Heat gains from water heating, kWh/month													
	34.3290	30.0244	30.9825	27.0113	25.9180	22.3652	20.7247	23.7819	24.0659	28.0465	30.6149	33.2458	(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	136.4892	136.4892	136.4892	136.4892	136.4892	136.4892	136.4892	136.4892	136.4892	136.4892	136.4892	136.4892	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	22.7024	20.1641	16.3985	12.4147	9.2802	7.8347	8.4657	11.0040	14.7695	18.7533	21.8879	23.3334	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	254.6518	257.2943	250.6353	236.4591	218.5642	201.7455	190.5096	187.8671	194.5261	208.7023	226.5972	243.4159	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.6489	36.6489	36.6489	36.6489	36.6489	36.6489	36.6489	36.6489	36.6489	36.6489	36.6489	36.6489	(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)													
	-109.1914	-109.1914	-109.1914	-109.1914	-109.1914	-109.1914	-109.1914	-109.1914	-109.1914	-109.1914	-109.1914	-109.1914	(71)
Water heating gains (Table 5)													
	46.1412	44.6791	41.6431	37.5157	34.8360	31.0628	27.8557	31.9649	33.4249	37.6969	42.5207	44.6853	(72)
Total internal gains													
	387.4421	386.0843	372.6237	350.3363	326.6271	304.5898	290.7778	294.7828	306.6673	329.0993	354.9526	375.3813	(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	
Northeast	3.0000	11.2829	0.4500	0.8000	0.7700	8.4446	(75)
South	8.3300	46.7521	0.4500	0.8000	0.7700	97.1587	(78)
Southwest	7.0000	36.7938	0.4500	0.8000	0.7700	64.2553	(79)
Northwest	9.9900	11.2829	0.4500	0.8000	0.7700	28.1205	(81)

Solar gains	197.9791	343.0008	486.5448	634.8669	742.5861	751.6679	718.6294	635.6572	537.2890	383.5515	238.1376	168.8041	(83)
Total gains	585.4212	729.0850	859.1685	985.2032	1069.2132	1056.2577	1009.4072	930.4400	843.9563	712.6508	593.0902	544.1853	(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	54.9726	55.0579	55.1416	55.5386	55.6136	55.9650	55.9650	56.0305	55.8291	55.6136	55.4622	55.3049	
alpha	4.6648	4.6705	4.6761	4.7026	4.7076	4.7310	4.7310	4.7354	4.7219	4.7076	4.6975	4.6870	
util living area													
	0.9981	0.9944	0.9836	0.9474	0.8532	0.6865	0.5220	0.5827	0.8279	0.9713	0.9956	0.9986	(86)
MIT	19.6020	19.8051	20.1047	20.4744	20.7790	20.9432	20.9875	20.9794	20.8594	20.4471	19.9454	19.5622	(87)
Th 2	19.8697	19.8713	19.8728	19.8799	19.8812	19.8875	19.8875	19.8886	19.8851	19.8812	19.8785	19.8757	(88)
util rest of house													
	0.9974	0.9924	0.9776	0.9278	0.8010	0.5895	0.3968	0.4536	0.7487	0.9568	0.9938	0.9982	(89)
MIT 2	18.6028	18.8061	19.1035	19.4655	19.7371	19.8626	19.8845	19.8831	19.8102	19.4477	18.9524	18.5678	(90)
Living area fraction										fLA = Living area / (4) =		0.3966	(91)
MIT	18.9991	19.2022	19.5006	19.8656	20.1503	20.2911	20.3219	20.3179	20.2263	19.8440	19.3462	18.9621	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9991	19.2022	19.5006	19.8656	20.1503	20.2911	20.3219	20.3179	20.2263	19.8440	19.3462	18.9621	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9967	0.9909	0.9751	0.9275	0.8149	0.6267	0.4469	0.5053	0.7759	0.9562	0.9926	0.9976	(94)
Useful gains	583.4981	722.4636	837.8129	913.8164	871.3428	661.9269	451.1216	470.1724	654.7850	681.4687	588.6923	542.8981	(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													
	1837.7397	1785.3607	1620.4043	1356.9998	1044.3159	698.9114	457.0777	480.5814	754.1828	1142.4112	1517.5594	1834.5385	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	933.1558	714.2669	582.2480	319.0920	128.6920	0.0000	0.0000	0.0000	0.0000	342.9412	668.7843	960.9805	(98)
Space heating												4650.1606	(98)
Space heating per m2											(98) / (4) =	46.9856	(99)

8c. Space cooling requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1154.3903	908.7754	932.2447	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8807	0.9336	0.9099	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1016.6443	848.4297	848.2168	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1339.0393	1282.0232	1191.5537	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	232.1244	322.5936	255.4427	0.0000	0.0000	0.0000	0.0000	(104)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Space cooling												810.1607 (104)
Cooled fraction											fC = cooled area / (4) =	1.0000 (105)
Intermittency factor (Table 10b)												
0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000		0.0000 (106)
Space cooling kWh												
0.0000	0.0000	0.0000	0.0000	0.0000	58.0311	80.6484	63.8607	0.0000	0.0000	0.0000		0.0000 (107)
Space cooling												202.5402 (107)
Space cooling per m2												2.0465 (108)
Energy for space heating												46.9856 (99)
Energy for space cooling												2.0465 (108)
Total												49.0320 (109)
Dwelling Fabric Energy Efficiency (DFEE)												49.0 (109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	98.9700 (1b)	x	2.5000 (2b)	=	247.4250	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	98.9700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	247.4250	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent 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)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1212	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3712	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3434	(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	0.4378	0.4293	0.4207	0.3777	0.3692	0.3262	0.3262	0.3176	0.3434	0.3692	0.3863	0.4035	(22b)
Effective ac	0.5959	0.5921	0.5885	0.5713	0.5681	0.5532	0.5532	0.5505	0.5590	0.5681	0.5746	0.5814	(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	
TER Opaque door			2.1400	1.0000	2.1400			(26)
TER Opening Type (Uw = 1.40)			22.6000	1.3258	29.9621			(27)
External Wall 1	68.9900	24.7400	44.2500	0.1800	7.9650			(29a)
Wall to Corridor	29.7800		29.7800	0.1800	5.3604			(29a)
External Roof 1	98.9700		98.9700	0.1300	12.8661			(30)
Total net area of external elements Aum(A, m2)			197.7400					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	58.2936			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							22.0531	(36)
Total fabric heat loss					(33) + (36) =		80.3467	(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	48.6515	48.3476	48.0497	46.6505	46.3888	45.1701	45.1701	44.9444	45.6395	46.3888	46.9183	47.4720	(38)
Heat transfer coeff	128.9982	128.6943	128.3964	126.9973	126.7355	125.5168	125.5168	125.2912	125.9862	126.7355	127.2651	127.8187	(39)
Average = Sum(39)m / 12 =												126.9960	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3034	1.3003	1.2973	1.2832	1.2805	1.2682	1.2682	1.2660	1.2730	1.2805	1.2859	1.2915	(40)
HLP (average)												1.2832	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.7298 (42)
Average daily hot water use (litres/day)		99.0324 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.9356	104.9743	101.0130	97.0517	93.0904	89.1291	89.1291	93.0904	97.0517	101.0130	104.9743	108.9356	(44)
Energy conte	161.5484	141.2912	145.7999	127.1119	121.9669	105.2481	97.5279	111.9147	113.2513	131.9834	144.0702	156.4510	(45)
Energy content (annual)										Total = Sum(45)m =		1558.1648	(45)
Distribution loss (46)m = 0.15 x (45)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	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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)
Heat gains from water heating, kWh/month													
	34.3290	30.0244	30.9825	27.0113	25.9180	22.3652	20.7247	23.7819	24.0659	28.0465	30.6149	33.2458	(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	136.4892	136.4892	136.4892	136.4892	136.4892	136.4892	136.4892	136.4892	136.4892	136.4892	136.4892	136.4892	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	22.7024	20.1641	16.3985	12.4147	9.2802	7.8347	8.4657	11.0040	14.7695	18.7533	21.8879	23.3334	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	254.6518	257.2943	250.6353	236.4591	218.5642	201.7455	190.5096	187.8671	194.5261	208.7023	226.5972	243.4159	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.6489	36.6489	36.6489	36.6489	36.6489	36.6489	36.6489	36.6489	36.6489	36.6489	36.6489	36.6489	(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)													
	-109.1914	-109.1914	-109.1914	-109.1914	-109.1914	-109.1914	-109.1914	-109.1914	-109.1914	-109.1914	-109.1914	-109.1914	(71)
Water heating gains (Table 5)													
	46.1412	44.6791	41.6431	37.5157	34.8360	31.0628	27.8557	31.9649	33.4249	37.6969	42.5207	44.6853	(72)
Total internal gains													
	387.4421	386.0843	372.6237	350.3363	326.6271	304.5898	290.7778	294.7828	306.6673	329.0993	354.9526	375.3813	(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	
Northeast	2.3900	11.2829	0.6300	0.7000	0.7700	8.2412	(75)
South	6.6500	46.7521	0.6300	0.7000	0.7700	95.0155	(78)
Southwest	5.5900	36.7938	0.6300	0.7000	0.7700	62.8577	(79)
Northwest	7.9700	11.2829	0.6300	0.7000	0.7700	27.4823	(81)

Solar gains	193.5967	335.3970	475.7299	620.7086	725.9859	734.8481	702.5556	621.4660	525.3305	375.0410	232.8642	165.0688	(83)
Total gains	581.0388	721.4813	848.3536	971.0449	1052.6129	1039.4379	993.3334	916.2488	831.9977	704.1402	587.8168	540.4501	(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	53.2792	53.4050	53.5289	54.1186	54.2304	54.7569	54.7569	54.8556	54.5529	54.2304	54.0047	53.7708	
alpha	4.5519	4.5603	4.5686	4.6079	4.6154	4.6505	4.6505	4.6570	4.6369	4.6154	4.6003	4.5847	
util living area													
	0.9981	0.9947	0.9848	0.9519	0.8650	0.7038	0.5393	0.6000	0.8401	0.9734	0.9958	0.9987	(86)
MIT	19.5467	19.7491	20.0516	20.4327	20.7515	20.9333	20.9846	20.9753	20.8419	20.4136	19.9039	19.5128	(87)
Th 2	19.8382	19.8406	19.8429	19.8540	19.8561	19.8658	19.8658	19.8676	19.8621	19.8561	19.8519	19.8475	(88)
util rest of house													
	0.9975	0.9928	0.9792	0.9335	0.8144	0.6053	0.4087	0.4663	0.7623	0.9598	0.9940	0.9982	(89)
MIT 2	18.5228	18.7262	19.0274	19.4050	19.6926	19.8363	19.8621	19.8609	19.7770	19.3952	18.8902	18.4963	(90)
Living area fraction										fLA = Living area / (4) =		0.3966	(91)
MIT	18.9289	19.1319	19.4336	19.8126	20.1125	20.2714	20.3073	20.3029	20.1993	19.7991	19.2922	18.8994	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9289	19.1319	19.4336	19.8126	20.1125	20.2714	20.3073	20.3029	20.1993	19.7991	19.2922	18.8994	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9967	0.9913	0.9767	0.9327	0.8271	0.6428	0.4610	0.5199	0.7884	0.9589	0.9928	0.9976	(94)
Useful gains	579.1496	715.1990	828.5925	905.7252	870.6510	668.1233	457.9511	476.3875	655.9625	675.2286	583.5990	539.1769	(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													
	1887.1003	1831.5613	1660.6261	1385.8708	1066.1643	711.8504	465.3259	488.9937	768.4304	1165.8524	1551.6422	1878.8647	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	973.1153	750.1955	619.0330	345.7048	145.4619	0.0000	0.0000	0.0000	0.0000	365.0241	696.9911	996.7277	(98)
Space heating												4892.2534	(98)
Space heating per m2											(98) / (4) =	49.4317	(99)

8c. Space cooling requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1179.8582	928.8246	952.2128	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8657	0.9231	0.8976	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1021.4011	857.4240	854.6966	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1319.3798	1263.2357	1174.9666	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	214.5446	301.9239	238.2809	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												754.7494	(104)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Cooled fraction											fC = cooled area / (4) =	1.0000 (105)
Intermittency factor (Table 10b)												
0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh												
0.0000	0.0000	0.0000	0.0000	0.0000	53.6362	75.4810	59.5702	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												188.6873 (107)
Space cooling per m2												1.9065 (108)
Energy for space heating												49.4317 (99)
Energy for space cooling												1.9065 (108)
Total												51.3382 (109)
Target Fabric Energy Efficiency (TFEE)												59.0 (109)

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

HODKINSON

Property Reference	B.06.03 Wootton	**Issued on Date**	26/11/2020
Assessment Reference	B.06.03 Wootton HP	**Prop Type Ref**	Blk B 2B4P (Mid floor)
Property			

SAP Rating	87 B	**DER**	15.09	**TER**	22.24
Environmental	89 B	**% DER<TER**	32.16		
CO_2 Emissions (t/year)	0.90	**DFEE**	37.44	**TFEE**	36.39
General Requirements Compliance	Fail	**% DFEE<TFEE**	-2.90		

Assessor Details	Mr. Jonathan Peck, Jonathan Peck, Tel: 02036031622, Jonathan@hodkinsonconsultancy.com	**Assessor ID**	M976-0001
Client			

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

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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England
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DWELLING AS DESIGNED

Mid-floor flat, total floor area 73 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Electricity
Fuel factor:1.55 (electricity)
Target Carbon Dioxide Emission Rate (TER) 22.24 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 15.09 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)36.4 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)37.4 kWh/m²/yrFail
Excess energy =1.0 kWh/m²/yr (2.7%)

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2 Fabric U-values

Element	Average	Highest	
External wall	0.18 (max. 0.30)	0.18 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	(no floor)		
Roof	(no roof)		
Openings	1.27 (max. 2.00)	1.30 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

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3 Air permeability
Air permeability at 50 pascals: 3.50 (design value)
Maximum 10.0 OK

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4 Heating efficiency
Main heating system: Heat pump with radiators or underfloor - Electric
Mitsubishi ECODAN 5kW PUHZ-W50VHA-BS

Secondary heating system: None

---
5 Cylinder insulation
Hot water storage Measured cylinder loss: 1.20 kWh/day
Permitted by DBSCG 2.03 OK
Primary pipework insulated: Yes OK

---
6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: Cylinderstat OK
Independent timer for DHW OK

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7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK

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8 Mechanical ventilation
Continuous supply and extract system
Specific fan power: 0.52
Maximum 1.5 OK
MVHR efficiency: 92%
Minimum: 70% OK

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9 Summertime temperature
Overheating risk (Thames Valley): Medium OK
Based on:
Overshading: Average
Windows facing North East: 9.99 m², No overhang
Windows facing South East: 11.93 m², No overhang
Air change rate: 3.00 ach
Blinds/curtains: None

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10 Key features
Party wall U-value 0.00 W/m²K
Door U-value 1.00 W/m²K
Air permeability 3.5 m³/m²h
Photovoltaic array 0.14 kW

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	72.8300 (1b)	x	2.5000 (2b)	=	182.0750	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	72.8300					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	182.0750	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent 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)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Measured/design AP50		3.5000	
Infiltration rate		0.1750	(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) =	0.1488	(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	0.1897	0.1859	0.1822	0.1636	0.1599	0.1413	0.1413	0.1376	0.1488	0.1599	0.1673	0.1748	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation:	0.5000	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	78.2000	(23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.2987	0.2949	0.2912	0.2726	0.2689	0.2503	0.2503	0.2466	0.2578	0.2689	0.2763	0.2838	(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	
Front Door			2.1400	1.0000	2.1400			(26)
Window G=0.37 (Uw = 1.30)			21.9200	1.2357	27.0875			(27)
External Wall 1	42.6300	24.0600	18.5700	0.1800	3.3426			(29a)
Wall to Corridor	8.7500		8.7500	0.1800	1.5750			(29a)
Total net area of external elements Aum(A, m2)			51.3800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		34.1451			(33)
Party Wall 1			56.7000	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	7.6179	(36)
Total fabric heat loss (33) + (36) =	41.7630	(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	17.9447	17.7212	17.4978	16.3806	16.1572	15.0400	15.0400	14.8165	15.4868	16.1572	16.6040	17.0509	(38)
Heat transfer coeff	59.7076	59.4842	59.2608	58.1436	57.9201	56.8029	56.8029	56.5795	57.2498	57.9201	58.3670	58.8139	(39)
Average = Sum(39)m / 12 =												58.0877	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.8198	0.8168	0.8137	0.7983	0.7953	0.7799	0.7799	0.7769	0.7861	0.7953	0.8014	0.8076	(40)
HLP (average)												0.7976	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.3128 (42)
Average daily hot water use (litres/day)	89.1296 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	98.0425	94.4773	90.9122	87.3470	83.7818	80.2166	80.2166	83.7818	87.3470	90.9122	94.4773	98.0425	(44)
Energy conte	145.3942	127.1627	131.2205	114.4013	109.7707	94.7238	87.7755	100.7237	101.9266	118.7857	129.6639	140.8066	(45)
Energy content (annual)											Total = Sum(45)m =	1402.3552	(45)
Distribution loss (46)m = 0.15 x (45)m	21.8091	19.0744	19.6831	17.1602	16.4656	14.2086	13.1663	15.1086	15.2890	17.8179	19.4496	21.1210	(46)

