Land at St Margarets Business Centre

Energy Assessment

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Contents

1 Executive Summary

1.1 Introduction

1.1.1 Erban Consulting Limited was instructed by Godstone Development Limited to prepare an energy assessment for the proposed development at Land at St Margarets Business Centre, Twickenham, London, TW1 1JN.

1.1.2 The purpose of this report is to serve as evidence that policy LP 22 of the London Borough of Richmond Upon Thames *Local Plan,* and policies SI 2, SI 3 and SI 4 of *The London Plan 2021* have been satisfied subject to approval of the proposals and their implementation thereafter.

1.2 Development description

1.2.1 Erection of 3 no. residential dwellings (Class C3) with associated parking, access, and landscaping.

1.3 Key measures and carbon dioxide (CO_2) reductions

1.3.1 The development would adopt a fabric-first approach and would be constructed in accordance with the energy hierarchy:

1) Be lean: use less energy and manage demand during operation
2) Be clean: exploit local energy resources and supply energy efficiently and cleanly
3) Be green: maximise opportunities for renewable energy
4) Be seen: monitor, verify and report on energy performance

1.3.2 Using SAP 10.0 carbon factors, it is proposed that the dwellings would achieve at least a 35 per cent on-site reduction in regulated CO_2 emissions.

1.3.3 Tables 1 and 2 and Figure 1 provide a summary of the estimated CO_2 emissions and emissions savings from each stage of the energy hierarchy.

1.3.4 It should be noted that whilst this report sets out the specification used to calculate the reduction in CO_2 emissions, this is subject to change as the detailed design of the development progresses. As a result of this, the actual reduction in CO_2 emissions may differ from the estimates provided in this report. The commitment that the dwellings would achieve at least a 35 per cent on-site reduction in CO_2 emissions, will not change.

Table 1: Dwellings' CO_2 emissions after each stage of the energy hierarchy

	Carbon dioxide emission (tonnes CO_2 per annum)	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building Regulations Compliant Development	6.3	2.8
After energy demand reduction (be lean)	5.8	2.8
After heat network connection (be clean)	5.8	2.8
After renewable energy (be green)	2.3	2.8

Table 2: Dwellings' regulated carbon dioxide savings from each stage of the energy hierarchy

	Regulated carbon dioxide savings	
	tonnes CO_2 per annum	%
Be lean: Savings from energy demand reduction	0.5	8
Be clean: Savings from heat network	0.0	0
Be green: Savings from renewable energy	3.5	56
Cumulative on-site savings	4.0	64
Carbon shortfall	2.3	-

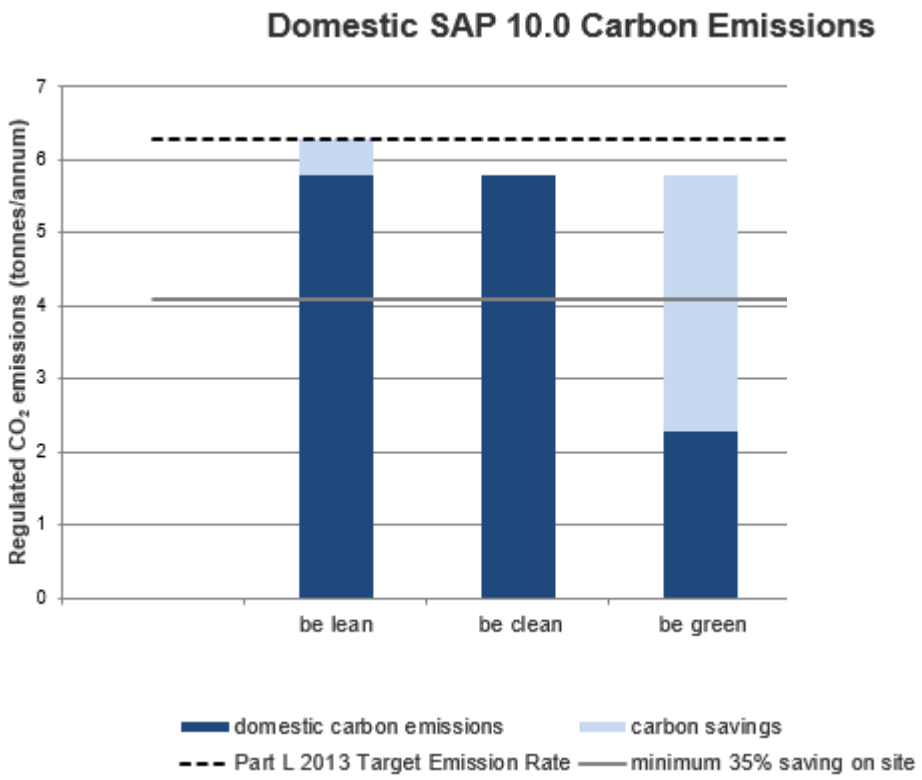

Figure 1: Domestic energy hierarchy and CO_2 savings

2 Legislation, Policy and Guidance

2.1 Legislation, Policy and Guidance

2.1.1 The following national, regional and local planning policy guidance have been considered in applying the energy standards for the proposed development.

2.2 National: National Planning Policy Framework (NPPF) (July 2021)

2.2.1 The *National Planning Policy Framework (NPPF)* was designed to simplify and clarify planning policy and to make the planning system more accessible. It details the government's view of what sustainable development in England means in practice and states that there are three objectives to sustainable development:

- **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;
- **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
- **an environmental objective** – to contribute to protecting and enhancing our natural, built and historic environment; including making effective use of land, improving biodiversity, using natural resources prudently, minimising waste and pollution, and mitigating and adapting to climate change, including moving to a low carbon economy.

2.2.2 The following are extracts from the NPPF that specifically relate to sustainable design and energy which have been referenced due to their relevance to this report.

> ***Paragraph 154***
>
> *New development should be planned for in ways that:*
>
> *a) avoid increased vulnerability to the range of impacts arising from climate change. When new development is brought forward in areas which are vulnerable, care should be taken to ensure that risks can be managed through suitable adaptation measures, including through the planning of green infrastructure; and*
>
> *b) can help to reduce greenhouse gas emissions, such as through its location, orientation and design. Any local requirements for the sustainability of buildings should reflect the Government's policy for national technical standards.*

> ***Paragraph 157***
>
> *In determining planning applications, local planning authorities should expect new development to:*
>
> *a) comply with any development plan policies on local requirements for decentralised energy supply unless it can be demonstrated by the applicant, having regard to the type of development involved and its design, that this is not feasible or viable; and*
>
> *b) take account of landform, layout, building orientation, massing and landscaping to minimise energy consumption.*

2.3 Regional: The London Plan 2021 (March 2021)

2.3.1 Policies SI 2, SI 3 and SI 4 of *The London Plan 2021* provide energy targets for both residential and non-residential development in London. Relevant extracts from these policies are provided below:

Policy SI 2 Minimising greenhouse gas emissions

A 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 manage 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.*
4) *Be seen: monitor, verify and report on energy performance.*

B Major development proposals should include a detailed energy strategy to demonstrate how the zero-carbon target will be met within the framework of the energy hierarchy.

C 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. Where it is clearly demonstrated that the zero-carbon target cannot be fully achieved on site, any shortfall should be provided, in agreement with the borough, either:

1) *Through a cash in lieu contribution to the borough's carbon offset fund, or*
2) *Off-site provided that an alternative proposal is identified and delivery is certain.*

D Boroughs must establish and administer a carbon offset fund. Offset fund payments must be ring-fenced to implement projects that deliver carbon reductions. The operation of offset funds should be monitored and reported on annually.

E Major development proposals should calculate and minimise carbon emissions from any other part of the development, including plant or equipment, that are not covered by Building Regulations, i.e. unregulated emissions.

Policy SI 3 Energy infrastructure

A Major development proposals within Heat Network Priority Areas should have a communal low-temperature heating system:

1) 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

2) CHP and ultra-low NOx gas boiler communal or district heating systems should be designed to ensure that they meet the requirements of policy SI1
3) where a heat network is planned but not yet in existence the development should be designed for connection at a later date.

Policy SI 4 Managing heat risk

A Development proposals should minimise adverse impacts on the urban heat island through design, layout, orientation, materials and the incorporation of green infrastructure.

B Major development proposals should demonstrate through an energy strategy how they will reduce the potential for internal overheating and reliance on air conditioning systems in accordance with the following cooling hierarchy:

1) Reduce the amount of heat entering a building through orientation, shading, high albedo materials, fenestration, insulation and the provision of green infrastructure
2) Minimise internal heat generation through energy efficient design
3) Manage the heat within the building though exposed internal thermal mass and high ceilings
4) Provide passive ventilation
5) Provide mechanical ventilation
6) Provide active cooling systems

2.4 Regional: Draft GLA Energy Assessment Guidance (April 2020)

2.4.1 The draft GLA *Energy Assessment Guidance* provides detail on how to prepare an energy assessment to demonstrate compliance with policies SI 2, SI 3 and SI 4 of *The London Plan 2021*.

2.5 Local: London Borough of Richmond Upon Thames Local Plan (July 2018)

2.5.1 Policy LP 22 (B, C, D) is the Council's energy and carbon reduction policy:

Policy LP 22

Reducing Carbon Dioxide Emission

B. Developers are required to incorporate measures to improve energy conservation and efficiency as well as contributions to renewable and low carbon energy generation. Proposed developments are required to meet the following minimum reductions in carbon dioxide emissions:

1. *All new major residential developments (10 units or more) should achieve zero carbon standards in line with London Plan policy.*
2. *All other new residential buildings should achieve a 35% reduction.*
3. *All non-residential buildings over 100sqm should achieve a 35% reduction. From 2019 all major non- residential buildings should achieve zero carbon standards in line with London Plan policy.*

Targets are expressed as a percentage improvement over the target emission rate (TER) based on Part L of the 2013 Building Regulations.

C. This should be achieved by following the Energy Hierarchy:

1. *be lean: use less energy*
2. *Be clean: supply energy efficiently*
3. *Be green: use renewable energy*

Decentralised Energy Networks

D. The Council requires developments to contribute towards the Mayor of London target of 25% of heat and power to be generated through localised decentralised energy (DE) systems by 2025. The following will be required:

1. *All new development will be required to connect to existing DE networks where feasible. This also applies where a DE network is planned and expected to be operational within 5 years of the development being completed.*
2. *Development proposals of 50 units or more, or new non-residential development of 1000sqm or more, will need to provide an assessment of the provision of on-site decentralised energy (DE) networks and combined heat and power (CHP).*
3. *Where feasible, new development of 50 units or more, or new non-residential development of 1000sqm or more, as well as schemes for the Proposal Sites identified in this Plan, will need to provide on-site DE and CHP; this is particularly necessary within the clusters identified for DE opportunities in the borough-wide Heat Mapping Study. Where on-site provision is not feasible, provision should be made for future connection to a local DE network should one become available.*

Applicants are required to consider the installation of low, or preferably ultra-low, NOx boilers to reduce the amount of NOx emitted in the borough.

Local opportunities to contribute towards decentralised energy supply from renewable and low-carbon technologies will be encouraged where appropriate.

3 Assessment

3.1 Targeted CO_2 reduction

3.1.1 The London Plan 2021 requires major developments to be net zero-carbon but does not apply the same requirement to minor development. This development is a minor development and, in accordance with Policy LP 22 of the London Borough of Richmond Upon Thames Local Plan, it will target a minimum 35% reduction in CO_2 emissions.

3.2 Carbon emission factors

3.2.1 This energy assessment uses SAP 10.0 carbon emission factors in accordance with the draft GLA *Energy Assessment Guidance.*

3.3 Baseline regulated CO_2 emissions

3.3.1 To establish the development's predicted baseline regulated CO_2 emissions, preliminary Standard Assessment Procedure (SAP) calculations have been undertaken to all dwellings.