Water storage loss:

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Store volume												170.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.2000	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.6480	(55)
Total storage loss													
	20.0880	18.1440	20.0880	19.4400	20.0880	19.4400	20.0880	20.0880	19.4400	20.0880	19.4400	20.0880	(56)
If cylinder contains dedicated solar storage													
	20.0880	18.1440	20.0880	19.4400	20.0880	19.4400	20.0880	20.0880	19.4400	20.0880	19.4400	20.0880	(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)
Total heat required for water heating calculated for each month													
	188.7446	166.3179	174.5709	156.3533	153.1211	136.6758	131.1259	144.0741	143.8786	162.1361	171.6159	184.1570	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
Solar input (sum of months) = Sum(63)m =												0.0000	(63)
Output from w/h													
	188.7446	166.3179	174.5709	156.3533	153.1211	136.6758	131.1259	144.0741	143.8786	162.1361	171.6159	184.1570	(64)
Total per year (kWh/year) = Sum(64)m =												1912.7712	(64)
Heat gains from water heating, kWh/month													
	83.0239	73.6058	78.3112	71.6000	71.1791	65.0573	63.8657	68.1709	67.4522	74.1766	76.6748	81.4985	(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	115.6412	115.6412	115.6412	115.6412	115.6412	115.6412	115.6412	115.6412	115.6412	115.6412	115.6412	115.6412	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	18.1698	16.1383	13.1245	9.9361	7.4274	6.2705	6.7755	8.8070	11.8208	15.0092	17.5179	18.6748	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	203.8099	205.9249	200.5954	189.2495	174.9273	161.4665	152.4739	150.3590	155.6885	167.0344	181.3565	194.8173	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	34.5641	34.5641	34.5641	34.5641	34.5641	34.5641	34.5641	34.5641	34.5641	34.5641	34.5641	34.5641	(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)													
	-92.5130	-92.5130	-92.5130	-92.5130	-92.5130	-92.5130	-92.5130	-92.5130	-92.5130	-92.5130	-92.5130	-92.5130	(71)
Water heating gains (Table 5)													
	111.5913	109.5324	105.2569	99.4445	95.6708	90.3573	85.8410	91.6276	93.6836	99.6997	106.4928	109.5410	(72)
Total internal gains													
	391.2634	389.2879	376.6692	356.3224	335.7179	315.7867	302.7827	308.4860	318.8853	339.4356	363.0596	380.7255	(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	
Northeast	9.9900	11.2829	0.3500	0.8000	0.7700	21.8715	(75)
Southeast	11.9300	36.7938	0.3500	0.8000	0.7700	85.1739	(77)

Solar gains	107.0455	189.6029	278.7196	377.6914	452.5681	462.2812	440.2843	382.4376	312.6812	214.7544	129.5388	90.7525	(83)
Total gains	498.3088	578.8907	655.3888	734.0138	788.2860	778.0679	743.0670	690.9236	631.5665	554.1900	492.5984	471.4780	(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	84.7067	85.0249	85.3455	86.9854	87.3209	89.0384	89.0384	89.3900	88.3434	87.3209	86.6524	85.9940	
alpha	6.6471	6.6683	6.6897	6.7990	6.8214	6.9359	6.9359	6.9593	6.8896	6.8214	6.7768	6.7329	
util living area													
	0.9950	0.9859	0.9557	0.8526	0.6664	0.4660	0.3362	0.3764	0.6160	0.9054	0.9864	0.9964	(86)
Tweekday	19.3189	19.5471	19.8475	20.1389	20.2413	20.2699	20.2707	20.2733	20.2596	20.1084	19.6792	19.2910	
Tweekend	20.5554	20.6566	20.7932	20.9308	20.9881	20.9991	20.9999	20.9998	20.9947	20.9104	20.7103	20.5392	
24 / 16	9	8	9	8	9	9	9	9	8	9	8	9	
24 / 9	22	20	22	22	22	21	22	22	22	22	22	22	
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	20.2362	20.2388	20.2415	20.2548	20.2574	20.2708	20.2708	20.2734	20.2654	20.2574	20.2521	20.2468	(88)
util rest of house													
	0.9935	0.9819	0.9437	0.8212	0.6186	0.4135	0.2806	0.3171	0.5544	0.8762	0.9817	0.9953	(89)
Tweekday	19.3189	19.5471	19.8475	20.1389	20.2413	20.2699	20.2707	20.2733	20.2596	20.1084	19.6792	19.2910	
Tweekend	19.3189	19.5471	19.8475	20.1389	20.2413	20.2699	20.2707	20.2733	20.2596	20.1084	19.6792	19.2910	
MIT 2	20.2362	20.2388	20.2415	20.2548	20.2574	20.2708	20.2708	20.2734	20.2654	20.2574	20.2521	20.2468	(90)
Living area fraction									fLA = Living area / (4) =			0.3525	(91)
MIT	20.5054	20.5071	20.5088	20.5174	20.5192	20.5278	20.5278	20.5295	20.5243	20.5192	20.5157	20.5123	(92)
Temperature adjustment												0.0000	
adjusted MIT	20.5054	20.5071	20.5088	20.5174	20.5192	20.5278	20.5278	20.5295	20.5243	20.5192	20.5157	20.5123	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9941	0.9834	0.9483	0.8328	0.6358	0.4320	0.3002	0.3380	0.5764	0.8873	0.9835	0.9957	(94)
Useful gains	495.3554	569.2921	621.5084	611.2953	501.1616	336.1420	223.0727	233.5641	364.0353	491.7303	484.4767	469.4630	(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													
	967.5864	928.3770	830.1743	675.4790	510.8067	336.7156	223.1098	233.6459	367.7917	574.5188	783.0349	959.3880	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	351.3398	241.3051	155.2474	46.2123	7.1759	0.0000	0.0000	0.0000	0.0000	61.5946	214.9619	364.5042	(98)

Space heating			1442.3412 (98)
Space heating per m2		(98) / (4) =	19.8042 (99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)			0.0000 (201)
Fraction of space heat from main system(s)			1.0000 (202)
Efficiency of main space heating system 1 (in %)			210.6252 (206)
Efficiency of secondary/supplementary heating system, %			100.0000 (208)
Space heating requirement			684.7904 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	351.3398	241.3051	155.2474	46.2123	7.1759	0.0000	0.0000	0.0000	0.0000	61.5946	214.9619	364.5042	(98)
Space heating efficiency (main heating system 1)	210.6252	210.6252	210.6252	210.6252	210.6252	0.0000	0.0000	0.0000	0.0000	210.6252	210.6252	210.6252	(210)
Space heating fuel (main heating system)	166.8081	114.5661	73.7079	21.9405	3.4070	0.0000	0.0000	0.0000	0.0000	29.2437	102.0590	173.0582	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	188.7446	166.3179	174.5709	156.3533	153.1211	136.6758	131.1259	144.0741	143.8786	162.1361	171.6159	184.1570	(64)
Efficiency of water heater												178.1250	(216)
(217)m	178.1250	178.1250	178.1250	178.1250	178.1250	178.1250	178.1250	178.1250	178.1250	178.1250	178.1250	178.1250	(217)
Fuel for water heating, kWh/month	105.9619	93.3715	98.0047	87.7773	85.9627	76.7303	73.6145	80.8837	80.7740	91.0238	96.3457	103.3864	(219)
Water heating fuel used												1073.8365	(219)
Annual totals kWh/year													
Space heating fuel - main system												684.7904	(211)
Space heating fuel - secondary												0.0000	(215)

Electricity for pumps and fans:		
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.6500)		
mechanical ventilation fans (SFP = 0.6500)		144.3855 (230a)
Total electricity for the above, kWh/year		144.3855 (231)
Electricity for lighting (calculated in Appendix L)		320.8844 (232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV Unit 0 (0.80 * 0.14 * 951 * 1.00) =		-106.4690 (233)
Total delivered energy for all uses		2117.4278 (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	684.7904	0.5190	355.4062	(261)
Space heating - secondary	0.0000	0.5190	0.0000	(263)
Water heating (other fuel)	1073.8365	0.5190	557.3211	(264)
Space and water heating			912.7273	(265)
Pumps and fans	144.3855	0.5190	74.9361	(267)
Energy for lighting	320.8844	0.5190	166.5390	(268)
Energy saving/generation technologies				
PV Unit	-106.4690	0.5190	-55.2574	(269)
Total CO2, kg/year			1098.9450	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			15.0900	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		15.0900	ZC1
Total Floor Area	TFA	72.8300	
Assumed number of occupants	N	2.3128	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		16.5829	ZC2
CO2 emissions from cooking, equation (L16)		2.3961	ZC3
Total CO2 emissions		34.0690	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		34.0690	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	72.8300 (1b)	x	2.5000 (2b)	=	182.0750	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	72.8300					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	182.0750	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent 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)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1648	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4148	(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) =	0.3526	(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	0.4495	0.4407	0.4319	0.3878	0.3790	0.3349	0.3349	0.3261	0.3526	0.3790	0.3966	0.4142	(22b)
Effective ac	0.6010	0.5971	0.5933	0.5752	0.5718	0.5561	0.5561	0.5532	0.5621	0.5718	0.5787	0.5858	(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	
TER Opaque door			2.1400	1.0000	2.1400			(26)
TER Opening Type (Uw = 1.40)			16.0600	1.3258	21.2917			(27)
External Wall 1	42.6300	18.2000	24.4300	0.1800	4.3974			(29a)
Wall to Corridor	8.7500		8.7500	0.1800	1.5750			(29a)
Total net area of external elements Aum(A, m2)			51.3800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		29.4041			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							4.5063	(36)
Total fabric heat loss					(33) + (36) =		33.9104	(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	36.1126	35.8768	35.6458	34.5606	34.3575	33.4124	33.4124	33.2373	33.7764	34.3575	34.7683	35.1977	(38)
Heat transfer coeff	70.0229	69.7872	69.5562	68.4710	68.2679	67.3227	67.3227	67.1477	67.6868	68.2679	68.6787	69.1081	(39)
Average = Sum(39)m / 12 =												68.4700	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9615	0.9582	0.9550	0.9401	0.9374	0.9244	0.9244	0.9220	0.9294	0.9374	0.9430	0.9489	(40)
HLP (average)												0.9401	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.3128 (42)
Average daily hot water use (litres/day)		89.1296 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	98.0425	94.4773	90.9122	87.3470	83.7818	80.2166	80.2166	83.7818	87.3470	90.9122	94.4773	98.0425	(44)
Energy conte	145.3942	127.1627	131.2205	114.4013	109.7707	94.7238	87.7755	100.7237	101.9266	118.7857	129.6639	140.8066	(45)
Energy content (annual)										Total = Sum(45)m =		1402.3552	(45)
Distribution loss (46)m = 0.15 x (45)m	21.8091	19.0744	19.6831	17.1602	16.4656	14.2086	13.1663	15.1086	15.2890	17.8179	19.4496	21.1210	(46)

Water storage loss:		
Store volume		170.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):		1.5003 (48)
Temperature factor from Table 2b		0.5400 (49)
Enter (49) or (54) in (55)		0.8102 (55)
Total storage loss		

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	25.1153	22.6848	25.1153	24.3051	25.1153	24.3051	25.1153	25.1153	24.3051	25.1153	24.3051	25.1153	(56)
If cylinder contains dedicated solar storage													
	25.1153	22.6848	25.1153	24.3051	25.1153	24.3051	25.1153	25.1153	24.3051	25.1153	24.3051	25.1153	(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)
Total heat required for water heating calculated for each month													
	193.7719	170.8587	179.5982	161.2184	158.1484	141.5409	136.1532	149.1014	148.7438	167.1634	176.4810	189.1843	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	193.7719	170.8587	179.5982	161.2184	158.1484	141.5409	136.1532	149.1014	148.7438	167.1634	176.4810	189.1843	(64)
								Total per year (kWh/year) = Sum(64)m =				1971.9637	(64)
Heat gains from water heating, kWh/month													
	87.0457	77.2384	82.3330	75.4921	75.2009	68.9494	67.8875	72.1928	71.3443	78.1984	80.5669	85.5203	(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	115.6412	115.6412	115.6412	115.6412	115.6412	115.6412	115.6412	115.6412	115.6412	115.6412	115.6412	115.6412	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	18.1748	16.1427	13.1281	9.9388	7.4294	6.2722	6.7773	8.8094	11.8240	15.0133	17.5227	18.6799	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	203.8099	205.9249	200.5954	189.2495	174.9273	161.4665	152.4739	150.3590	155.6885	167.0344	181.3565	194.8173	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	34.5641	34.5641	34.5641	34.5641	34.5641	34.5641	34.5641	34.5641	34.5641	34.5641	34.5641	34.5641	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-92.5130	-92.5130	-92.5130	-92.5130	-92.5130	-92.5130	-92.5130	-92.5130	-92.5130	-92.5130	-92.5130	-92.5130	(71)
Water heating gains (Table 5)													
	116.9970	114.9381	110.6626	104.8502	101.0765	95.7630	91.2467	97.0333	99.0893	105.1054	111.8985	114.9467	(72)
Total internal gains													
	399.6740	397.6980	385.0784	364.7308	344.1256	324.1941	311.1903	316.8941	327.2942	347.8454	371.4701	389.1363	(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	
Northeast	7.3200	11.2829	0.6300	0.7000	0.7700	25.2409	(75)
Southeast	8.7400	36.7938	0.6300	0.7000	0.7700	98.2784	(77)