3.3.2 SAP uses the target emission rate (TER), which is expressed in kilograms of carbon dioxide per metre square of total useful floor area per annum, as the benchmark for compliance with *Approved Document L1A: Conservation of fuel and power in dwellings (2013 edition incorporating 2016 amendments)* (L1A).

3.3.3 By extracting the relevant energy consumption figures from the SAP calculations, and by using the *GLA Carbon Emission Reporting Spreadsheet* to apply the relevant SAP 10.0 carbon emissions factors, the baseline predicted regulated CO_2 emissions of the proposed development have been calculated as 6.3 tonnes CO_2 per annum.

3.3.4 In the calculation of the CO_2 emissions for the 'baseline' scenario and the 'be lean' scenario, a gas boiler with an efficiency of 93.5% has been specified to the dwellings, in accordance with L1A notional values.

3.4 Baseline unregulated CO_2 emissions

3.4.1 To establish the dwellings' baseline predicted unregulated CO_2 emissions, the CO_2 emissions from appliances and cooking have been calculated in accordance with BREDEM 2012 and converted into SAP 10 carbon emission factors. The annual cooking energy has been calculated on the assumption that normal size electric cookers would be installed.

3.4.2 By following this approach, the baseline predicted unregulated CO_2 emissions of the development have been calculated as 2.8 tonnes CO_2 per annum.

3.5 Be lean: use less energy

3.5.1 It is estimated that baseline regulated domestic CO_2 emissions would be reduced by 8% through the following energy efficiency measures.

Passive solar design

3.5.2 The buildings have been designed in accordance with the principles of passive solar design as far as is practical. The site has very good solar access with little overshading from existing buildings. Where practical, relatively large windows have been incorporated so that the dwellings can benefit from solar gain in the winter months.

Passive cooling design

3.5.3 The buildings have also been designed in accordance with the cooling hierarchy to reduce the risk of overheating and to reduce the demand for active cooling.

3.5.4 Internal heat generation would be minimised by:

- Specifying a heating system that does not require permanently heated distribution pipework;
- Insulating all hot water pipes beyond Building Regulation standards;
- Installing low energy lighting; and
- Installing energy efficient equipment where applicable.

3.5.5 Heat entering the buildings would be minimised through:

- High levels of insulation; and
- Specifying glazing with a solar transmittance value that has been carefully considered to strike the balance between useful solar gain in the winter and unwanted solar gain in the summer.

3.5.6 Passive ventilation has been designed for by:

- Avoiding small, south facing single façade units; and
- Including openable windows to all rooms.

3.5.7 In addition, soft landscaping and the installation of extensive green roofs would provide evaporative cooling around the buildings.

3.5.8 These measures mean that the dwellings would be at reduced risk of overheating and would not be specified with active cooling systems.

High standards of energy efficiency

3.5.9 Estimations of the dwellings' CO_2 emissions have been based on the construction specification proposed in Table 3. The second column in this table sets out L1A limiting fabric parameters to show the elements of the specification that provide a significant improvement. The specification incorporates low U-values, a low air leakage, and 100% low energy lighting.

Table 3: Proposed construction specification to the dwellings

	L1A limiting fabric parameters	Proposed construction specification
U-value of main external walls	0.30 W/m^{2}K	0.19 W/m^{2}K
U-value of floors	0.25 W/m^{2}K	0.11-0.12 W/m^{2}K
U-value of roofs	0.20 W/m^{2}K	0.13-0.15 W/m^{2}K
U-value of windows	2.00 W/m^{2}K	1.20 W/m^{2}K
Air permeability	10 m^3/h.m^2 at 50 Pa	3 m^3/h.m^2 at 50 Pa
Thermal bridging	Default y-value of 0.15	The use of calculated details to provide a y-value of circa 0.074 to 0.107
Ventilation	Intermittent extracts	Mechanical extract ventilation
Lighting	75% low energy lighting	100% low energy lighting

3.5.10 The construction specification ensures that the dwellings exceed L1A target fabric energy efficiency (FEE) standards. Table 4 details the total Part L FEEs for the dwellings.

Table 4: FEEs

	Target fabric energy efficiency (kWh/m^2)	Design fabric energy efficiency (kWh/m^2)	Improvement (%)
Development total	58.90	48.87	17

3.5.11 The combination of the energy efficiency measures detailed means that it is estimated that development CO_2 emissions would be reduced by 0.5 tonnes CO_2 per annum beyond the baseline CO_2 emissions of the development. This equates to an 8% reduction.

3.5.12 A DER/TER calculation printout for Unit 01, showing the 'baseline' scenario and the 'be lean' scenario is provided in appendix A so that the method for calculating emissions can be validated.

3.6 Be clean: supply energy efficiently

3.6.1 Having reduced the energy demand of the development, the next step in the energy hierarchy is to supply energy efficiently. The extract from the *London Heat Map* provided in appendix B shows that the development lies in a Heat Network Priority Area. It is expected that major development proposals within Heat Priority Network Areas should have a communal low-temperature heating system with the heat source 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

Connect to local existing or planned heat networks

3.6.2 The extract from the *London Heat Map* provided in appendix B indicates that there are no existing or proposed networks in the vicinity of the development to connect to.

Communal low-temperature heating system

3.6.3 Communal heating systems can operate at higher efficiencies than individual heating systems. They can also provide a single energy centre solution meaning that it can be easier to connect to a future district energy network. However, they have the following disadvantages which have led to the conclusion that it is not practical or desirable solution on this minor development of three dwellings:

- Distribution losses for a communal system can be high and it is estimated that at least 15% of heat generated would be lost before it reaches the intended location.
- Residents would have to pay more via their service charge for maintenance and depreciation of the equipment installed.
- System failure would mean that there is no heating and hot water for all properties.
- Residents would not be able to choose who their supplier is.
- Residents would not have access to the same services offered by mainstream utility companies including discounts for payments by direct debit or single occupancy.
- Space would be required for a plant room and it is anticipated that this would result in a reduction of the number of dwellings proposed.

Use of local secondary heat sources

3.6.4 The publication of SAP 10 carbon factors has considerably strengthened the case for electric heating solutions and, in particular, highly-efficient electric heat pump technology that uses local secondary heat sources.

3.6.5 It is proposed that individual air source heat pumps are installed in each of the dwellings to provide space heating and hot water. In addition to achieving greater CO_2 emissions reductions than a communal gas heating solution, there are no on-site emissions associated with combustion and so the heating strategy has no impact on local air quality.

3.6.6 The CO_2 emissions reductions achieved through the installation of heat pumps are included within the 'be green' stage of the energy hierarchy. Therefore, there are zero emissions reductions from the 'be clean' stage.

3.7 Be green: use renewable energy

3.7.1 Renewable energy is the final consideration in the energy hierarchy. Below is an assessment of the feasibility of incorporating additional low or zero carbon (LZC) energy systems at this site, beyond the installation of air source heat pumps.

Biomass

3.7.2 New buildings have short heating response times because they are well insulated. They also have variable space heating demand and intermittent water heating demand. Biomass boilers are not suited to this because the burning of fuel is not instantaneous and they take a long time to heat up and cool down. The boilers are not usually able to modulate below 30% of output, potentially meaning that a back-up heating system would be required to not only provide output when heat demand was high, but also to provide output when heat demand was low. These factors reduce the potential running hours of a biomass boiler and mean that it would likely be sized to meet a small proportion of the maximum heat output required.

3.7.3 Further concerns regarding the installation of a biomass heating system at this development include:

- The Nitrous Oxide (NOx) and particulate matter (PM10) emissions from biomass systems are higher than for gas and electricity, and their use can have a significant impact on local air quality.
- A significant amount of space would be required for plant, fuel storage and delivery.

3.7.4 For these reasons, biomass boilers are not considered a viable solution at this development.

Wind power

3.7.5 Locating a wind turbine in an urban area presents several difficulties. These include the area required for the turbine, turbulence caused by nearby buildings, installation and maintenance access, environmental impact from noise and vibration, and visual impact on the landscape.

3.7.6 The RenSMART Maps Wind Speed Tool shows that average wind speed at 10 metres above ground at this development is 4.5m/s. Once the turbulence from the man-made obstacles around the development has been taken into consideration, it is unlikely that a wind turbine would generate sufficient electricity to make it cost effective. For these reasons wind power is not considered a feasible solution.

Ground source heat pumps

3.7.7 Ground source heat pumps require the installation of either a ground loop or a vertical borehole which means that their installation is more expensive and more complicated than the installation of air source heat pumps. They are considered a potential solution for this development. However, air source heat pumps are preferred.

Solar thermal collectors

3.7.8 Solar thermal collectors are a mature and reliable technology. They are considered a potential solution for this development. However, when considered in conjunction with the proposed heat pump strategy, solar thermal collectors are not considered a feasible solution as hot water demand is already provided by an LZC technology in the form of the heat pumps.

Solar photovoltaic (PV) panels

3.7.9 Solar PV panels are a mature and reliable technology and are considered a potential solution at this development. There are pitched roof areas that could be used for their installation.

LZC strategy

3.7.10 It is proposed that that the development's CO_2 emissions would be reduced by 3.5 tonnes CO_2 per annum through the installation of an LZC energy system in the form of heat pumps. This equates to a 56% reduction in site wide emissions. This has been calculated based on the assumption that a Mitsubishi PUHZ-W85VAA outdoor unit and a Mitsubishi EHPT25X-UKHCW cylinder would be specified to each of the dwellings.

3.7.11 The proposed locations of the outdoor units and hot water cylinders are shown in appendix C.

3.7.12 A DER/TER calculation printout for Unit 01, showing the 'be green' scenario is provided in appendix D so that the method for calculating emissions can be validated.

3.8 Be seen: monitor, verify and report on energy performance

3.8.1 In attempt to diminish the gap between the estimated performance of a building at design stage and the actual building performance post-construction, the development would monitor and submit energy performance data at the pre-commencement stage, the as-built stage and annually for at least 5 operational years. The data would be uploaded to the GLA 'be seen' monitoring portal.

3.9 Reducing peak energy demand

3.9.1 Energy display devices would be provided to display electrical consumption data to future residents of the dwellings. This would allow residents to better understand the energy implications of the way they occupy and use their home.

3.10 Unregulated emissions

3.10.1 In addition to the numerous measures adopted to reduce regulated CO_2 emissions, unregulated operational CO_2 emissions would be minimised by:

- Ensuring that any fridges or fridge-freezers installed would have an A+ rating under the EU Energy Efficiency Labelling Scheme;
- Ensuring that any washing machines or dishwashers installed would have an A rating under the EU Energy Efficiency Labelling Scheme;
- Ensuring that any tumble dryers or washer dryers installed would have a B rating under the EU Energy Efficiency Labelling Scheme;

- Providing building users with a leaflet explaining the EU Energy Efficiency Labelling Scheme to encourage responsible purchasing of white goods;
- Installing an energy display device in each dwelling to display electricity fuel consumption data to building users; and
- Providing all external space lighting with energy efficient lamps and passive infrared red (PIR) sensors.

3.10.2 Furthermore, each dwelling would be provided with a home user guide to encourage future residents to reduce energy use and to educate them in how to run their home efficiently. The home user guide would cover the following topics:

- Easy to understand operating and maintenance instructions for each of the fixed building services;
- Water saving measures;
- Information about recycling and waste collection;
- Public transport;
- Local amenities; and
- Responsible purchasing.

3.11 Future-proofing

3.11.1 The development would be heated and powered entirely by electricity. Therefore, the development would achieve zero carbon emissions on site at a point when the electric national grid becomes zero carbon.

3.12 Anticipated cost to occupants

3.12.1 The preliminary SAP calculations show that the dwellings would achieve a SAP rating of between 87B and 88B. Based on a fuel price of 19.44p/kWh for electricity, it is estimated that the regulated fuel costs of the dwellings would be between £496.98 and £622.96 per year.