Solar gains	123.5194	218.7832	321.6182	435.8275	522.2334	533.4433	508.0596	441.3058	360.8084	247.8065	149.4745	104.7189	(83)
Total gains	523.1934	616.4812	706.6966	800.5583	866.3590	857.6374	819.2499	758.1999	688.1026	595.6518	520.9447	493.8551	(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	72.2283	72.4723	72.7130	73.8655	74.0852	75.1253	75.1253	75.3211	74.7212	74.0852	73.6421	73.1845	
alpha	5.8152	5.8315	5.8475	5.9244	5.9390	6.0084	6.0084	6.0214	5.9814	5.9390	5.9095	5.8790	
util living area													
	0.9948	0.9861	0.9590	0.8698	0.6979	0.4984	0.3611	0.4063	0.6557	0.9194	0.9871	0.9962	(86)
MIT	20.1335	20.3110	20.5577	20.8228	20.9594	20.9954	20.9994	20.9989	20.9787	20.7822	20.4099	20.1045	(87)
Th 2	20.1156	20.1183	20.1210	20.1335	20.1359	20.1468	20.1468	20.1489	20.1426	20.1359	20.1311	20.1261	(88)
util rest of house													
	0.9932	0.9820	0.9471	0.8379	0.6438	0.4337	0.2913	0.3317	0.5834	0.8910	0.9825	0.9950	(89)
MIT 2	18.9659	19.2246	19.5764	19.9403	20.1002	20.1440	20.1466	20.1484	20.1277	19.8996	19.3791	18.9317	(90)
Living area fraction										fLA = Living area / (4) =		0.3525	(91)
MIT	19.3774	19.6075	19.9223	20.2514	20.4030	20.4441	20.4472	20.4482	20.4276	20.2107	19.7424	19.3451	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.3774	19.6075	19.9223	20.2514	20.4030	20.4441	20.4472	20.4482	20.4276	20.2107	19.7424	19.3451	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9914	0.9789	0.9440	0.8426	0.6610	0.4564	0.3159	0.3580	0.6081	0.8938	0.9799	0.9936	(94)
Useful gains	518.7057	603.4857	667.1022	674.5793	572.7015	391.4588	258.8294	271.4638	418.4510	532.3960	510.4562	490.6847	(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													
	1055.7662	1026.3949	933.6015	777.2406	594.1382	393.4392	259.0046	271.8263	428.2974	656.1005	868.2655	1046.6478	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	399.5730	284.1950	198.2755	73.9161	15.9489	0.0000	0.0000	0.0000	0.0000	92.0361	257.6226	413.6365	(98)
Space heating												1735.2038	(98)
Space heating per m2											(98) / (4) =	23.8254	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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 %)												93.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												1855.8329	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	399.5730	284.1950	198.2755	73.9161	15.9489	0.0000	0.0000	0.0000	0.0000	92.0361	257.6226	413.6365	(98)
Space heating efficiency (main heating system 1)													
	93.5000	93.5000	93.5000	93.5000	0.0000	0.0000	0.0000	0.0000	0.0000	93.5000	93.5000	93.5000	(210)
Space heating fuel (main heating system)													
	427.3508	303.9518	212.0593	79.0547	17.0577	0.0000	0.0000	0.0000	0.0000	98.4343	275.5322	442.3920	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	193.7719	170.8587	179.5982	161.2184	158.1484	141.5409	136.1532	149.1014	148.7438	167.1634	176.4810	189.1843	(64)
Efficiency of water heater												79.8000	(216)
(217)m	86.7034	86.1622	85.0781	82.8804	80.6738	79.8000	79.8000	79.8000	79.8000	83.2969	85.8218	86.8455	(217)
Fuel for water heating, kWh/month													
	223.4884	198.2990	211.0982	194.5193	196.0345	177.3696	170.6181	186.8438	186.3957	200.6837	205.6367	217.8400	(219)
Water heating fuel used												2368.8268	(219)
Annual totals kWh/year													
Space heating fuel - main system												1855.8329	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												320.9719	(232)
Total delivered energy for all uses												4620.6316	(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	1855.8329	0.2160	400.8599	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2368.8268	0.2160	511.6666	(264)
Space and water heating			912.5265	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	320.9719	0.5190	166.5844	(268)
Total CO2, kg/m2/year			1118.0359	(272)
Emissions per m2 for space and water heating			12.5295	(272a)
Fuel factor (electricity)			1.5500	
Emissions per m2 for lighting			2.2873	(272b)
Emissions per m2 for pumps and fans			0.5345	(272c)
Target Carbon Dioxide Emission Rate (TER) = (12.5295 * 1.55) + 2.2873 + 0.5345, rounded to 2 d.p.			22.2400	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	72.8300 (1b)	x	2.5000 (2b)	=	182.0750	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	72.8300					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	182.0750	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent 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)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1648	(8)
Pressure test		Yes	
Measured/design AP50		3.5000	
Infiltration rate		0.3398	(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) =	0.2888	(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	0.3682	0.3610	0.3538	0.3177	0.3105	0.2744	0.2744	0.2671	0.2888	0.3105	0.3249	0.3393	(22b)
Effective ac	0.5678	0.5652	0.5626	0.5505	0.5482	0.5376	0.5376	0.5357	0.5417	0.5482	0.5528	0.5576	(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	
Front Door			2.1400	1.0000	2.1400			(26)
Window G=0.37 (Uw = 1.30)			21.9200	1.2357	27.0875			(27)
External Wall 1	42.6300	24.0600	18.5700	0.1800	3.3426			(29a)
Wall to Corridor	8.7500		8.7500	0.1800	1.5750			(29a)
Total net area of external elements Aum(A, m2)			51.3800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		34.1451			(33)
Party Wall 1			56.7000	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	7.6179	(36)
Total fabric heat loss (33) + (36) =	41.7630	(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	34.1158	33.9576	33.8025	33.0743	32.9381	32.3038	32.3038	32.1863	32.5481	32.9381	33.2137	33.5019	(38)
Heat transfer coeff	75.8787	75.7205	75.5655	74.8373	74.7010	74.0668	74.0668	73.9493	74.3111	74.7010	74.9766	75.2648	(39)
Average = Sum(39)m / 12 =												74.8366	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0419	1.0397	1.0376	1.0276	1.0257	1.0170	1.0170	1.0154	1.0203	1.0257	1.0295	1.0334	(40)
HLP (average)												1.0276	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.3128	(42)
Average daily hot water use (litres/day)	89.1296	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	98.0425	94.4773	90.9122	87.3470	83.7818	80.2166	80.2166	83.7818	87.3470	90.9122	94.4773	98.0425	(44)
Energy conte	145.3942	127.1627	131.2205	114.4013	109.7707	94.7238	87.7755	100.7237	101.9266	118.7857	129.6639	140.8066	(45)
Energy content (annual)										Total = Sum(45)m =		1402.3552	(45)
Distribution loss (46)m = 0.15 x (45)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	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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)
Heat gains from water heating, kWh/month													
	30.8963	27.0221	27.8844	24.3103	23.3263	20.1288	18.6523	21.4038	21.6594	25.2420	27.5536	29.9214	(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	115.6412	115.6412	115.6412	115.6412	115.6412	115.6412	115.6412	115.6412	115.6412	115.6412	115.6412	115.6412	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	18.1698	16.1383	13.1245	9.9361	7.4274	6.2705	6.7755	8.8070	11.8208	15.0092	17.5179	18.6748	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	203.8099	205.9249	200.5954	189.2495	174.9273	161.4665	152.4739	150.3590	155.6885	167.0344	181.3565	194.8173	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	34.5641	34.5641	34.5641	34.5641	34.5641	34.5641	34.5641	34.5641	34.5641	34.5641	34.5641	34.5641	(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)													
	-92.5130	-92.5130	-92.5130	-92.5130	-92.5130	-92.5130	-92.5130	-92.5130	-92.5130	-92.5130	-92.5130	-92.5130	(71)
Water heating gains (Table 5)													
	41.5273	40.2114	37.4790	33.7643	31.3525	27.9567	25.0703	28.7685	30.0825	33.9274	38.2688	40.2169	(72)
Total internal gains													
	321.1994	319.9669	308.8912	290.6422	271.3996	253.3861	242.0120	245.6269	255.2841	273.6633	294.8357	311.4014	(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	
Northeast	9.9900	11.2829	0.3500	0.8000	0.7700	21.8715	(75)
Southeast	11.9300	36.7938	0.3500	0.8000	0.7700	85.1739	(77)

Solar gains	107.0455	189.6029	278.7196	377.6914	452.5681	462.2812	440.2843	382.4376	312.6812	214.7544	129.5388	90.7525	(83)
Total gains	428.2448	509.5698	587.6108	668.3335	723.9677	715.6673	682.2964	628.0645	567.9654	488.4177	424.3745	402.1539	(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	66.6543	66.7935	66.9305	67.5818	67.7051	68.2849	68.2849	68.3933	68.0604	67.7051	67.4562	67.1979	
alpha	5.4436	5.4529	5.4620	5.5055	5.5137	5.5523	5.5523	5.5596	5.5374	5.5137	5.4971	5.4799	
util living area													
	0.9982	0.9950	0.9843	0.9429	0.8285	0.6380	0.4735	0.5333	0.8006	0.9698	0.9957	0.9987	(86)
MIT	19.8954	20.0629	20.3190	20.6368	20.8748	20.9770	20.9963	20.9931	20.9234	20.5999	20.1831	19.8633	(87)
Th 2	20.0486	20.0504	20.0522	20.0604	20.0620	20.0692	20.0692	20.0705	20.0664	20.0620	20.0588	20.0556	(88)
util rest of house													
	0.9976	0.9933	0.9789	0.9235	0.7779	0.5553	0.3756	0.4299	0.7264	0.9558	0.9940	0.9983	(89)
MIT 2	19.0386	19.2068	19.4612	19.7729	19.9808	20.0591	20.0683	20.0686	20.0258	19.7453	19.3340	19.0122	(90)
Living area fraction									fLA = Living area / (4) =			0.3525	(91)
MIT	19.3406	19.5086	19.7636	20.0774	20.2959	20.3826	20.3954	20.3945	20.3421	20.0465	19.6333	19.3122	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.3406	19.5086	19.7636	20.0774	20.2959	20.3826	20.3954	20.3945	20.3421	20.0465	19.6333	19.3122	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9970	0.9921	0.9769	0.9239	0.7915	0.5841	0.4102	0.4665	0.7502	0.9555	0.9930	0.9978	(94)
Useful gains	426.9540	505.5291	574.0218	617.4678	573.0315	418.0008	279.9032	293.0093	426.1021	466.6677	421.4129	401.2807	(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													
	1141.2637	1106.1679	1002.2670	836.4845	642.1231	428.3000	281.1093	295.3868	463.8600	705.6655	939.7021	1137.4162	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	531.4464	403.6293	318.6144	157.6920	51.4041	0.0000	0.0000	0.0000	0.0000	177.8144	373.1682	547.6848	(98)
Space heating												2561.4537	(98)
Space heating per m2											(98) / (4) =	35.1703	(99)

8c. Space cooling requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	696.2275	548.0940	562.0147	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9389	0.9717	0.9579	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	653.6873	532.5977	538.3454	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	922.4027	881.6463	819.6537	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	193.4751	259.6922	209.2934	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												662.4606	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)													

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000 (106)
Space cooling kWh												
	0.0000	0.0000	0.0000	0.0000	0.0000	48.3688	64.9230	52.3233	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												165.6152 (107)
Space cooling per m2												2.2740 (108)
Energy for space heating												35.1703 (99)
Energy for space cooling												2.2740 (108)
Total												37.4443 (109)
Dwelling Fabric Energy Efficiency (DFEE)												37.4 (109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	72.8300 (1b)	x	2.5000 (2b)	=	182.0750	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	72.8300					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	182.0750	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent 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)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1648	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4148	(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) =	0.3526	(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	0.4495	0.4407	0.4319	0.3878	0.3790	0.3349	0.3349	0.3261	0.3526	0.3790	0.3966	0.4142	(22b)
Effective ac	0.6010	0.5971	0.5933	0.5752	0.5718	0.5561	0.5561	0.5532	0.5621	0.5718	0.5787	0.5858	(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	
TER Opaque door			2.1400	1.0000	2.1400			(26)
TER Opening Type (Uw = 1.40)			16.0600	1.3258	21.2917			(27)
External Wall 1	42.6300	18.2000	24.4300	0.1800	4.3974			(29a)
Wall to Corridor	8.7500		8.7500	0.1800	1.5750			(29a)
Total net area of external elements Aum(A, m2)			51.3800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		29.4041			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							4.5063	(36)
Total fabric heat loss					(33) + (36) =		33.9104	(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	36.1126	35.8768	35.6458	34.5606	34.3575	33.4124	33.4124	33.2373	33.7764	34.3575	34.7683	35.1977	(38)
Heat transfer coeff	70.0229	69.7872	69.5562	68.4710	68.2679	67.3227	67.3227	67.1477	67.6868	68.2679	68.6787	69.1081	(39)
Average = Sum(39)m / 12 =												68.4700	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9615	0.9582	0.9550	0.9401	0.9374	0.9244	0.9244	0.9220	0.9294	0.9374	0.9430	0.9489	(40)
HLP (average)												0.9401	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.3128 (42)
Average daily hot water use (litres/day)		89.1296 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	98.0425	94.4773	90.9122	87.3470	83.7818	80.2166	80.2166	83.7818	87.3470	90.9122	94.4773	98.0425	(44)
Energy conte	145.3942	127.1627	131.2205	114.4013	109.7707	94.7238	87.7755	100.7237	101.9266	118.7857	129.6639	140.8066	(45)
Energy content (annual)										Total = Sum(45)m =		1402.3552	(45)
Distribution loss (46)m = 0.15 x (45)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	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
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)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Heat gains from water heating, kWh/month

	30.8963	27.0221	27.8844	24.3103	23.3263	20.1288	18.6523	21.4038	21.6594	25.2420	27.5536	29.9214 (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	115.6412	115.6412	115.6412	115.6412	115.6412	115.6412	115.6412	115.6412	115.6412	115.6412	115.6412	115.6412	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	18.1748	16.1427	13.1281	9.9388	7.4294	6.2722	6.7773	8.8094	11.8240	15.0133	17.5227	18.6799	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	203.8099	205.9249	200.5954	189.2495	174.9273	161.4665	152.4739	150.3590	155.6885	167.0344	181.3565	194.8173	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	34.5641	34.5641	34.5641	34.5641	34.5641	34.5641	34.5641	34.5641	34.5641	34.5641	34.5641	34.5641	(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)													
	-92.5130	-92.5130	-92.5130	-92.5130	-92.5130	-92.5130	-92.5130	-92.5130	-92.5130	-92.5130	-92.5130	-92.5130	(71)
Water heating gains (Table 5)													
	41.5273	40.2114	37.4790	33.7643	31.3525	27.9567	25.0703	28.7685	30.0825	33.9274	38.2688	40.2169	(72)
Total internal gains													
	321.2043	319.9713	308.8948	290.6449	271.4016	253.3878	242.0139	245.6293	255.2874	273.6674	294.8404	311.4065	(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	
Northeast	7.3200	11.2829	0.6300	0.7000	0.7700	25.2409	(75)
Southeast	8.7400	36.7938	0.6300	0.7000	0.7700	98.2784	(77)

Solar gains	123.5194	218.7832	321.6182	435.8275	522.2334	533.4433	508.0596	441.3058	360.8084	247.8065	149.4745	104.7189	(83)
Total gains	444.7237	538.7545	630.5130	726.4724	793.6350	786.8311	750.0735	686.9351	616.0958	521.4738	444.3150	416.1254	(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	72.2283	72.4723	72.7130	73.8655	74.0852	75.1253	75.1253	75.3211	74.7212	74.0852	73.6421	73.1845	
alpha	5.8152	5.8315	5.8475	5.9244	5.9390	6.0084	6.0084	6.0214	5.9814	5.9390	5.9095	5.8790	
util living area	0.9978	0.9928	0.9750	0.9054	0.7460	0.5409	0.3940	0.4476	0.7172	0.9519	0.9941	0.9985	(86)
MIT	20.0310	20.2134	20.4734	20.7710	20.9425	20.9929	20.9991	20.9981	20.9661	20.7134	20.3127	20.0021	(87)
Th 2	20.1156	20.1183	20.1210	20.1335	20.1359	20.1468	20.1468	20.1489	20.1426	20.1359	20.1311	20.1261	(88)
util rest of house	0.9970	0.9905	0.9671	0.8788	0.6924	0.4717	0.3181	0.3659	0.6434	0.9322	0.9919	0.9980	(89)
MIT 2	19.2288	19.4122	19.6695	19.9582	20.1005	20.1438	20.1466	20.1483	20.1257	19.9147	19.5224	19.2088	(90)
Living area fraction										fLA = Living area / (4) =		0.3525	(91)
MIT	19.5115	19.6946	19.9528	20.2447	20.3973	20.4431	20.4471	20.4479	20.4219	20.1962	19.8009	19.4884	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.5115	19.6946	19.9528	20.2447	20.3973	20.4431	20.4471	20.4479	20.4219	20.1962	19.8009	19.4884	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9964	0.9891	0.9652	0.8826	0.7093	0.4960	0.3449	0.3948	0.6685	0.9338	0.9908	0.9975	(94)
Useful gains	443.1069	532.8823	608.6017	641.1834	562.9432	390.2939	258.7104	271.1862	411.8797	486.9431	440.2290	415.0698	(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	1065.1567	1032.4745	935.7283	776.7841	593.7445	393.3716	258.9954	271.8051	427.9110	655.1128	872.2835	1056.5499	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	462.8051	335.7259	243.3822	97.6325	22.9162	0.0000	0.0000	0.0000	0.0000	125.1182	311.0792	477.2612	(98)
Space heating												2075.9206	(98)
Space heating per m2											(98) / (4) =	28.5036	(99)

8c. Space cooling requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	632.8337	498.1882	510.3225	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9761	0.9906	0.9846	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	617.7298	493.5068	502.4544	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1005.5834	960.8688	888.4667	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	279.2546	347.7173	287.1932	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												914.1651	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Space cooling kWh

0.0000	0.0000	0.0000	0.0000	0.0000	69.8137	86.9293	71.7983	0.0000	0.0000	0.0000	0.0000 (107)

Space cooling	228.5413 (107)
Space cooling per m2	3.1380 (108)
Energy for space heating	28.5036 (99)
Energy for space cooling	3.1380 (108)
Total	31.6417 (109)
Target Fabric Energy Efficiency (TFEE)	36.4 (109)

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

HODKINSON

Property Reference	B.09.01 Wootton	**Issued on Date**	26/11/2020
Assessment Reference	B.09.01 Wootton HP	**Prop Type Ref**	Blk B 2B4P (Top F)
Property			

SAP Rating	84 B	**DER**	18.09	**TER**	31.08
Environmental	87 B	**% DER<TER**	41.80		
CO_2 Emissions (t/year)	1.11	**DFEE**	56.41	**TFEE**	65.41
General Requirements Compliance	Pass	**% DFEE<TFEE**	13.76		

Assessor Details	Mr. Jonathan Peck, Jonathan Peck, Tel: 02036031622, Jonathan@hodkinsonconsultancy.com	**Assessor ID**	M976-0001
Client			