4 Conclusions

4.1.1 The proposed development of 3 dwellings at Land at St Margarets Business Centre would adopt a fabric-first approach and would be constructed in accordance with the energy hierarchy.

4.1.2 Using SAP 10 carbon factors, it is estimated that energy efficiency measures would enable the dwellings to achieve an 8 per cent reduction in CO_2 emissions beyond the baseline emissions. It is proposed that individual air source heat pumps are installed in each of the dwellings to provide space heating and hot water and provide a further 56 per cent reduction in CO_2 emissions. It is estimated that a combination of energy efficiency measures and the installation of heat pumps would enable the proposed dwellings to achieve a 64 per cent on-site reduction in CO_2 emissions.

5 Appendix A: DER/TER calculation printout for Unit 01 for the ‘baseline’ and ‘be lean’ scenarios

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

Design SAP
elmhurst energy

Property Reference	01	**Issued on Date**	31/03/2022
Assessment Reference	01	**Prop Type Ref**	Unit 01
Property	Unit 01, St Margaret's Business Park, St Margaret's, Twickenham		

SAP Rating	85 B	**DER**	15.02	**TER**	15.90
Environmental	85 B	**% DER<TER**	5.53		
CO_2 Emissions (t/year)	2.15	**DFEE**	48.93	**TFEE**	59.16
General Requirements Compliance	Pass	**% DFEE<TFEE**	17.29		

Assessor Details	Mr. George Jones, Erban Consulting Limited, Tel: 01626 369277, george.jones@erbanconsulting.co.uk	**Assessor ID**	K945-0001
Client			

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

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DWELLING AS DESIGNED

End-Terrace House, total floor area 166 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) 15.90 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 15.02 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)59.2 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)48.9 kWh/m²/yrOK

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2 Fabric U-values

Element	Average	Highest	
External wall	0.19 (max. 0.30)	0.19 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.13 (max. 0.25)	0.20 (max. 0.70)	OK
Roof	0.14 (max. 0.20)	0.15 (max. 0.35)	OK
Openings	1.25 (max. 2.00)	1.70 (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: 3.00 (design value)
Maximum 10.0 OK

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4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from manufacturer
u u

Efficiency: 89.5% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

---
5 Cylinder insulation
Hot water storage: Measured cylinder loss: 1.67 kWh/day
Permitted by DBSCG 2.56 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

Boiler interlock: Yes 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 extract system (decentralised)
Specific fan power: 0.1300 0.1100
Maximum: 0.7 OK

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9 Summertime temperature
Overheating risk (Thames Valley): Medium OK
Based on:
Overshading: Average
Windows facing North: 13.42 m², No overhang
Windows facing East: 9.47 m², No overhang
Windows facing South: 1.16 m², No overhang
Windows facing West: 14.68 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

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10 Key features
Party wall U-value: 0.00 W/m²K
Floor U-value: 0.12 W/m²K
Door U-value: 1.00 W/m²K
Air permeability: 3.0 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	61.2100	(1b)	x 2.5500	(2b) =	156.0855	(1b) - (3b)
First floor	62.4500	(1c)	x 2.9100	(2c) =	181.7295	(1c) - (3c)
Second floor	42.2500	(1d)	x 2.4000	(2d) =	101.4000	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	165.9100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		439.2150	(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			3.0000	
Infiltration rate			0.1500	(18)
Number of sides sheltered			3	(19)
Shelter factor		(20) = 1 - [0.075 x (19)] =	0.7750	(20)
Infiltration rate adjusted to include shelter factor		(21) = (18) x (20) =	0.1163	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.1482	0.1453	0.1424	0.1279	0.1250	0.1104	0.1104	0.1075	0.1163	0.1250	0.1308	0.1366	(22b)
Mechanical extract ventilation - decentralised													
If mechanical ventilation:												0.5000	(23a)
Effective ac	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	(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 = 1.20)			35.4300	1.1450	40.5687			(27)
Door			2.1000	1.0000	2.1000			(26)
Window glazed part (Uw = 1.20)			3.3000	1.1450	3.7786			(27)
Window opaque part			3.9400	1.2000	4.7280			(26)
Rooflights (Uw = 1.70)			5.6400	1.5918	8.9775			(27a)
Ground Floor			61.2100	0.1200	7.3452	75.0000	4590.7500	(28a)
Exposed floor			6.3800	0.2000	1.2760	20.0000	127.6000	(28b)
External Wall	184.8200	44.7700	140.0500	0.1900	26.6095	60.0000	8403.0000	(29a)
Sloping	49.9700	5.6400	44.3300	0.1300	5.7629	9.0000	398.9700	(30)
Flat roof	18.2100		18.2100	0.1500	2.7315	9.0000	163.8900	(30)
Total net area of external elements Aum(A, m2)			320.5900					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	103.8780			(33)
Party Wall			67.5100	0.0000	0.0000	45.0000	3037.9500	(32)
GF Timber			68.1000			9.0000	612.9000	(32c)
FF Timber			115.3000			9.0000	1037.7000	(32c)
SF Timber			48.9200			9.0000	440.2800	(32c)
Internal Floor 1			56.0700			18.0000	1009.2600	(32d)
Internal Floor 2			49.3800			18.0000	888.8400	(32d)
Internal Ceiling 1			56.0700			18.0000	1009.2600	(32e)
Internal Ceiling 2			49.3800			18.0000	888.8400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	22609.2400	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		136.2741	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		23.8153	(36)
Total fabric heat loss	(33) + (36) =	127.6933	(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	72.4705	72.4705	72.4705	72.4705	72.4705	72.4705	72.4705	72.4705	72.4705	72.4705	72.4705	72.4705	(38)
Heat transfer coeff	200.1638	200.1638	200.1638	200.1638	200.1638	200.1638	200.1638	200.1638	200.1638	200.1638	200.1638	200.1638	(39)
Average = Sum(39)m / 12 =												200.1638	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2065	1.2065	1.2065	1.2065	1.2065	1.2065	1.2065	1.2065	1.2065	1.2065	1.2065	1.2065	(40)
HLP (average)												1.2065	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.9571	(42)
Average daily hot water use (litres/day)												104.4302	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	114.8732	110.6960	106.5188	102.3416	98.1644	93.9871	93.9871	98.1644	102.3416	106.5188	110.6960	114.8732	(44)
Energy conte	170.3536	148.9923	153.7468	134.0401	128.6147	110.9847	102.8437	118.0146	119.4241	139.1772	151.9228	164.9784	(45)
Energy content (annual)										Total = Sum(45)m =		1643.0931	(45)
Distribution loss (46)m = 0.15 x (45)m	25.5530	22.3489	23.0620	20.1060	19.2922	16.6477	15.4265	17.7022	17.9136	20.8766	22.7884	24.7468	(46)
Water storage loss:													
Store volume												250.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.6700	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.9018	(55)
Total storage loss	27.9558	25.2504	27.9558	27.0540	27.9558	27.0540	27.9558	27.9558	27.0540	27.9558	27.0540	27.9558	(56)
If cylinder contains dedicated solar storage	27.9558	25.2504	27.9558	27.0540	27.9558	27.0540	27.9558	27.9558	27.0540	27.9558	27.0540	27.9558	(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	221.5718	195.2539	204.9650	183.6061	179.8329	160.5507	154.0619	169.2328	168.9901	190.3954	201.4888	216.1966	(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	221.5718	195.2539	204.9650	183.6061	179.8329	160.5507	154.0619	169.2328	168.9901	190.3954	201.4888	216.1966	(64)
									Total per year (kWh/year) = Sum(64)m =			2246.1461	(64)
Heat gains from water heating, kWh/month	97.6171	86.5492	92.0954	84.2211	83.7390	76.5552	75.1701	80.2144	79.3613	87.2510	90.1671	95.8299	(65)