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

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

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DWELLING AS DESIGNED

Top-floor flat, total floor area 74 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Electricity
Fuel factor:1.55 (electricity)
Target Carbon Dioxide Emission Rate (TER) 31.08 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 18.09 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)65.4 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)56.4 kWh/m²/yrOK

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2 Fabric U-values

Element	Average	Highest	
External wall	0.18 (max. 0.30)	0.18 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	(no floor)		
Roof	0.10 (max. 0.20)	0.10 (max. 0.35)	OK
Openings	1.27 (max. 2.00)	1.30 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

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3 Air permeability
Air permeability at 50 pascals: 3.50 (design value)
Maximum 10.0 OK

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4 Heating efficiency
Main heating system: Heat pump with radiators or underfloor - Electric
Mitsubishi ECODAN 5kW PUHZ-W50VHA-BS

Secondary heating system: None

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5 Cylinder insulation
Hot water storage: Measured cylinder loss: 1.20 kWh/day
Permitted by DBSCG 2.03 OK
Primary pipework insulated: Yes OK

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6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: Cylinderstat OK
Independent timer for DHW OK

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7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK

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8 Mechanical ventilation
Continuous supply and extract system
Specific fan power: 0.52
Maximum 1.5 OK
MVHR efficiency: 92%
Minimum: 70% OK

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9 Summertime temperature
Overheating risk (Thames Valley): Slight OK
Based on:
Overshading: Average
Windows facing North: 11.85 m², No overhang
Windows facing North East: 3.33 m², No overhang
Windows facing North West: 8.33 m², No overhang
Air change rate: 6.00 ach
Blinds/curtains: None

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10 Key features
Party wall U-value 0.00 W/m²K
Roof U-value 0.10 W/m²K
Door U-value 1.00 W/m²K
Air permeability 3.5 m³/m²h
Photovoltaic array 0.14 kW

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	73.6900 (1b)	x	2.5000 (2b)	=	184.2250	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	73.6900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	184.2250	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent 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)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Measured/design AP50		3.5000	
Infiltration rate		0.1750	(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) =	0.1488	(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	0.1897	0.1859	0.1822	0.1636	0.1599	0.1413	0.1413	0.1376	0.1488	0.1599	0.1673	0.1748	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation:	0.5000	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	78.2000	(23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.2987	0.2949	0.2912	0.2726	0.2689	0.2503	0.2503	0.2466	0.2578	0.2689	0.2763	0.2838	(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	
Window (Uw = 1.30)			20.1800	1.2357	24.9373			(27)
Front Door			2.1400	1.0000	2.1400			(26)
Window G=0.37 (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
External Wall 1	56.5300	25.6500	30.8800	0.1800	5.5584			(29a)
Wall to Corridor	17.2300		17.2300	0.1800	3.1014			(29a)
External Roof 1	73.6900		73.6900	0.1000	7.3690			(30)
Total net area of external elements Aum(A, m2)			147.4500					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	47.2211			(33)
Party Wall 1			17.6000	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	14.4553	(36)
Total fabric heat loss (33) + (36) =	61.6764	(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	18.1566	17.9305	17.7044	16.5740	16.3480	15.2176	15.2176	14.9915	15.6697	16.3480	16.8001	17.2523	(38)
Heat transfer coeff	79.8330	79.6069	79.3808	78.2504	78.0243	76.8939	76.8939	76.6679	77.3461	78.0243	78.4765	78.9286	(39)
Average = Sum(39)m / 12 =												78.1939	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0834	1.0803	1.0772	1.0619	1.0588	1.0435	1.0435	1.0404	1.0496	1.0588	1.0650	1.0711	(40)
HLP (average)												1.0611	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.3323	(42)
Average daily hot water use (litres/day)	89.5916	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	98.5507	94.9671	91.3834	87.7998	84.2161	80.6324	80.6324	84.2161	87.7998	91.3834	94.9671	98.5507	(44)
Energy conte	146.1479	127.8219	131.9007	114.9943	110.3397	95.2148	88.2305	101.2458	102.4550	119.4014	130.3360	141.5364	(45)
Energy content (annual)										Total = Sum(45)m =		1409.6245	(45)

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

	21.9222	19.1733	19.7851	17.2491	16.5510	14.2822	13.2346	15.1869	15.3682	17.9102	19.5504	21.2305	(46)
Water storage loss:													
Store volume												170.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.2000	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.6480	(55)
Total storage loss													
	20.0880	18.1440	20.0880	19.4400	20.0880	19.4400	20.0880	20.0880	19.4400	20.0880	19.4400	20.0880	(56)
If cylinder contains dedicated solar storage													
	20.0880	18.1440	20.0880	19.4400	20.0880	19.4400	20.0880	20.0880	19.4400	20.0880	19.4400	20.0880	(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)
Total heat required for water heating calculated for each month													
	189.4983	166.9771	175.2511	156.9463	153.6901	137.1668	131.5809	144.5962	144.4070	162.7518	172.2880	184.8868	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	189.4983	166.9771	175.2511	156.9463	153.6901	137.1668	131.5809	144.5962	144.4070	162.7518	172.2880	184.8868	(64)
									Total per year (kWh/year) = Sum(64)m =			1920.0405	(64)
Heat gains from water heating, kWh/month													
	83.2745	73.8249	78.5373	71.7972	71.3683	65.2205	64.0170	68.3445	67.6279	74.3813	76.8983	81.7412	(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	116.6139	116.6139	116.6139	116.6139	116.6139	116.6139	116.6139	116.6139	116.6139	116.6139	116.6139	116.6139	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	18.3429	16.2920	13.2496	10.0308	7.4981	6.3302	6.8400	8.8909	11.9334	15.1522	17.6848	18.8527	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	205.7517	207.8868	202.5065	191.0525	176.5939	163.0049	153.9266	151.7915	157.1718	168.6258	183.0844	196.6734	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	34.6614	34.6614	34.6614	34.6614	34.6614	34.6614	34.6614	34.6614	34.6614	34.6614	34.6614	34.6614	(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)													
	-93.2911	-93.2911	-93.2911	-93.2911	-93.2911	-93.2911	-93.2911	-93.2911	-93.2911	-93.2911	-93.2911	-93.2911	(71)
Water heating gains (Table 5)													
	111.9281	109.8585	105.5609	99.7183	95.9251	90.5841	86.0443	91.8610	93.9276	99.9749	106.8032	109.8672	(72)
Total internal gains													
	394.0069	392.0215	379.3011	358.7858	338.0013	317.9033	304.7951	310.5276	321.0170	341.7370	365.5566	383.3775	(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	11.8500	10.6334	0.4500	0.8000	0.7700	31.4359	(74)
Northwest	8.3300	11.2829	0.4500	0.8000	0.7700	23.4479	(81)
Northeast	3.3300	11.2829	0.3500	0.8000	0.7700	7.2905	(75)

Solar gains	62.1743	122.6444	214.8123	349.1053	469.7408	501.7706	468.9582	373.0114	260.0992	147.9762	77.4570	51.3090	(83)
Total gains	456.1811	514.6659	594.1134	707.8911	807.7421	819.6739	773.7533	683.5389	581.1162	489.7132	443.0136	434.6865	(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	64.1009	64.2829	64.4660	65.3972	65.5867	66.5509	66.5509	66.7471	66.1619	65.5867	65.2088	64.8353	
alpha	5.2734	5.2855	5.2977	5.3598	5.3724	5.4367	5.4367	5.4498	5.4108	5.3724	5.3473	5.3224	
util living area													
	0.9977	0.9952	0.9852	0.9370	0.7946	0.5848	0.4345	0.5091	0.8060	0.9726	0.9952	0.9982	(86)
Tweekday	18.5032	18.7085	19.0908	19.6095	19.9344	20.0370	20.0463	20.0474	19.9762	19.5292	18.9400	18.4803	
Tweekend	20.2677	20.3579	20.5277	20.7626	20.9298	20.9893	20.9982	20.9960	20.9452	20.7192	20.4561	20.2543	
24 / 16	9	8	9	8	9	9	9	9	8	9	8	9	
24 / 9	22	20	22	22	22	21	22	22	22	22	22	22	
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	20.0144	20.0170	20.0195	20.0321	20.0346	20.0473	20.0473	20.0498	20.0422	20.0346	20.0296	20.0245	(88)
util rest of house													
	0.9969	0.9935	0.9801	0.9159	0.7397	0.5044	0.3419	0.4075	0.7311	0.9595	0.9933	0.9976	(89)
Tweekday	18.5032	18.7085	19.0908	19.6095	19.9344	20.0370	20.0463	20.0474	19.9762	19.5292	18.9400	18.4803	
Tweekend	18.5032	18.7085	19.0908	19.6095	19.9344	20.0370	20.0463	20.0474	19.9762	19.5292	18.9400	18.4803	
MIT 2	20.0144	20.0170	20.0195	20.0321	20.0346	20.0473	20.0473	20.0498	20.0422	20.0346	20.0296	20.0245	(90)
Living area fraction									fLA = Living area / (4) =			0.4896	(91)
MIT	20.4970	20.4983	20.4996	20.5060	20.5073	20.5137	20.5137	20.5150	20.5112	20.5073	20.5047	20.5021	(92)
Temperature adjustment												0.0000	
adjusted MIT	20.4970	20.4983	20.4996	20.5060	20.5073	20.5137	20.5137	20.5150	20.5112	20.5073	20.5047	20.5021	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9973	0.9944	0.9828	0.9270	0.7679	0.5445	0.3875	0.4579	0.7702	0.9666	0.9943	0.9979	(94)
Useful gains	454.9658	511.7881	583.8944	656.2312	620.2508	446.3157	299.8567	312.9604	447.5724	473.3712	440.4874	433.7928	(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													
	1293.0538	1241.7300	1111.2962	908.1737	687.1822	454.7307	300.9428	315.4908	495.8777	773.0090	1051.9541	1286.7051	(97)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	623.5375	490.5210	392.3870	181.3986	49.7970	0.0000	0.0000	0.0000	0.0000	222.9305	440.2561	634.5667	(98)
Space heating												3035.3943	(98)
Space heating per m2											(98) / (4) =	41.1914	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	269.2239	(206)
Efficiency of secondary/supplementary heating system, %	100.0000	(208)
Space heating requirement	1127.4611	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	623.5375	490.5210	392.3870	181.3986	49.7970	0.0000	0.0000	0.0000	0.0000	222.9305	440.2561	634.5667	(98)
Space heating efficiency (main heating system 1)	269.2239	269.2239	269.2239	269.2239	269.2239	0.0000	0.0000	0.0000	0.0000	269.2239	269.2239	269.2239	(210)
Space heating fuel (main heating system)	231.6056	182.1982	145.7475	67.3784	18.4965	0.0000	0.0000	0.0000	0.0000	82.8049	163.5279	235.7022	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	189.4983	166.9771	175.2511	156.9463	153.6901	137.1668	131.5809	144.5962	144.4070	162.7518	172.2880	184.8868	(64)
Efficiency of water heater												178.1250	(216)
(217)m	178.1250	178.1250	178.1250	178.1250	178.1250	178.1250	178.1250	178.1250	178.1250	178.1250	178.1250	178.1250	(217)
Fuel for water heating, kWh/month	106.3850	93.7415	98.3866	88.1102	86.2822	77.0059	73.8700	81.1768	81.0706	91.3694	96.7231	103.7961	(219)
Water heating fuel used												1077.9175	(219)
Annual totals kWh/year													
Space heating fuel - main system												1127.4611	(211)
Space heating fuel - secondary												0.0000	(215)

Electricity for pumps and fans:		
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.6500)		
mechanical ventilation fans (SFP = 0.6500)	146.0904	(230a)
Total electricity for the above, kWh/year	146.0904	(231)
Electricity for lighting (calculated in Appendix L)	323.9416	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV Unit 0 (0.80 * 0.14 * 951 * 1.00) =	-106.4690	(233)
Total delivered energy for all uses	2568.9416	(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	1127.4611	0.5190	585.1523	(261)
Space heating - secondary	0.0000	0.5190	0.0000	(263)
Water heating (other fuel)	1077.9175	0.5190	559.4392	(264)
Space and water heating			1144.5915	(265)
Pumps and fans	146.0904	0.5190	75.8209	(267)
Energy for lighting	323.9416	0.5190	168.1257	(268)
Energy saving/generation technologies				
PV Unit	-106.4690	0.5190	-55.2574	(269)
Total CO2, kg/year			1333.2807	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			18.0900	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		18.0900	ZC1
Total Floor Area	TFA	73.6900	
Assumed number of occupants	N	2.3323	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		16.5455	ZC2
CO2 emissions from cooking, equation (L16)		2.3745	ZC3
Total CO2 emissions		37.0100	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		37.0100	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	73.6900 (1b)	x	2.5000 (2b)	=	184.2250	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	73.6900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	184.2250	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent 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)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1628	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4128	(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) =	0.3509	(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	0.4474	0.4386	0.4299	0.3860	0.3772	0.3334	0.3334	0.3246	0.3509	0.3772	0.3948	0.4123	(22b)
Effective ac	0.6001	0.5962	0.5924	0.5745	0.5712	0.5556	0.5556	0.5527	0.5616	0.5712	0.5779	0.5850	(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	
TER Opaque door			2.1400	1.0000	2.1400			(26)
TER Opening Type (Uw = 1.40)			16.2900	1.3258	21.5966			(27)
External Wall 1	56.5300	18.4300	38.1000	0.1800	6.8580			(29a)
Wall to Corridor	17.2300		17.2300	0.1800	3.1014			(29a)
External Roof 1	73.6900		73.6900	0.1300	9.5797			(30)
Total net area of external elements Aum(A, m2)			147.4500					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		43.2757			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							16.0810	(36)
Total fabric heat loss						(33) + (36) =	59.3567	(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	36.4822	36.2459	36.0143	34.9264	34.7229	33.7754	33.7754	33.5999	34.1403	34.7229	35.1346	35.5651	(38)
Heat transfer coeff	95.8389	95.6026	95.3710	94.2831	94.0796	93.1321	93.1321	92.9566	93.4970	94.0796	94.4913	94.9218	(39)
Average = Sum(39)m / 12 =												94.2821	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3006	1.2974	1.2942	1.2795	1.2767	1.2638	1.2638	1.2615	1.2688	1.2767	1.2823	1.2881	(40)
HLP (average)												1.2794	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.3323 (42)
Average daily hot water use (litres/day)		89.5916 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	98.5507	94.9671	91.3834	87.7998	84.2161	80.6324	80.6324	84.2161	87.7998	91.3834	94.9671	98.5507	(44)
Energy conte	146.1479	127.8219	131.9007	114.9943	110.3397	95.2148	88.2305	101.2458	102.4550	119.4014	130.3360	141.5364	(45)
Energy content (annual)										Total = Sum(45)m =		1409.6245	(45)
Distribution loss (46)m = 0.15 x (45)m	21.9222	19.1733	19.7851	17.2491	16.5510	14.2822	13.2346	15.1869	15.3682	17.9102	19.5504	21.2305	(46)

Water storage loss:		
Store volume		170.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):		1.5003 (48)
Temperature factor from Table 2b		0.5400 (49)
Enter (49) or (54) in (55)		0.8102 (55)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Total storage loss
25.1153 22.6848 25.1153 24.3051 25.1153 24.3051 25.1153 25.1153 24.3051 25.1153 24.3051 25.1153 (56)
If cylinder contains dedicated solar storage
25.1153 22.6848 25.1153 24.3051 25.1153 24.3051 25.1153 25.1153 24.3051 25.1153 24.3051 25.1153 (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)
Total heat required for water heating calculated for each month
194.5256 171.5179 180.2784 161.8114 158.7174 142.0319 136.6082 149.6235 149.2721 167.7791 177.1531 189.9141 (62)
Solar input 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (63)
Solar input (sum of months) = Sum(63)m = 0.0000 (63)
Output from w/h
194.5256 171.5179 180.2784 161.8114 158.7174 142.0319 136.6082 149.6235 149.2721 167.7791 177.1531 189.9141 (64)
Total per year (kWh/year) = Sum(64)m = 1979.2329 (64)
Heat gains from water heating, kWh/month
87.2963 77.4576 82.5592 75.6893 75.3901 69.1126 68.0388 72.3664 71.5200 78.4031 80.7904 85.7630 (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	116.6139	116.6139	116.6139	116.6139	116.6139	116.6139	116.6139	116.6139	116.6139	116.6139	116.6139	116.6139	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	18.3466	16.2953	13.2522	10.0328	7.4996	6.3315	6.8414	8.8927	11.9358	15.1552	17.6884	18.8565	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	205.7517	207.8868	202.5065	191.0525	176.5939	163.0049	153.9266	151.7915	157.1718	168.6258	183.0844	196.6734	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	34.6614	34.6614	34.6614	34.6614	34.6614	34.6614	34.6614	34.6614	34.6614	34.6614	34.6614	34.6614	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-93.2911	-93.2911	-93.2911	-93.2911	-93.2911	-93.2911	-93.2911	-93.2911	-93.2911	-93.2911	-93.2911	-93.2911	(71)
Water heating gains (Table 5)													
	117.3338	115.2642	110.9666	105.1240	101.3308	95.9898	91.4500	97.2667	99.3333	105.3806	112.2089	115.2729	(72)
Total internal gains													
	402.4163	400.4305	387.7095	367.1935	346.4085	326.3103	313.2021	318.9351	329.4251	350.1457	373.9658	391.7870	(73)