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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	147.8530	147.8530	147.8530	147.8530	147.8530	147.8530	147.8530	147.8530	147.8530	147.8530	147.8530	147.8530	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	30.0754	26.7127	21.7242	16.4467	12.2941	10.3792	11.2151	14.5778	19.5662	24.8438	28.9964	30.9113	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	337.3547	340.8554	332.0338	313.2536	289.5470	267.2662	252.3812	248.8805	257.7021	276.4823	300.1889	322.4698	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.7853	37.7853	37.7853	37.7853	37.7853	37.7853	37.7853	37.7853	37.7853	37.7853	37.7853	37.7853	(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)	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	(71)
Water heating gains (Table 5)	131.2058	128.7935	123.7841	116.9738	112.5524	106.3267	101.0350	107.8151	110.2240	117.2728	125.2321	128.8036	(72)
Total internal gains	568.9919	566.7176	547.8980	517.0300	484.7493	454.3279	434.9872	441.6292	457.8483	488.9548	524.7733	552.5405	(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	13.4200	10.6334	0.5000	0.7000	0.7700	34.6119	(74)
East	7.3300	19.6403	0.5000	0.7000	0.7700	34.9183	(76)
West	14.6800	19.6403	0.5000	0.7000	0.7700	69.9318	(80)
East	2.1400	19.6403	0.5000	1.0000	0.7700	14.5635	(76)
South	1.1600	46.7521	0.5000	1.0000	0.7700	18.7915	(78)
South	5.6400	42.0754	0.5000	0.0000	1.0000	118.6525	(82)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	291.4694	549.7298	873.5138	1252.9059	1535.3013	1575.8924	1498.2834	1283.8968	1006.5232	642.2282	359.2975	242.5835	(83)
Total gains	860.4613	1116.4474	1421.4118	1769.9359	2020.0506	2030.2203	1933.2706	1725.5260	1464.3715	1131.1830	884.0708	795.1241	(84)

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7. Mean internal temperature (heating season)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
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)													
tau	31.3760	31.3760	31.3760	31.3760	31.3760	31.3760	31.3760	31.3760	31.3760	31.3760	31.3760	31.3760	
alpha	3.0917	3.0917	3.0917	3.0917	3.0917	3.0917	3.0917	3.0917	3.0917	3.0917	3.0917	3.0917	
util living area	0.9888	0.9750	0.9407	0.8588	0.7239	0.5649	0.4328	0.4950	0.7331	0.9245	0.9801	0.9911	(86)
MIT	18.8321	19.1434	19.6382	20.2153	20.6527	20.8832	20.9618	20.9420	20.7323	20.0988	19.3333	18.7601	(87)
Th 2	19.9148	19.9148	19.9148	19.9148	19.9148	19.9148	19.9148	19.9148	19.9148	19.9148	19.9148	19.9148	(88)
util rest of house	0.9865	0.9701	0.9289	0.8314	0.6732	0.4876	0.3348	0.3923	0.6632	0.9036	0.9754	0.9893	(89)
MIT 2	17.0139	17.4653	18.1757	18.9804	19.5525	19.8207	19.8942	19.8808	19.6693	18.8415	17.7451	16.9091	(90)
Living area fraction									fLA = Living area / (4) =			0.2565	(91)
MIT	17.4802	17.8957	18.5508	19.2971	19.8346	20.0932	20.1680	20.1530	19.9419	19.1640	18.1524	17.3838	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.4802	17.8957	18.5508	19.2971	19.8346	20.0932	20.1680	20.1530	19.9419	19.1640	18.1524	17.3838	(93)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9787	0.9569	0.9095	0.8130	0.6691	0.5010	0.3585	0.4159	0.6652	0.8849	0.9639	0.9828	(94)
Useful gains	842.1218	1068.3139	1292.8392	1438.9058	1351.6219	1017.1424	693.1064	717.6640	974.0520	1001.0064	852.1844	781.4098	(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	2638.1904	2601.2585	2412.1337	2081.1283	1628.2582	1099.5311	714.1870	751.2089	1169.3375	1714.1975	2212.2964	2638.9184	(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	1336.2751	1030.1387	832.7552	462.4002	205.8174	0.0000	0.0000	0.0000	0.0000	530.6142	979.2807	1381.9864	(98)
Space heating												6759.2679	(98)
Space heating per m2											(98) / (4) =	40.7406	(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 %)	93.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	7229.1635	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1336.2751	1030.1387	832.7552	462.4002	205.8174	0.0000	0.0000	0.0000	0.0000	530.6142	979.2807	1381.9864	(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)	1429.1712	1101.7527	890.6472	494.5457	220.1256	0.0000	0.0000	0.0000	0.0000	567.5018	1047.3590	1478.0603	(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	221.5718	195.2539	204.9650	183.6061	179.8329	160.5507	154.0619	169.2328	168.9901	190.3954	201.4888	216.1966	(64)
Efficiency of water heater												79.8000	(216)
(217)m	88.8064	88.6069	88.1651	87.1777	85.1744	79.8000	79.8000	79.8000	79.8000	87.4052	88.4756	88.8877	(217)
Fuel for water heating, kWh/month	249.4999	220.3597	232.4787	210.6113	211.1348	201.1914	193.0600	212.0712	211.7670	217.8308	227.7337	243.2244	(219)
Water heating fuel used												2630.9629	(219)
Annual totals kWh/year													
Space heating fuel - main system												7229.1635	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
(MEVDecentralised, Database: total watage = 6.2785, total flow = 37.0000, SFP = 0.1697)													
mechanical ventilation fans (SFP = 0.1697)												90.9266	(230a)
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												165.9266	(231)
Electricity for lighting (calculated in Appendix L)												531.1413	(232)
Total delivered energy for all uses												10557.1944	(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	7229.1635	0.2160	1561.4993	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2630.9629	0.2160	568.2880	(264)
Space and water heating			2129.7873	(265)
Pumps and fans	165.9266	0.5190	86.1159	(267)
Energy for lighting	531.1413	0.5190	275.6624	(268)
Total CO2, kg/year			2491.5656	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			15.0200	(273)