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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	8.2100	10.6334	0.6300	0.7000	0.7700	26.6801	(74)
Northeast	2.3100	11.2829	0.6300	0.7000	0.7700	7.9654	(75)
Northwest	5.7700	11.2829	0.6300	0.7000	0.7700	19.8962	(81)

Solar gains	54.5416	107.7000	188.8181	306.9719	413.0334	441.1667	412.3308	327.9955	228.6750	130.0011	67.9703	44.9950	(83)
Total gains	456.9579	508.1305	576.5276	674.1654	759.4420	767.4770	725.5329	646.9306	558.1001	480.1468	441.9362	436.7819	(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, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	53.3955	53.5274	53.6574	54.2766	54.3940	54.9474	54.9474	55.0511	54.7329	54.3940	54.1570	53.9114	
alpha	4.5597	4.5685	4.5772	4.6184	4.6263	4.6632	4.6632	4.6701	4.6489	4.6263	4.6105	4.5941	
util living area													
	0.9976	0.9958	0.9893	0.9620	0.8751	0.7065	0.5470	0.6251	0.8770	0.9807	0.9956	0.9981	(86)
MIT	19.5801	19.7176	19.9910	20.3870	20.7380	20.9328	20.9839	20.9710	20.8058	20.3678	19.9130	19.5595	(87)
Th 2	19.8404	19.8429	19.8454	19.8570	19.8591	19.8693	19.8693	19.8712	19.8654	19.8591	19.8547	19.8501	(88)
util rest of house													
	0.9968	0.9943	0.9852	0.9468	0.8266	0.6083	0.4154	0.4889	0.8084	0.9704	0.9938	0.9974	(89)
MIT 2	17.9620	18.1643	18.5635	19.1370	19.6040	19.8256	19.8636	19.8594	19.7048	19.1199	18.4585	17.9385	(90)
Living area fraction									fLA = Living area / (4) =			0.4896	(91)
MIT	18.7543	18.9248	19.2624	19.7491	20.1592	20.3677	20.4121	20.4037	20.2438	19.7309	19.1706	18.7322	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7543	18.9248	19.2624	19.7491	20.1592	20.3677	20.4121	20.4037	20.2438	19.7309	19.1706	18.7322	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9957	0.9926	0.9825	0.9450	0.8409	0.6540	0.4803	0.5560	0.8346	0.9689	0.9922	0.9965	(94)
Useful gains	455.0048	504.3641	566.4481	637.0903	638.6519	501.9606	348.4419	359.6735	465.8067	465.2225	438.4990	435.2643	(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													
	1385.2824	1340.8111	1217.1646	1022.8828	795.8396	537.1579	355.0281	372.1702	574.4312	859.0300	1140.5712	1379.4176	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	692.1265	562.0924	484.1331	277.7706	116.9477	0.0000	0.0000	0.0000	0.0000	292.9928	505.4920	702.4501	(98)
Space heating												3634.0051	(98)
Space heating per m2											(98) / (4) =	49.3148	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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 %)												93.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3886.6365	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	692.1265	562.0924	484.1331	277.7706	116.9477	0.0000	0.0000	0.0000	0.0000	292.9928	505.4920	702.4501	(98)
Space heating efficiency (main heating system 1)													
	93.5000	93.5000	93.5000	93.5000	93.5000	0.0000	0.0000	0.0000	0.0000	93.5000	93.5000	93.5000	(210)
Space heating fuel (main heating system)													
	740.2422	601.1683	517.7894	297.0809	125.0777	0.0000	0.0000	0.0000	0.0000	313.3613	540.6331	751.2835	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	194.5256	171.5179	180.2784	161.8114	158.7174	142.0319	136.6082	149.6235	149.2721	167.7791	177.1531	189.9141	(64)
Efficiency of water heater												79.8000	(216)
(217)m	87.9138	87.7491	87.3230	86.2433	84.0140	79.8000	79.8000	79.8000	79.8000	86.2871	87.4568	87.9891	(217)
Fuel for water heating, kWh/month													
	221.2686	195.4639	206.4501	187.6220	188.9178	177.9849	171.1882	187.4981	187.0578	194.4428	202.5607	215.8382	(219)
Water heating fuel used												2336.2931	(219)
Annual totals kWh/year													
Space heating fuel - main system												3886.6365	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												324.0069	(232)
Total delivered energy for all uses												6621.9365	(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	3886.6365	0.2160	839.5135	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2336.2931	0.2160	504.6393	(264)
Space and water heating			1344.1528	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	324.0069	0.5190	168.1596	(268)
Total CO2, kg/m2/year			1551.2374	(272)
Emissions per m2 for space and water heating			18.2406	(272a)
Fuel factor (electricity)			1.5500	
Emissions per m2 for lighting			2.2820	(272b)
Emissions per m2 for pumps and fans			0.5282	(272c)
Target Carbon Dioxide Emission Rate (TER) = (18.2406 * 1.55) + 2.2820 + 0.5282, rounded to 2 d.p.			31.0800	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	73.6900 (1b)	x	2.5000 (2b)	=	184.2250	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	73.6900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	184.2250	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent 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)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1628	(8)
Pressure test		Yes	
Measured/design AP50		3.5000	
Infiltration rate		0.3378	(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) =	0.2872	(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	0.3661	0.3590	0.3518	0.3159	0.3087	0.2728	0.2728	0.2656	0.2872	0.3087	0.3231	0.3374	(22b)
Effective ac	0.5670	0.5644	0.5619	0.5499	0.5476	0.5372	0.5372	0.5353	0.5412	0.5476	0.5522	0.5569	(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	
Window (Uw = 1.30)			20.1800	1.2357	24.9373			(27)
Front Door			2.1400	1.0000	2.1400			(26)
Window G=0.37 (Uw = 1.30)			3.3300	1.2357	4.1150			(27)
External Wall 1	56.5300	25.6500	30.8800	0.1800	5.5584			(29a)
Wall to Corridor	17.2300		17.2300	0.1800	3.1014			(29a)
External Roof 1	73.6900		73.6900	0.1000	7.3690			(30)
Total net area of external elements Aum(A, m2)			147.4500					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		47.2211			(33)
Party Wall 1			17.6000	0.0000	0.0000			(32)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							14.4553	(36)
Total fabric heat loss					(33) + (36) =		61.6764	(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	34.4721	34.3139	34.1588	33.4302	33.2939	32.6594	32.6594	32.5419	32.9038	33.2939	33.5697	33.8579	(38)
Heat transfer coeff	96.1485	95.9902	95.8351	95.1066	94.9703	94.3358	94.3358	94.2183	94.5802	94.9703	95.2461	95.5343	(39)
Average = Sum(39)m / 12 =												95.1060	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3048	1.3026	1.3005	1.2906	1.2888	1.2802	1.2802	1.2786	1.2835	1.2888	1.2925	1.2964	(40)
HLP (average)												1.2906	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.3323	(42)
Average daily hot water use (litres/day)												89.5916	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	98.5507	94.9671	91.3834	87.7998	84.2161	80.6324	80.6324	84.2161	87.7998	91.3834	94.9671	98.5507	(44)
Energy conte	146.1479	127.8219	131.9007	114.9943	110.3397	95.2148	88.2305	101.2458	102.4550	119.4014	130.3360	141.5364	(45)
Energy content (annual)										Total = Sum(45)m =		1409.6245	(45)
Distribution loss (46)m = 0.15 x (45)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	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(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	(59)

Heat gains from water heating, kWh/month

	31.0564	27.1622	28.0289	24.4363	23.4472	20.2331	18.7490	21.5147	21.7717	25.3728	27.6964	30.0765 (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	116.6139	116.6139	116.6139	116.6139	116.6139	116.6139	116.6139	116.6139	116.6139	116.6139	116.6139	116.6139	(66)

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

	18.3429	16.2920	13.2496	10.0308	7.4981	6.3302	6.8400	8.8909	11.9334	15.1522	17.6848	18.8527 (67)

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

	205.7517	207.8868	202.5065	191.0525	176.5939	163.0049	153.9266	151.7915	157.1718	168.6258	183.0844	196.6734 (68)

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

	34.6614	34.6614	34.6614	34.6614	34.6614	34.6614	34.6614	34.6614	34.6614	34.6614	34.6614	34.6614 (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)

	-93.2911	-93.2911	-93.2911	-93.2911	-93.2911	-93.2911	-93.2911	-93.2911	-93.2911	-93.2911	-93.2911	-93.2911 (71)

Water heating gains (Table 5)

	41.7425	40.4199	37.6733	33.9393	31.5150	28.1016	25.2002	28.9177	30.2385	34.1032	38.4672	40.4254 (72)

Total internal gains

	323.8213	322.5828	311.4135	293.0067	273.5912	255.4209	243.9510	247.5843	257.3278	275.8653	297.2206	313.9357 (73)

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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	11.8500	10.6334	0.4500	0.8000	0.7700	31.4359	(74)
Northwest	8.3300	11.2829	0.4500	0.8000	0.7700	23.4479	(81)
Northeast	3.3300	11.2829	0.3500	0.8000	0.7700	7.2905	(75)

Solar gains	62.1743	122.6444	214.8123	349.1053	469.7408	501.7706	468.9582	373.0114	260.0992	147.9762	77.4570	51.3090	(83)
Total gains	385.9956	445.2272	526.2257	642.1120	743.3320	757.1914	712.9092	620.5956	517.4270	423.8416	374.6776	365.2447	(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, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	53.2235	53.3113	53.3975	53.8066	53.8838	54.2462	54.2462	54.3139	54.1060	53.8838	53.7278	53.5657	
alpha	4.5482	4.5541	4.5598	4.5871	4.5923	4.6164	4.6164	4.6209	4.6071	4.5923	4.5819	4.5710	
util living area	0.9988	0.9975	0.9925	0.9684	0.8840	0.7184	0.5612	0.6521	0.9023	0.9882	0.9978	0.9991	(86)
MIT	19.4876	19.6344	19.9241	20.3427	20.7190	20.9256	20.9813	20.9643	20.7689	20.2929	19.8198	19.4606	(87)
Th 2	19.8371	19.8388	19.8404	19.8482	19.8496	19.8564	19.8564	19.8577	19.8538	19.8496	19.8467	19.8436	(88)
util rest of house	0.9984	0.9966	0.9897	0.9553	0.8374	0.6196	0.4258	0.5119	0.8417	0.9815	0.9968	0.9988	(89)
MIT 2	18.4631	18.6109	18.9005	19.3165	19.6613	19.8231	19.8519	19.8476	19.7186	19.2748	18.8025	18.4413	(90)
Living area fraction									fLA = Living area / (4) =			0.4896	(91)
MIT	18.9647	19.1120	19.4017	19.8189	20.1791	20.3629	20.4049	20.3943	20.2329	19.7733	19.3006	18.9404	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9647	19.1120	19.4017	19.8189	20.1791	20.3629	20.4049	20.3943	20.2329	19.7733	19.3006	18.9404	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9980	0.9959	0.9882	0.9549	0.8524	0.6660	0.4927	0.5812	0.8652	0.9809	0.9962	0.9984	(94)
Useful gains	385.2211	443.3940	520.0247	613.1211	633.6114	504.3142	351.2724	360.7166	447.6580	415.7398	373.2550	364.6779	(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	1409.9903	1364.2128	1236.4365	1038.4619	805.2657	543.6494	358.9371	376.3387	580.0466	871.1870	1162.0579	1408.2109	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	762.4283	618.7902	533.0104	306.2454	127.7108	0.0000	0.0000	0.0000	0.0000	338.8527	567.9381	776.3885	(98)
Space heating												4031.3645	(98)
Space heating per m2											(98) / (4) =	54.7071	(99)

8c. Space cooling requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	886.7566	698.0850	716.0591	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8574	0.9139	0.8694	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	760.2656	637.9567	622.5749	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	971.6746	918.1459	811.6583	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	152.2144	208.4608	140.6780	0.0000	0.0000	0.0000	0.0000	(104)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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Space cooling                                                                                                  501.3532 (104)
Cooled fraction                                                                  fC = cooled area / (4) =        1.0000 (105)
Intermittency factor (Table 10b)
          0.0000    0.0000    0.0000    0.0000    0.0000    0.2500    0.2500    0.2500    0.0000    0.0000    0.0000    0.0000 (106)
Space cooling kWh
          0.0000    0.0000    0.0000    0.0000    0.0000   38.0536   52.1152   35.1695    0.0000    0.0000    0.0000    0.0000 (107)
Space cooling                                                                                                  125.3383 (107)
Space cooling per m2                                                                                             1.7009 (108)
Energy for space heating                                                                                        54.7071 (99)
Energy for space cooling                                                                                         1.7009 (108)
Total                                                                                                           56.4080 (109)
Dwelling Fabric Energy Efficiency (DFEE)                                                                        56.4 (109)


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CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	73.6900 (1b)	x	2.5000 (2b)	=	184.2250	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	73.6900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	184.2250	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent 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)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1628	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4128	(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) =	0.3509	(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	0.4474	0.4386	0.4299	0.3860	0.3772	0.3334	0.3334	0.3246	0.3509	0.3772	0.3948	0.4123	(22b)
Effective ac	0.6001	0.5962	0.5924	0.5745	0.5712	0.5556	0.5556	0.5527	0.5616	0.5712	0.5779	0.5850	(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	
TER Opaque door			2.1400	1.0000	2.1400			(26)
TER Opening Type (Uw = 1.40)			16.2900	1.3258	21.5966			(27)
External Wall 1	56.5300	18.4300	38.1000	0.1800	6.8580			(29a)
Wall to Corridor	17.2300		17.2300	0.1800	3.1014			(29a)
External Roof 1	73.6900		73.6900	0.1300	9.5797			(30)
Total net area of external elements Aum(A, m2)			147.4500					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		43.2757			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							16.0810	(36)
Total fabric heat loss					(33) + (36) =		59.3567	(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	36.4822	36.2459	36.0143	34.9264	34.7229	33.7754	33.7754	33.5999	34.1403	34.7229	35.1346	35.5651	(38)
Heat transfer coeff	95.8389	95.6026	95.3710	94.2831	94.0796	93.1321	93.1321	92.9566	93.4970	94.0796	94.4913	94.9218	(39)
Average = Sum(39)m / 12 =												94.2821	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3006	1.2974	1.2942	1.2795	1.2767	1.2638	1.2638	1.2615	1.2688	1.2767	1.2823	1.2881	(40)
HLP (average)												1.2794	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.3323 (42)
Average daily hot water use (litres/day)		89.5916 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	98.5507	94.9671	91.3834	87.7998	84.2161	80.6324	80.6324	84.2161	87.7998	91.3834	94.9671	98.5507	(44)
Energy conte	146.1479	127.8219	131.9007	114.9943	110.3397	95.2148	88.2305	101.2458	102.4550	119.4014	130.3360	141.5364	(45)
Energy content (annual)										Total = Sum(45)m =		1409.6245	(45)
Distribution loss (46)m = 0.15 x (45)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	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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)
Heat gains from water heating, kWh/month													
	31.0564	27.1622	28.0289	24.4363	23.4472	20.2331	18.7490	21.5147	21.7717	25.3728	27.6964	30.0765	(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	116.6139	116.6139	116.6139	116.6139	116.6139	116.6139	116.6139	116.6139	116.6139	116.6139	116.6139	116.6139	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	18.3466	16.2953	13.2522	10.0328	7.4996	6.3315	6.8414	8.8927	11.9358	15.1552	17.6884	18.8565	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	205.7517	207.8868	202.5065	191.0525	176.5939	163.0049	153.9266	151.7915	157.1718	168.6258	183.0844	196.6734	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	34.6614	34.6614	34.6614	34.6614	34.6614	34.6614	34.6614	34.6614	34.6614	34.6614	34.6614	34.6614	(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)													
	-93.2911	-93.2911	-93.2911	-93.2911	-93.2911	-93.2911	-93.2911	-93.2911	-93.2911	-93.2911	-93.2911	-93.2911	(71)
Water heating gains (Table 5)													
	41.7425	40.4199	37.6733	33.9393	31.5150	28.1016	25.2002	28.9177	30.2385	34.1032	38.4672	40.4254	(72)
Total internal gains													
	323.8250	322.5861	311.4161	293.0087	273.5927	255.4221	243.9524	247.5860	257.3302	275.8684	297.2241	313.9395	(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	8.2100	10.6334	0.6300	0.7000	0.7700	26.6801	(74)
Northeast	2.3100	11.2829	0.6300	0.7000	0.7700	7.9654	(75)
Northwest	5.7700	11.2829	0.6300	0.7000	0.7700	19.8962	(81)

Solar gains	54.5416	107.7000	188.8181	306.9719	413.0334	441.1667	412.3308	327.9955	228.6750	130.0011	67.9703	44.9950	(83)
Total gains	378.3666	430.2861	500.2343	599.9807	686.6262	696.5888	656.2832	575.5816	486.0052	405.8695	365.1945	358.9344	(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	53.3955	53.5274	53.6574	54.2766	54.3940	54.9474	54.9474	55.0511	54.7329	54.3940	54.1570	53.9114	
alpha	4.5597	4.5685	4.5772	4.6184	4.6263	4.6632	4.6632	4.6701	4.6489	4.6263	4.6105	4.5941	
util living area													
	0.9989	0.9979	0.9939	0.9749	0.9058	0.7538	0.5964	0.6844	0.9172	0.9899	0.9980	0.9992	(86)
MIT	19.4835	19.6225	19.9001	20.3079	20.6848	20.9114	20.9770	20.9579	20.7513	20.2817	19.8190	19.4634	(87)
Th 2	19.8404	19.8429	19.8454	19.8570	19.8591	19.8693	19.8693	19.8712	19.8654	19.8591	19.8547	19.8501	(88)
util rest of house													
	0.9986	0.9971	0.9915	0.9642	0.8648	0.6574	0.4569	0.5434	0.8628	0.9842	0.9972	0.9989	(89)
MIT 2	18.4616	18.6023	18.8807	19.2910	19.6426	19.8283	19.8635	19.8588	19.7160	19.2716	18.8081	18.4491	(90)
Living area fraction									fLA = Living area / (4) =			0.4896	(91)
MIT	18.9619	19.1018	19.3798	19.7889	20.1529	20.3586	20.4087	20.3970	20.2229	19.7661	19.3030	18.9457	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9619	19.1018	19.3798	19.7889	20.1529	20.3586	20.4087	20.3970	20.2229	19.7661	19.3030	18.9457	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9982	0.9964	0.9902	0.9634	0.8769	0.7022	0.5259	0.6132	0.8831	0.9836	0.9966	0.9986	(94)
Useful gains	377.6688	428.7408	495.3459	578.0433	602.0842	489.1223	345.1715	352.9334	429.1860	399.1973	363.9481	358.4200	(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													
	1405.1810	1357.7304	1228.3615	1026.6375	795.2449	536.3116	354.7137	371.5439	572.4714	862.3466	1153.0820	1399.6856	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	764.4691	624.2810	545.3636	322.9879	143.7116	0.0000	0.0000	0.0000	0.0000	344.5831	568.1764	774.7016	(98)
Space heating												4088.2743	(98)
Space heating per m2											(98) / (4) =	55.4794	(99)

8c. Space cooling requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	875.4413	689.1772	706.4701	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8350	0.8983	0.8518	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	730.9817	619.0986	601.8029	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	900.8421	851.9615	759.0468	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	122.2995	173.2500	116.9895	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												412.5390	(104)
Cooled fraction									fC = cooled area / (4) =			1.0000	(105)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Intermittency factor (Table 10b)												
0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh												
0.0000	0.0000	0.0000	0.0000	0.0000	30.5749	43.3125	29.2474	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling											103.1347	(107)
Space cooling per m2											1.3996	(108)
Energy for space heating											55.4794	(99)
Energy for space cooling											1.3996	(108)
Total											56.8789	(109)
Target Fabric Energy Efficiency (TFEE)											65.4	(109)

FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Designed)

HODKINSON

Property Reference	B.09.02 Wootton	**Issued on Date**	26/11/2020
Assessment Reference	B.09.02 Wootton HP	**Prop Type Ref**	Blk B 1B2P (Top F)
Property			

SAP Rating	83 B	**DER**	22.99	**TER**	35.11
Environmental	85 B	**% DER<TER**	34.52		
CO_2 Emissions (t/year)	0.96	**DFEE**	63.73	**TFEE**	69.60
General Requirements Compliance	Pass	**% DFEE<TFEE**	8.43		

Assessor Details	Mr. Jonathan Peck, Jonathan Peck, Tel: 02036031622, Jonathan@hodkinsonconsultancy.com	**Assessor ID**	M976-0001
Client			

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

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

DWELLING AS DESIGNED

Top-floor flat, total floor area 50 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER
Fuel for main heating:Electricity
Fuel factor:1.55 (electricity)
Target Carbon Dioxide Emission Rate (TER) 35.11 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 22.99 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)69.6 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)63.7 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.20 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	(no floor)		
Roof	0.10 (max. 0.20)	0.10 (max. 0.35)	OK
Openings	1.27 (max. 2.00)	1.30 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability
Air permeability at 50 pascals: 3.50 (design value)
Maximum 10.0 OK

4 Heating efficiency
Main heating system: Heat pump with radiators or underfloor - Electric
Mitsubishi ECODAN 5kW PUHZ-W50VHA-BS

Secondary heating system: None

5 Cylinder insulation
Hot water storage: Measured cylinder loss: 1.20 kWh/day
Permitted by DBSCG 2.03: OK
Primary pipework insulated: Yes OK

6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: Cylinderstat OK
Independent timer for DHW OK

7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK

8 Mechanical ventilation
Continuous supply and extract system
Specific fan power: 0.48
Maximum 1.5 OK
MVHR efficiency: 92%
Minimum: 70% OK

9 Summertime temperature
Overheating risk (Thames Valley): Slight OK
Based on:
Overshading: Average
Windows facing North East: 12.16 m², No overhang
Windows facing South East: 5.00 m², No overhang
Air change rate: 6.00 ach
Blinds/curtains: None

10 Key features
Party wall U-value 0.00 W/m²K
Roof U-value 0.10 W/m²K
Door U-value 1.00 W/m²K
Air permeability 3.5 m³/m²h
Photovoltaic array 0.14 kW

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.4800 (1b)	x	2.5000 (2b)	=	126.2000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	50.4800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	126.2000	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent 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)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Measured/design AP50		3.5000	
Infiltration rate		0.1750	(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) =	0.1488	(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	0.1897	0.1859	0.1822	0.1636	0.1599	0.1413	0.1413	0.1376	0.1488	0.1599	0.1673	0.1748	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation:	0.5000	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	78.2000	(23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.2987	0.2949	0.2912	0.2726	0.2689	0.2503	0.2503	0.2466	0.2578	0.2689	0.2763	0.2838	(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	
Window (Uw = 1.30)			5.0000	1.2357	6.1787			(27)
Front Door			2.1400	1.0000	2.1400			(26)
Window G=0.37 (Uw = 1.30)			12.1600	1.2357	15.0266			(27)
External Wall 1	68.9900	19.3000	49.6900	0.1800	8.9442			(29a)
Wall to Corridor	11.5500		11.5500	0.1800	2.0790			(29a)
Wall to stair	12.3800		12.3800	0.2500	3.0950			(29a)
Wall to lift shaft	4.3800		4.3800	0.2500	1.0950			(29a)
External Roof 1	50.4800		50.4800	0.1000	5.0480			(30)
Total net area of external elements Aum(A, m2)			147.7800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	43.6065			(33)
Party Wall 1			16.8500	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	10.3904	(36)
Total fabric heat loss (33) + (36) =	53.9969	(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	12.4378	12.2830	12.1281	11.3537	11.1989	10.4245	10.4245	10.2696	10.7343	11.1989	11.5086	11.8184	(38)
Heat transfer coeff	66.4348	66.2799	66.1250	65.3507	65.1958	64.4214	64.4214	64.2666	64.7312	65.1958	65.5055	65.8153	(39)
Average = Sum(39)m / 12 =												65.3119	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3161	1.3130	1.3099	1.2946	1.2915	1.2762	1.2762	1.2731	1.2823	1.2915	1.2977	1.3038	(40)
HLP (average)												1.2938	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.7042 (42)
Average daily hot water use (litres/day)	74.6757 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	82.1433	79.1562	76.1692	73.1822	70.1952	67.2081	67.2081	70.1952	73.1822	76.1692	79.1562	82.1433	(44)
Energy conte	121.8161	106.5411	109.9409	95.8492	91.9695	79.3627	73.5412	84.3896	85.3975	99.5226	108.6367	117.9724	(45)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy content (annual)											Total = Sum(45)m =	1174.9396	(45)
Distribution loss (46)m = 0.15 x (45)m													
	18.2724	15.9812	16.4911	14.3774	13.7954	11.9044	11.0312	12.6584	12.8096	14.9284	16.2955	17.6959	(46)
Water storage loss:													
Store volume												170.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.2000	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.6480	(55)
Total storage loss													
	20.0880	18.1440	20.0880	19.4400	20.0880	19.4400	20.0880	20.0880	19.4400	20.0880	19.4400	20.0880	(56)
If cylinder contains dedicated solar storage													
	20.0880	18.1440	20.0880	19.4400	20.0880	19.4400	20.0880	20.0880	19.4400	20.0880	19.4400	20.0880	(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)
Total heat required for water heating calculated for each month													
	165.1665	145.6963	153.2913	137.8012	135.3199	121.3147	116.8916	127.7400	127.3495	142.8730	150.5887	161.3228	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
										Solar input (sum of months) = Sum(63)m =		0.0000	(63)
Output from w/h													
	165.1665	145.6963	153.2913	137.8012	135.3199	121.3147	116.8916	127.7400	127.3495	142.8730	150.5887	161.3228	(64)
										Total per year (kWh/year) = Sum(64)m =		1685.3556	(64)
Heat gains from water heating, kWh/month													
	75.1842	66.7491	71.2357	65.4314	65.2602	59.9497	59.1328	62.7399	61.9563	67.7716	69.6833	73.9061	(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	85.2120	85.2120	85.2120	85.2120	85.2120	85.2120	85.2120	85.2120	85.2120	85.2120	85.2120	85.2120	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	13.2371	11.7571	9.5615	7.2387	5.4110	4.5682	4.9361	6.4161	8.6117	10.9346	12.7622	13.6051	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	148.4805	150.0213	146.1386	137.8729	127.4389	117.6323	111.0810	109.5402	113.4229	121.6886	132.1227	141.9292	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	31.5212	31.5212	31.5212	31.5212	31.5212	31.5212	31.5212	31.5212	31.5212	31.5212	31.5212	31.5212	(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)													
	-68.1696	-68.1696	-68.1696	-68.1696	-68.1696	-68.1696	-68.1696	-68.1696	-68.1696	-68.1696	-68.1696	-68.1696	(71)
Water heating gains (Table 5)													
	101.0540	99.3290	95.7469	90.8770	87.7153	83.2635	79.4795	84.3278	86.0504	91.0908	96.7824	99.3362	(72)
Total internal gains													
	311.3353	309.6710	300.0106	284.5522	269.1288	254.0276	244.0602	248.8477	256.6486	272.2776	290.2309	303.4341	(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	
Southeast	5.0000	36.7938	0.4500	0.8000	0.7700	45.8966	(77)
Northeast	12.1600	11.2829	0.3500	0.8000	0.7700	26.6224	(75)

Solar gains	72.5190	132.3696	204.6022	292.8820	363.9873	377.1617	357.0462	301.5819	234.7925	152.6297	88.4714	61.0191	(83)
Total gains	383.8543	442.0406	504.6128	577.4341	633.1160	631.1894	601.1064	550.4296	491.4411	424.9073	378.7023	364.4532	(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	52.7669	52.8902	53.0141	53.6422	53.7697	54.4160	54.4160	54.5471	54.1556	53.7697	53.5154	53.2636	
alpha	4.5178	4.5260	4.5343	4.5761	4.5846	4.6277	4.6277	4.6365	4.6104	4.5846	4.5677	4.5509	
util living area													
	0.9946	0.9891	0.9734	0.9226	0.8027	0.6185	0.4638	0.5227	0.7804	0.9527	0.9893	0.9957	(86)
Tweekday	18.1076	18.3646	18.7871	19.3200	19.6849	19.8353	19.8567	19.8566	19.7699	19.2966	18.6176	18.0703	
Tweekend	20.1505	20.2643	20.4535	20.6976	20.8850	20.9742	20.9945	20.9907	20.9259	20.6796	20.3724	20.1309	
24 / 16	9	8	9	8	9	9	9	9	8	9	8	9	
24 / 9	22	20	22	22	22	21	22	22	22	22	22	22	
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	19.8283	19.8307	19.8331	19.8451	19.8475	19.8595	19.8595	19.8620	19.8547	19.8475	19.8427	19.8379	(88)
util rest of house													
	0.9928	0.9854	0.9643	0.8962	0.7423	0.5224	0.3476	0.4006	0.6932	0.9308	0.9850	0.9942	(89)
Tweekday	18.1076	18.3646	18.7871	19.3200	19.6849	19.8353	19.8567	19.8566	19.7699	19.2966	18.6176	18.0703	
Tweekend	18.1076	18.3646	18.7871	19.3200	19.6849	19.8353	19.8567	19.8566	19.7699	19.2966	18.6176	18.0703	
MIT 2	19.8283	19.8307	19.8331	19.8451	19.8475	19.8595	19.8595	19.8620	19.8547	19.8475	19.8427	19.8379	(90)
Living area fraction										fLA = Living area / (4) =		0.4307	(91)
MIT	20.3329	20.3343	20.3356	20.3425	20.3438	20.3507	20.3507	20.3521	20.3479	20.3438	20.3411	20.3384	(92)
Temperature adjustment												0.0000	
adjusted MIT	20.3329	20.3343	20.3356	20.3425	20.3438	20.3507	20.3507	20.3521	20.3479	20.3438	20.3411	20.3384	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9936	0.9871	0.9686	0.9086	0.7701	0.5653	0.3984	0.4545	0.7337	0.9414	0.9871	0.9949	(94)
Useful gains	381.4043	436.3567	488.7851	524.6465	487.5684	356.7884	239.4837	250.1466	360.5773	400.0110	373.8102	362.6074	(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													