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

DER		15.0200	ZC1
Total Floor Area	TFA	165.9100	
Assumed number of occupants	N	2.9571	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		12.0493	ZC2
CO2 emissions from cooking, equation (L16)		1.1450	ZC3
Total CO2 emissions		28.2143	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		28.2143	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	61.2100 (1b)	x	2.5500 (2b)	=	156.0855	(1b) - (3b)
First floor	62.4500 (1c)	x	2.9100 (2c)	=	181.7295	(1c) - (3c)
Second floor	42.2500 (1d)	x	2.4000 (2d)	=	101.4000	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	165.9100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	439.2150	(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							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.0911	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.3411	(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) =		0.2643	(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	0.3370	0.3304	0.3238	0.2908	0.2842	0.2511	0.2511	0.2445	0.2643	0.2842	0.2974	0.3106	(22b)
Effective ac	0.5568	0.5546	0.5524	0.5423	0.5404	0.5315	0.5315	0.5299	0.5349	0.5404	0.5442	0.5482	(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			6.0400	1.0000	6.0400			(26)
TER Opening Type (Uw = 1.40)			30.9500	1.3258	41.0322			(27)
TER Room Window (Uw = 1.70)			4.5000	1.5918	7.1629			(27a)
Ground Floor			61.2100	0.1300	7.9573			(28a)
Exposed floor			6.3800	0.1300	0.8294			(28b)
External Wall	184.8200	36.9900	147.8300	0.1800	26.6094			(29a)
Sloping	49.9700	4.5000	45.4700	0.1300	5.9111			(30)
Flat roof	18.2100		18.2100	0.1300	2.3673			(30)
Total net area of external elements Aum(A, m2)			320.5900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		97.9096			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	23.4426	(36)
Total fabric heat loss (33) + (36) =	121.3522	(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	80.7019	80.3823	80.0690	78.5974	78.3220	77.0403	77.0403	76.8030	77.5340	78.3220	78.8790	79.4613	(38)
Heat transfer coeff	202.0541	201.7345	201.4212	199.9496	199.6743	198.3926	198.3926	198.1552	198.8862	199.6743	200.2313	200.8136	(39)
Average = Sum(39)m / 12 =												199.9483	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2179	1.2159	1.2140	1.2052	1.2035	1.1958	1.1958	1.1944	1.1988	1.2035	1.2069	1.2104	(40)
HLP (average)												1.2052	(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	2.9571 (42)
Average daily hot water use (litres/day)	104.4302 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	114.8732	110.6960	106.5188	102.3416	98.1644	93.9871	93.9871	98.1644	102.3416	106.5188	110.6960	114.8732	(44)
Energy conte	170.3536	148.9923	153.7468	134.0401	128.6147	110.9847	102.8437	118.0146	119.4241	139.1772	151.9228	164.9784	(45)
Energy content (annual)										Total = Sum(45)m =		1643.0931	(45)
Distribution loss (46)m = 0.15 x (45)m	25.5530	22.3489	23.0620	20.1060	19.2922	16.6477	15.4265	17.7022	17.9136	20.8766	22.7884	24.7468	(46)

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Water storage loss:
Store volume 250.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): 1.8903 (48)
Temperature factor from Table 2b 0.5400 (49)
Enter (49) or (54) in (55) 1.0208 (55)
Total storage loss

	31.6444	28.5820	31.6444	30.6236	31.6444	30.6236	31.6444	31.6444	30.6236	31.6444	30.6236	31.6444 (56)

If cylinder contains dedicated solar storage

	31.6444	28.5820	31.6444	30.6236	31.6444	30.6236	31.6444	31.6444	30.6236	31.6444	30.6236	31.6444 (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

	225.2604	198.5856	208.6535	187.1758	183.5215	164.1203	157.7504	172.9214	172.5597	194.0840	205.0584	219.8852 (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

	225.2604	198.5856	208.6535	187.1758	183.5215	164.1203	157.7504	172.9214	172.5597	194.0840	205.0584	219.8852 (64)

Total per year (kWh/year) = Sum(64)m = 2289.5762 (64)