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

	1065.1416	1022.9811	914.8810	747.7725	563.5416	370.4682	241.6253	253.9862	404.4371	635.2569	867.3649	1062.1505	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	508.7006	394.2116	317.0153	160.6508	56.5241	0.0000	0.0000	0.0000	0.0000	175.0230	355.3594	520.4600	(98)
Space heating												2487.9447	(98)
Space heating per m2											(98) / (4) =	49.2858	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												232.3834	(206)
Efficiency of secondary/supplementary heating system, %												100.0000	(208)
Space heating requirement												1070.6208	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	508.7006	394.2116	317.0153	160.6508	56.5241	0.0000	0.0000	0.0000	0.0000	175.0230	355.3594	520.4600	(98)
Space heating efficiency (main heating system 1)													
	232.3834	232.3834	232.3834	232.3834	232.3834	0.0000	0.0000	0.0000	0.0000	232.3834	232.3834	232.3834	(210)
Space heating fuel (main heating system)													
	218.9058	169.6385	136.4191	69.1318	24.3236	0.0000	0.0000	0.0000	0.0000	75.3165	152.9195	223.9661	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	165.1665	145.6963	153.2913	137.8012	135.3199	121.3147	116.8916	127.7400	127.3495	142.8730	150.5887	161.3228	(64)
Efficiency of water heater												178.1250	(216)
(217)m	178.1250	178.1250	178.1250	178.1250	178.1250	178.1250	178.1250	178.1250	178.1250	178.1250	178.1250	178.1250	(217)
Fuel for water heating, kWh/month													
	92.7251	81.7944	86.0583	77.3621	75.9691	68.1065	65.6234	71.7137	71.4945	80.2094	84.5410	90.5672	(219)
Water heating fuel used												946.1646	(219)
Annual totals kWh/year													
Space heating fuel - main system												1070.6208	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.6000)													
mechanical ventilation fans (SFP = 0.6000)												92.3784	(230a)
Total electricity for the above, kWh/year												92.3784	(231)
Electricity for lighting (calculated in Appendix L)												233.7722	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 0.14 * 951 * 1.00) =												-106.4690	(233)
Total delivered energy for all uses												2236.4669	(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	1070.6208	0.5190	555.6522	(261)
Space heating - secondary	0.0000	0.5190	0.0000	(263)
Water heating (other fuel)	946.1646	0.5190	491.0594	(264)
Space and water heating			1046.7116	(265)
Pumps and fans	92.3784	0.5190	47.9444	(267)
Energy for lighting	233.7722	0.5190	121.3278	(268)
Energy saving/generation technologies				
PV Unit	-106.4690	0.5190	-55.2574	(269)
Total CO2, kg/year			1160.7263	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			22.9900	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		22.9900	ZC1
Total Floor Area	TFA	50.4800	
Assumed number of occupants	N	1.7042	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		17.4300	ZC2
CO2 emissions from cooking, equation (L16)		3.1676	ZC3
Total CO2 emissions		43.5876	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		43.5876	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.4800 (1b)	x	2.5000 (2b)	=	126.2000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	50.4800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	126.2000	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent 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)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1585	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4085	(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) =	0.3472	(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	0.4427	0.4340	0.4253	0.3819	0.3732	0.3298	0.3298	0.3212	0.3472	0.3732	0.3906	0.4080	(22b)
Effective ac	0.5980	0.5942	0.5905	0.5729	0.5697	0.5544	0.5544	0.5516	0.5603	0.5697	0.5763	0.5832	(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	
TER Opaque door			2.1400	1.0000	2.1400			(26)
TER Opening Type (Uw = 1.40)			10.4800	1.3258	13.8939			(27)
External Wall 1	68.9900	12.6200	56.3700	0.1800	10.1466			(29a)
Wall to Corridor	11.5500		11.5500	0.1800	2.0790			(29a)
Wall to stair	12.3800		12.3800	0.1800	2.2284			(29a)
Wall to lift shaft	4.3800		4.3800	0.1800	0.7884			(29a)
External Roof 1	50.4800		50.4800	0.1300	6.5624			(30)
Total net area of external elements Aum(A, m2)			147.7800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	37.8387			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	10.5386	(36)
Total fabric heat loss (33) + (36) =	48.3773	(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	24.9038	24.7453	24.5900	23.8604	23.7239	23.0885	23.0885	22.9708	23.3333	23.7239	24.0001	24.2887	(38)
Heat transfer coeff	73.2811	73.1226	72.9673	72.2378	72.1013	71.4659	71.4659	71.3482	71.7106	72.1013	72.3774	72.6661	(39)
Average = Sum(39)m / 12 =												72.2371	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.4517	1.4485	1.4455	1.4310	1.4283	1.4157	1.4157	1.4134	1.4206	1.4283	1.4338	1.4395	(40)
HLP (average)												1.4310	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.7042	(42)
Average daily hot water use (litres/day)	74.6757	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	82.1433	79.1562	76.1692	73.1822	70.1952	67.2081	67.2081	70.1952	73.1822	76.1692	79.1562	82.1433	(44)
Energy conte	121.8161	106.5411	109.9409	95.8492	91.9695	79.3627	73.5412	84.3896	85.3975	99.5226	108.6367	117.9724	(45)
Energy content (annual)										Total = Sum(45)m =		1174.9396	(45)
Distribution loss (46)m = 0.15 x (45)m	18.2724	15.9812	16.4911	14.3774	13.7954	11.9044	11.0312	12.6584	12.8096	14.9284	16.2955	17.6959	(46)

Water storage loss:		
Store volume	170.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):	1.5003	(48)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.8102	(55)
Total storage loss													
	25.1153	22.6848	25.1153	24.3051	25.1153	24.3051	25.1153	25.1153	24.3051	25.1153	24.3051	25.1153	(56)
If cylinder contains dedicated solar storage													
	25.1153	22.6848	25.1153	24.3051	25.1153	24.3051	25.1153	25.1153	24.3051	25.1153	24.3051	25.1153	(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)
Total heat required for water heating calculated for each month													
	170.1938	150.2371	158.3186	142.6663	140.3472	126.1799	121.9189	132.7673	132.2146	147.9003	155.4538	166.3501	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	170.1938	150.2371	158.3186	142.6663	140.3472	126.1799	121.9189	132.7673	132.2146	147.9003	155.4538	166.3501	(64)
									Total per year (kWh/year) = Sum(64)m =			1744.5481	(64)
Heat gains from water heating, kWh/month													
	79.2060	70.3817	75.2575	69.3235	69.2820	63.8418	63.1546	66.7617	65.8484	71.7934	73.5754	77.9280	(65)

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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	85.2120	85.2120	85.2120	85.2120	85.2120	85.2120	85.2120	85.2120	85.2120	85.2120	85.2120	85.2120	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	13.2848	11.7994	9.5959	7.2647	5.4305	4.5846	4.9539	6.4392	8.6427	10.9739	12.8082	13.6540	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	148.4805	150.0213	146.1386	137.8729	127.4389	117.6323	111.0810	109.5402	113.4229	121.6886	132.1227	141.9292	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	31.5212	31.5212	31.5212	31.5212	31.5212	31.5212	31.5212	31.5212	31.5212	31.5212	31.5212	31.5212	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-68.1696	-68.1696	-68.1696	-68.1696	-68.1696	-68.1696	-68.1696	-68.1696	-68.1696	-68.1696	-68.1696	-68.1696	(71)
Water heating gains (Table 5)													
	106.4597	104.7347	101.1526	96.2827	93.1210	88.6692	84.8852	89.7335	91.4561	96.4965	102.1881	104.7419	(72)
Total internal gains													
	319.7886	318.1190	308.4508	292.9839	277.5540	262.4498	252.4837	257.2765	265.0853	280.7227	298.6825	311.8887	(73)

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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	
Northeast	7.4300	11.2829	0.6300	0.7000	0.7700	25.6202	(75)
Southeast	3.0500	36.7938	0.6300	0.7000	0.7700	34.2963	(77)

Solar gains	59.9165	110.5699	173.8907	253.3469	318.3520	331.2615	313.0410	262.2187	201.0396	128.2980	73.3159	50.2732	(83)
Total gains	379.7051	428.6890	482.3415	546.3309	595.9060	593.7112	565.5247	519.4953	466.1249	409.0207	371.9984	362.1619	(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, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	47.8371	47.9408	48.0428	48.5280	48.6199	49.0522	49.0522	49.1331	48.8848	48.6199	48.4344	48.2420	
alpha	4.1891	4.1961	4.2029	4.2352	4.2413	4.2701	4.2701	4.2755	4.2590	4.2413	4.2290	4.2161	
util living area													
	0.9949	0.9908	0.9796	0.9440	0.8537	0.6927	0.5349	0.5959	0.8332	0.9637	0.9906	0.9958	(86)
MIT	19.5080	19.6721	19.9663	20.3658	20.7135	20.9181	20.9788	20.9670	20.8113	20.3702	19.8721	19.4799	(87)
Th 2	19.7239	19.7263	19.7286	19.7396	19.7417	19.7513	19.7513	19.7531	19.7476	19.7417	19.7375	19.7332	(88)
util rest of house													
	0.9931	0.9876	0.9721	0.9224	0.7980	0.5868	0.3935	0.4513	0.7490	0.9454	0.9867	0.9944	(89)
MIT 2	17.7784	18.0186	18.4452	19.0161	19.4712	19.6999	19.7443	19.7407	19.6026	19.0351	18.3186	17.7437	(90)
Living area fraction									fLA = Living area / (4) =			0.4307	(91)
MIT	18.5233	18.7307	19.1003	19.5974	20.0062	20.2246	20.2760	20.2688	20.1231	19.6101	18.9877	18.4914	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.5233	18.7307	19.1003	19.5974	20.0062	20.2246	20.2760	20.2688	20.1231	19.6101	18.9877	18.4914	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9907	0.9841	0.9673	0.9194	0.8112	0.6296	0.4550	0.5141	0.7778	0.9429	0.9834	0.9923	(94)
Useful gains	376.1742	421.8717	466.5523	502.3012	483.4124	373.8108	257.2873	267.0492	362.5431	385.6623	365.8317	359.3723	(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													
	1042.2975	1011.3394	919.4089	772.7543	598.8879	401.9639	262.7078	276.0314	431.9216	649.6390	860.3986	1038.4997	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	495.5957	396.1223	336.9253	194.7263	85.9137	0.0000	0.0000	0.0000	0.0000	196.3987	356.0882	505.2708	(98)
Space heating												2567.0409	(98)
Space heating per m2											(98) / (4) =	50.8526	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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 %)												93.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												2745.4983	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	495.5957	396.1223	336.9253	194.7263	85.9137	0.0000	0.0000	0.0000	0.0000	196.3987	356.0882	505.2708	(98)
Space heating efficiency (main heating system 1)													
	93.5000	93.5000	93.5000	93.5000	93.5000	0.0000	0.0000	0.0000	0.0000	93.5000	93.5000	93.5000	(210)
Space heating fuel (main heating system)													
	530.0489	423.6602	360.3480	208.2634	91.8863	0.0000	0.0000	0.0000	0.0000	210.0520	380.8430	540.3966	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	170.1938	150.2371	158.3186	142.6663	140.3472	126.1799	121.9189	132.7673	132.2146	147.9003	155.4538	166.3501	(64)
Efficiency of water heater												79.8000	(216)
(217)m	87.5008	87.2819	86.7802	85.6442	83.5509	79.8000	79.8000	79.8000	79.8000	85.5712	86.9567	87.5910	(217)
Fuel for water heating, kWh/month													
	194.5053	172.1287	182.4362	166.5803	167.9781	158.1201	152.7806	166.3751	165.6825	172.8389	178.7714	189.9168	(219)
Water heating fuel used												2068.1141	(219)
Annual totals kWh/year													
Space heating fuel - main system												2745.4983	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												234.6135	(232)
Total delivered energy for all uses												5123.2260	(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	2745.4983	0.2160	593.0276	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2068.1141	0.2160	446.7127	(264)
Space and water heating			1039.7403	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	234.6135	0.5190	121.7644	(268)
Total CO2, kg/m2/year			1200.4297	(272)
Emissions per m2 for space and water heating			20.5971	(272a)
Fuel factor (electricity)			1.5500	
Emissions per m2 for lighting			2.4121	(272b)
Emissions per m2 for pumps and fans			0.7711	(272c)
Target Carbon Dioxide Emission Rate (TER) = (20.5971 * 1.55) + 2.4121 + 0.7711, rounded to 2 d.p.			35.1100	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.4800 (1b)	x	2.5000 (2b)	=	126.2000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	50.4800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	126.2000	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent 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)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1585	(8)
Pressure test		Yes	
Measured/design AP50		3.5000	
Infiltration rate		0.3335	(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) =	0.2835	(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	0.3614	0.3543	0.3472	0.3118	0.3047	0.2693	0.2693	0.2622	0.2835	0.3047	0.3189	0.3331	(22b)
Effective ac	0.5653	0.5628	0.5603	0.5486	0.5464	0.5363	0.5363	0.5344	0.5402	0.5464	0.5508	0.5555	(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	
Window (Uw = 1.30)			5.0000	1.2357	6.1787			(27)
Front Door			2.1400	1.0000	2.1400			(26)
Window G=0.37 (Uw = 1.30)			12.1600	1.2357	15.0266			(27)
External Wall 1	68.9900	19.3000	49.6900	0.1800	8.9442			(29a)
Wall to Corridor	11.5500		11.5500	0.1800	2.0790			(29a)
Wall to stair	12.3800		12.3800	0.2500	3.0950			(29a)
Wall to lift shaft	4.3800		4.3800	0.2500	1.0950			(29a)
External Roof 1	50.4800		50.4800	0.1000	5.0480			(30)
Total net area of external elements Aum(A, m2)			147.7800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		43.6065			(33)
Party Wall 1			16.8500	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	10.3904	(36)
Total fabric heat loss (33) + (36) =	53.9969	(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	23.5428	23.4372	23.3337	22.8474	22.7565	22.3330	22.3330	22.2545	22.4961	22.7565	22.9405	23.1329	(38)
Heat transfer coeff	77.5397	77.4341	77.3306	76.8444	76.7534	76.3299	76.3299	76.2515	76.4930	76.7534	76.9374	77.1298	(39)
Average = Sum(39)m / 12 =												76.8439	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.5360	1.5340	1.5319	1.5223	1.5205	1.5121	1.5121	1.5105	1.5153	1.5205	1.5241	1.5279	(40)
HLP (average)												1.5223	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.7042 (42)
Average daily hot water use (litres/day)	74.6757 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	82.1433	79.1562	76.1692	73.1822	70.1952	67.2081	67.2081	70.1952	73.1822	76.1692	79.1562	82.1433	(44)
Energy conte	121.8161	106.5411	109.9409	95.8492	91.9695	79.3627	73.5412	84.3896	85.3975	99.5226	108.6367	117.9724	(45)
Energy content (annual)										Total = Sum(45)m =		1174.9396	(45)
Distribution loss (46)m = 0.15 x (45)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	(46)
Water storage loss:													

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Total storage loss
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (56)
If cylinder contains dedicated solar storage
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (57)
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)
Heat gains from water heating, kWh/month
25.8859 22.6400 23.3624 20.3679 19.5435 16.8646 15.6275 17.9328 18.1470 21.1485 23.0853 25.0691 (65)

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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	85.2120	85.2120	85.2120	85.2120	85.2120	85.2120	85.2120	85.2120	85.2120	85.2120	85.2120	85.2120	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	13.2371	11.7571	9.5615	7.2387	5.4110	4.5682	4.9361	6.4161	8.6117	10.9346	12.7622	13.6051	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	148.4805	150.0213	146.1386	137.8729	127.4389	117.6323	111.0810	109.5402	113.4229	121.6886	132.1227	141.9292	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	31.5212	31.5212	31.5212	31.5212	31.5212	31.5212	31.5212	31.5212	31.5212	31.5212	31.5212	31.5212	(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)													
	-68.1696	-68.1696	-68.1696	-68.1696	-68.1696	-68.1696	-68.1696	-68.1696	-68.1696	-68.1696	-68.1696	-68.1696	(71)
Water heating gains (Table 5)													
	34.7929	33.6905	31.4011	28.2888	26.2682	23.4230	21.0047	24.1032	25.2041	28.4255	32.0629	33.6951	(72)
Total internal gains													
	245.0742	244.0325	235.6649	221.9640	207.6816	194.1872	185.5854	188.6232	195.8023	209.6123	225.5114	237.7929	(73)

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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	
Southeast	5.0000	36.7938	0.4500	0.8000	0.7700	45.8966	(77)
Northeast	12.1600	11.2829	0.3500	0.8000	0.7700	26.6224	(75)

Solar gains	72.5190	132.3696	204.6022	292.8820	363.9873	377.1617	357.0462	301.5819	234.7925	152.6297	88.4714	61.0191	(83)
Total gains	317.5932	376.4021	440.2671	514.8459	571.6689	571.3489	542.6316	490.2050	430.5948	362.2419	313.9829	298.8121	(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, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	45.2098	45.2715	45.3321	45.6189	45.6730	45.9264	45.9264	45.9736	45.8284	45.6730	45.5637	45.4501	
alpha	4.0140	4.0181	4.0221	4.0413	4.0449	4.0618	4.0618	4.0649	4.0552	4.0449	4.0376	4.0300	
util living area													
	0.9973	0.9943	0.9857	0.9569	0.8796	0.7352	0.5821	0.6516	0.8745	0.9772	0.9950	0.9979	(86)
MIT	19.2997	19.4830	19.8045	20.2383	20.6323	20.8805	20.9651	20.9453	20.7361	20.2257	19.6814	19.2636	(87)
Th 2	19.6606	19.6621	19.6637	19.6708	19.6722	19.6785	19.6785	19.6796	19.6760	19.6722	19.6695	19.6666	(88)
util rest of house													
	0.9964	0.9922	0.9802	0.9389	0.8281	0.6260	0.4247	0.4934	0.7984	0.9646	0.9928	0.9972	(89)
MIT 2	18.1403	18.3239	18.6436	19.0710	19.4308	19.6261	19.6706	19.6653	19.5317	19.0676	18.5280	18.1088	(90)
Living area fraction										fLA = Living area / (4) =		0.4307	(91)
MIT	18.6396	18.8231	19.1436	19.5737	19.9482	20.1663	20.2281	20.2165	20.0504	19.5663	19.0247	18.6061	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6396	18.8231	19.1436	19.5737	19.9482	20.1663	20.2281	20.2165	20.0504	19.5663	19.0247	18.6061	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9953	0.9905	0.9774	0.9373	0.8404	0.6699	0.4935	0.5625	0.8238	0.9632	0.9913	0.9963	(94)
Useful gains	316.1065	372.8126	430.3100	482.5713	480.4519	382.7693	267.8035	275.7268	354.7200	348.9228	311.2494	297.7122	(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													
	1111.8890	1078.1203	977.7341	820.2150	633.0805	424.8765	276.9310	291.0157	455.1636	688.1976	917.4590	1111.1405	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	592.0622	473.9667	407.2835	243.1035	113.5557	0.0000	0.0000	0.0000	0.0000	252.4204	436.4709	605.1907	(98)
Space heating												3124.0537	(98)
Space heating per m2											(98) / (4) =	61.8870	(99)

8c. Space cooling requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	717.5009	564.8411	579.5110	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8105	0.8770	0.8387	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	581.5541	495.3456	486.0153	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	732.2671	697.4787	637.1492	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

```
                0.0000     0.0000     0.0000     0.0000     0.0000   108.5133   150.3870   112.4436     0.0000     0.0000     0.0000     0.0000 (104)
Space cooling                                                                                                                          371.3439 (104)
Cooled fraction                                                                                    fC = cooled area / (4) =              1.0000 (105)
Intermittency factor (Table 10b)
                0.0000     0.0000     0.0000     0.0000     0.0000     0.2500     0.2500     0.2500     0.0000     0.0000     0.0000     0.0000 (106)
Space cooling kWh
                0.0000     0.0000     0.0000     0.0000     0.0000    27.1283    37.5968    28.1109     0.0000     0.0000     0.0000     0.0000 (107)
Space cooling                                                                                                                           92.8360 (107)
Space cooling per m2                                                                                                                     1.8391 (108)
Energy for space heating                                                                                                                61.8870 (99)
Energy for space cooling                                                                                                                 1.8391 (108)
Total                                                                                                                                   63.7260 (109)
Dwelling Fabric Energy Efficiency (DFEE)                                                                                                   63.7 (109)


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CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.4800 (1b)	x	2.5000 (2b)	=	126.2000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	50.4800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	126.2000	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent 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)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1585	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4085	(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) =	0.3472	(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	0.4427	0.4340	0.4253	0.3819	0.3732	0.3298	0.3298	0.3212	0.3472	0.3732	0.3906	0.4080	(22b)
Effective ac	0.5980	0.5942	0.5905	0.5729	0.5697	0.5544	0.5544	0.5516	0.5603	0.5697	0.5763	0.5832	(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	
TER Opaque door			2.1400	1.0000	2.1400			(26)
TER Opening Type (Uw = 1.40)			10.4800	1.3258	13.8939			(27)
External Wall 1	68.9900	12.6200	56.3700	0.1800	10.1466			(29a)
Wall to Corridor	11.5500		11.5500	0.1800	2.0790			(29a)
Wall to stair	12.3800		12.3800	0.1800	2.2284			(29a)
Wall to lift shaft	4.3800		4.3800	0.1800	0.7884			(29a)
External Roof 1	50.4800		50.4800	0.1300	6.5624			(30)
Total net area of external elements Aum(A, m2)			147.7800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	37.8387			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	10.5386	(36)
Total fabric heat loss (33) + (36) =	48.3773	(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	24.9038	24.7453	24.5900	23.8604	23.7239	23.0885	23.0885	22.9708	23.3333	23.7239	24.0001	24.2887	(38)
Heat transfer coeff	73.2811	73.1226	72.9673	72.2378	72.1013	71.4659	71.4659	71.3482	71.7106	72.1013	72.3774	72.6661	(39)
Average = Sum(39)m / 12 =												72.2371	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.4517	1.4485	1.4455	1.4310	1.4283	1.4157	1.4157	1.4134	1.4206	1.4283	1.4338	1.4395	(40)
HLP (average)												1.4310	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.7042 (42)
Average daily hot water use (litres/day)	74.6757 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	82.1433	79.1562	76.1692	73.1822	70.1952	67.2081	67.2081	70.1952	73.1822	76.1692	79.1562	82.1433	(44)
Energy conte	121.8161	106.5411	109.9409	95.8492	91.9695	79.3627	73.5412	84.3896	85.3975	99.5226	108.6367	117.9724	(45)
Energy content (annual)										Total = Sum(45)m =		1174.9396	(45)
Distribution loss (46)m = 0.15 x (45)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	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(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	(59)

Heat gains from water heating, kWh/month

	25.8859	22.6400	23.3624	20.3679	19.5435	16.8646	15.6275	17.9328	18.1470	21.1485	23.0853	25.0691 (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	85.2120	85.2120	85.2120	85.2120	85.2120	85.2120	85.2120	85.2120	85.2120	85.2120	85.2120	85.2120	(66)

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

	13.2848	11.7994	9.5959	7.2647	5.4305	4.5846	4.9539	6.4392	8.6427	10.9739	12.8082	13.6540 (67)

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

	148.4805	150.0213	146.1386	137.8729	127.4389	117.6323	111.0810	109.5402	113.4229	121.6886	132.1227	141.9292 (68)

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

	31.5212	31.5212	31.5212	31.5212	31.5212	31.5212	31.5212	31.5212	31.5212	31.5212	31.5212	31.5212 (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)

	-68.1696	-68.1696	-68.1696	-68.1696	-68.1696	-68.1696	-68.1696	-68.1696	-68.1696	-68.1696	-68.1696	-68.1696 (71)

Water heating gains (Table 5)

	34.7929	33.6905	31.4011	28.2888	26.2682	23.4230	21.0047	24.1032	25.2041	28.4255	32.0629	33.6951 (72)

Total internal gains

	245.1218	244.0748	235.6993	221.9900	207.7011	194.2036	185.6032	188.6463	195.8333	209.6516	225.5574	237.8419 (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	
Northeast	7.4300	11.2829	0.6300	0.7000	0.7700	25.6202	(75)
Southeast	3.0500	36.7938	0.6300	0.7000	0.7700	34.2963	(77)

Solar gains	59.9165	110.5699	173.8907	253.3469	318.3520	331.2615	313.0410	262.2187	201.0396	128.2980	73.3159	50.2732	(83)
Total gains	305.0383	354.6447	409.5900	475.3370	526.0531	525.4651	498.6442	450.8650	396.8730	337.9496	298.8732	288.1151	(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	47.8371	47.9408	48.0428	48.5280	48.6199	49.0522	49.0522	49.1331	48.8848	48.6199	48.4344	48.2420	
alpha	4.1891	4.1961	4.2029	4.2352	4.2413	4.2701	4.2701	4.2755	4.2590	4.2413	4.2290	4.2161	
util living area	0.9978	0.9954	0.9886	0.9639	0.8930	0.7502	0.5949	0.6652	0.8873	0.9810	0.9958	0.9983	(86)
MIT	19.3785	19.5456	19.8469	20.2639	20.6445	20.8879	20.9684	20.9498	20.7471	20.2593	19.7468	19.3508	(87)
Th 2	19.7239	19.7263	19.7286	19.7396	19.7417	19.7513	19.7513	19.7531	19.7476	19.7417	19.7375	19.7332	(88)
util rest of house	0.9970	0.9938	0.9841	0.9488	0.8464	0.6464	0.4432	0.5134	0.8180	0.9704	0.9940	0.9976	(89)
MIT 2	18.2669	18.4352	18.7362	19.1520	19.5034	19.7007	19.7438	19.7393	19.6051	19.1553	18.6450	18.2464	(90)
Living area fraction									fLA = Living area / (4) =			0.4307	(91)
MIT	18.7457	18.9134	19.2145	19.6309	19.9948	20.2120	20.2712	20.2606	20.0969	19.6307	19.1195	18.7220	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7457	18.9134	19.2145	19.6309	19.9948	20.2120	20.2712	20.2606	20.0969	19.6307	19.1195	18.7220	(93)

---

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9961	0.9923	0.9818	0.9472	0.8573	0.6882	0.5095	0.5797	0.8409	0.9692	0.9928	0.9969	(94)
Useful gains	303.8533	351.9314	402.1213	450.2256	450.9659	361.6094	254.0754	261.3695	333.7168	327.5461	296.7251	287.2349	(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	1058.5938	1024.6989	927.7459	775.1736	598.0691	401.0671	262.3674	275.4498	430.0413	651.1282	869.9413	1055.2585	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	561.5269	452.0998	391.0647	233.9626	109.4448	0.0000	0.0000	0.0000	0.0000	240.7450	412.7157	571.4095	(98)
Space heating												2972.9691	(98)
Space heating per m2											(98) / (4) =	58.8940	(99)

8c. Space cooling requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	671.7790	528.8473	542.2462	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8144	0.8816	0.8437	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	547.0676	466.2442	457.5108	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	678.6585	646.0885	591.1981	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	94.7454	133.8041	99.4633	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												328.0129	(104)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Cooled fraction											fC = cooled area / (4) =	1.0000 (105)
Intermittency factor (Table 10b)												
0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh												
0.0000	0.0000	0.0000	0.0000	0.0000	23.6864	33.4510	24.8658	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												82.0032 (107)
Space cooling per m2												1.6245 (108)
Energy for space heating												58.8940 (99)
Energy for space cooling												1.6245 (108)
Total												60.5185 (109)
Target Fabric Energy Efficiency (TFEE)												69.6 (109)

Appendix G
Be Green BRUKL

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name **Shell and Core**

Wootton Street Planning SBEM

As designed

Date: Thu Nov 26 17:33:13 2020

Administrative information

Building Details

Address: ,

Certification tool

Calculation engine: SBEM

Calculation engine version: v5.6.b.0

Interface to calculation engine: DesignBuilder SBEM

Interface to calculation engine version: v6.1.7

BRUKL compliance check version: v5.6.b.0

Certifier details

Name:

Telephone number:

Address: , ,

Criterion 1: The calculated CO_2 emission rate for the building must not exceed the target

CO_2 emission rate from the notional building, $kgCO_2/m^2.annum$	17.2
Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	17.2
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	13.3
Are emissions from the building less than or equal to the target?	BER =< TER
Are as built details the same as used in the BER calculations?	Separate submission

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

Values which do not achieve the standards in the Non-Domestic Building Services Compliance Guide and Part L are displayed in red.

Building fabric

Element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	Surface where the maximum value occurs*
Wall**	0.35	0.19	0.2	"000 GF Non residential D1 - WC_P_7"
Floor	0.25	0.1	0.1	"000 GF Non residential D1 - WC_S_3"
Roof	0.25	0.15	0.15	"000 GF Non residential D1 - Refuse store_R_5"
Windows***, roof windows, and rooflights	2.2	1.3	1.3	"000 GF Non residential D1 - D1 Use type_Main Area 1
Personnel doors	2.2	2	2	"000 GF Non residential D1 - Refuse store_D_9"
Vehicle access & similar large doors	1.5	-	-	"No external vehicle access doors"
High usage entrance doors	3.5	-	-	"No external high usage entrance doors"

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [$W/(m^2K)$]
$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [$W/(m^2K)$]
$U_{i\text{-}Calc}$ = Calculated maximum individual element U-values [$W/(m^2K)$]

* There might be more than one surface where the maximum U-value occurs.
** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.
*** Display windows and similar glazing are excluded from the U-value check.
N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air Permeability	Worst acceptable standard	This building
$m^3/(h.m^2)$ at 50 Pa	10	9

Building services

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

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

1- ASHP - Heating only or indirectly heated

	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. For types <=12 kW output, refer to EN 14825 for limiting standards.

2- ASHP - Heating and Cooling

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	4.5	4.2	-	-	-
Standard value	2.5*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO

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

1- Instantaneous

	Water heating efficiency	**Storage loss factor [kWh/litre per day]**
This building	1	-
Standard value	1	N/A

Local mechanical ventilation, exhaust, and terminal units

ID	**System type in Non-domestic Building Services Compliance Guide**
A	Local supply or extract ventilation units serving a single area
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 supply and extract ventilation units serving a single room or zone with heating and heat recovery
E	Local supply and extract ventilation system serving a single area with heating and heat recovery
F	Other local ventilation units
G	Fan-assisted terminal VAV unit
H	Fan coil units
I	Zonal extract system where the fan is remote from the zone with grease filter

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	1.9	1.6	0.5	1.1	0.5	1	**Zone**	**Standard**
000 GF Non residential D1 - WC	-	-	0.3	-	-	-	-	-	-	-	N/A
000 GF Non residential D1 - Kitchen	0.3	-	-	-	-	-	-	-	-	-	N/A
000 GF Non residential D1 - D1 Use type_Main Area 1				1.3	-	-	-	-	-	0.75	0.5

Shell and core configuration

Zone	**Assumed shell?**
000 GF Non residential D1 - WC	NO
000 GF Non residential D1 - D1 Use type_Corridor	NO
000 GF Non residential D1 - storage	NO
000 GF Non residential D1 - Kitchen	NO

Shell and core configuration

Zone	Assumed shell?
000 GF Non residential D1 - Refuse store	NO
000 GF Non residential D1 - D1 Use type_Main Area 1	NO

General lighting and display lighting

	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
000 GF Non residential D1 - WC	-	100	-	59
000 GF Non residential D1 - D1 Use type_Corridor	100	-	-	92
000 GF Non residential D1 - storage	100	-	-	11
000 GF Non residential D1 - Kitchen	100	-	-	145
000 GF Non residential D1 - Refuse store	100	-	-	13
000 GF Non residential D1 - D1 Use type_Main Area	100	-	-	1952

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

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
000 GF Non residential D1 - D1 Use type_Corridor	N/A	N/A
000 GF Non residential D1 - Kitchen	N/A	N/A
000 GF Non residential D1 - D1 Use type_Main Area	NO (-60.6%)	NO

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

Separate submission

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

Separate submission

EPBD (Recast): Consideration of alternative energy systems

Were alternative energy systems considered and analysed as part of the design process?	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
Area [m²]	378.2	378.2
External area [m²]	827.6	827.6
Weather	LON	LON
Infiltration [m³/hm²@ 50Pa]	9	3
Average conductance [W/K]	206.4	371.05
Average U-value [W/m²K]	0.25	0.45
Alpha value* [%]	21.87	15.34

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

Building Use

% Area	Building Type
	A1/A2 Retail/Financial and Professional services
	A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways
	B1 Offices and Workshop businesses
	B2 to B7 General Industrial and Special Industrial Groups
	B8 Storage or Distribution
	C1 Hotels
	C2 Residential Institutions: Hospitals and Care Homes
	C2 Residential Institutions: Residential schools
	C2 Residential Institutions: Universities and colleges
	C2A Secure Residential Institutions
	Residential spaces
100	**D1 Non-residential Institutions: Community/Day Centre**
	D1 Non-residential Institutions: Libraries, Museums, and Galleries
	D1 Non-residential Institutions: Education
	D1 Non-residential Institutions: Primary Health Care Building
	D1 Non-residential Institutions: Crown and County Courts
	D2 General Assembly and Leisure, Night Clubs, and Theatres
	Others: Passenger terminals
	Others: Emergency services
	Others: Miscellaneous 24hr activities
	Others: Car Parks 24 hrs
	Others: Stand alone utility block

Energy Consumption by End Use [kWh/m²]

	Actual	Notional
Heating	5.13	10
Cooling	2.75	5.48
Auxiliary	4.58	2.61
Lighting	9.93	13.49
Hot water	3.27	3.78
Equipment*	24.56	24.56
TOTAL**	**25.65**	**35.37**

* 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/m²]

	Actual	Notional
Photovoltaic systems	0	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m²]	125.14	172.04
Primary energy* [kWh/m²]	78.76	98.71
Total emissions [kg/m²]	13.3	17.2

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

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] Heat pump (electric): air source, [HFT] Electricity, [CFT] Natural Gas										
	Actual	175.8	21	12.2	0	4.9	4.01	0	4.5	0
	Notional	161.3	89.8	18.4	0	5.6	2.43	0	----	----
[ST] Split or multi-split system, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity										
	Actual	58.6	53.9	3.9	3.2	4.5	4.19	4.62	4.5	6.5
	Notional	74.3	83.7	8.5	6.5	2.1	2.43	3.6	----	----

Key to terms

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

Key Features

The Building Control Body is advised to give particular attention to items whose specifications are better than typically expected.

Building fabric

Element	$U_{i\text{-}Typ}$	$U_{i\text{-}Min}$	Surface where the minimum value occurs*
Wall	0.23	0.18	"000 GF Non residential D1 - Refuse store_W_8"
Floor	0.2	0.1	"000 GF Non residential D1 - WC_S_3"
Roof	0.15	0.15	"000 GF Non residential D1 - Refuse store_R_5"
Windows, roof windows, and rooflights	1.5	1.3	"000 GF Non residential D1 - D1 Use type_Main Area 1_G_7"
Personnel doors	1.5	2	"000 GF Non residential D1 - Refuse store_D_9"
Vehicle access & similar large doors	1.5	-	"No external vehicle access doors"
High usage entrance doors	1.5	-	"No external high usage entrance doors"

$U_{i\text{-}Typ}$ = Typical individual element U-values [W/(m²K)] $U_{i\text{-}Min}$ = Minimum individual element U-values [W/(m²K)]

* There might be more than one surface where the minimum U-value occurs.

Air Permeability	Typical value	This building
$m^3/(h.m^2)$ at 50 Pa	5	9