Heat gains from water heating, kWh/month

	100.5680	89.2145	95.0462	87.0768	86.6898	79.4109	78.1209	83.1653	82.2170	90.2019	93.0228	98.7807 (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	147.8530	147.8530	147.8530	147.8530	147.8530	147.8530	147.8530	147.8530	147.8530	147.8530	147.8530	147.8530	(66)

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

	30.0893	26.7251	21.7343	16.4543	12.2997	10.3840	11.2202	14.5845	19.5753	24.8553	29.0098	30.9256	(67)

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

	337.3547	340.8554	332.0338	313.2536	289.5470	267.2662	252.3812	248.8805	257.7021	276.4823	300.1889	322.4698	(68)

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

	37.7853	37.7853	37.7853	37.7853	37.7853	37.7853	37.7853	37.7853	37.7853	37.7853	37.7853	37.7853	(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)

	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	(71)

Water heating gains (Table 5)

	135.1720	132.7597	127.7503	120.9400	116.5186	110.2929	105.0013	111.7813	114.1903	121.2391	129.1984	132.7698	(72)

Total internal gains

	572.9720	570.6961	551.8743	521.0038	488.7213	458.2989	438.9586	445.6022	461.8235	492.9326	528.7530	556.5211	(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	10.7200	10.6334	0.6300	0.7000	0.7700	34.8368	(74)
East	7.5700	19.6403	0.6300	0.7000	0.7700	45.4376	(76)
South	0.9300	46.7521	0.6300	0.7000	0.7700	13.2879	(78)
West	11.7300	19.6403	0.6300	0.7000	0.7700	70.4072	(80)
South	4.5000	42.0754	0.6300	0.7000	1.0000	75.1487	(82)

Solar gains	239.1182	453.7914	727.6272	1053.1116	1298.1016	1335.5653	1268.5199	1082.0803	841.6061	531.9306	295.2796	198.6754	(83)
Total gains	812.0902	1024.4876	1279.5015	1574.1154	1786.8229	1793.8643	1707.4784	1527.6824	1303.4296	1024.8631	824.0325	755.1964	(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	57.0220	57.1123	57.2012	57.6222	57.7016	58.0744	58.0744	58.1440	57.9302	57.7016	57.5411	57.3743	
alpha	4.8015	4.8075	4.8134	4.8415	4.8468	4.8716	4.8716	4.8763	4.8620	4.8468	4.8361	4.8250	
util living area	0.9992	0.9973	0.9893	0.9525	0.8445	0.6636	0.5015	0.5763	0.8500	0.9832	0.9980	0.9994	(86)
MIT	19.5670	19.7548	20.0741	20.4844	20.8049	20.9555	20.9907	20.9825	20.8517	20.4007	19.9014	19.5337	(87)
Th 2	19.9057	19.9073	19.9088	19.9159	19.9172	19.9234	19.9234	19.9245	19.9210	19.9172	19.9145	19.9117	(88)
util rest of house	0.9989	0.9964	0.9854	0.9347	0.7918	0.5696	0.3838	0.4516	0.7768	0.9742	0.9972	0.9992	(89)
MIT 2	17.9877	18.2633	18.7286	19.3156	19.7317	19.8951	19.9201	19.9176	19.8017	19.2095	18.4833	17.9431	(90)
Living area fraction										fLA = Living area / (4) =		0.2565	(91)
MIT	18.3927	18.6458	19.0737	19.6154	20.0069	20.1670	20.1947	20.1907	20.0710	19.5150	18.8470	18.3510	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.3927	18.6458	19.0737	19.6154	20.0069	20.1670	20.1947	20.1907	20.0710	19.5150	18.8470	18.3510	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9983	0.9947	0.9811	0.9286	0.7967	0.5920	0.4142	0.4837	0.7886	0.9696	0.9959	0.9988	(94)
Useful gains	810.6842	1019.0850	1255.3784	1461.6714	1423.6050	1062.0333	707.2211	738.9802	1027.9270	993.6943	820.6699	754.2691	(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	2847.4958	2773.0024	2532.6107	2142.5356	1658.6784	1104.4568	713.1610	751.1481	1187.5425	1780.0940	2352.1160	2841.7210	(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	1515.3878	1178.6325	950.2608	490.2222	174.8946	0.0000	0.0000	0.0000	0.0000	585.0814	1102.6412	1553.0643	(98)
Space heating												7550.1849	(98)
Space heating per m2											(98) / (4) =	45.5077	(99)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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 %)												93.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												8075.0640	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1515.3878	1178.6325	950.2608	490.2222	174.8946	0.0000	0.0000	0.0000	0.0000	585.0814	1102.6412	1553.0643	(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)													
	1620.7356	1260.5695	1016.3217	524.3019	187.0530	0.0000	0.0000	0.0000	0.0000	625.7555	1179.2954	1661.0313	(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													
	225.2604	198.5856	208.6535	187.1758	183.5215	164.1203	157.7504	172.9214	172.5597	194.0840	205.0584	219.8852	(64)
Efficiency of water heater												79.8000	(216)
(217)m	88.9564	88.7834	88.3667	87.2668	84.6858	79.8000	79.8000	79.8000	79.8000	87.5750	88.6364	89.0196	(217)
Fuel for water heating, kWh/month													
	253.2256	223.6741	236.1223	214.4868	216.7087	205.6646	197.6823	216.6935	216.2402	221.6203	231.3480	247.0075	(219)
Water heating fuel used												2680.4738	(219)
Annual totals kWh/year													
Space heating fuel - main system												8075.0640	(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)												531.3868	(232)
Total delivered energy for all uses												11361.9246	(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	8075.0640	0.2160	1744.2138	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2680.4738	0.2160	578.9823	(264)
Space and water heating			2323.1962	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	531.3868	0.5190	275.7898	(268)
Total CO2, kg/m2/year			2637.9109	(272)
Emissions per m2 for space and water heating			14.0027	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			1.6623	(272b)
Emissions per m2 for pumps and fans			0.2346	(272c)
Target Carbon Dioxide Emission Rate (TER) = (14.0027 * 1.00) + 1.6623 + 0.2346, rounded to 2 d.p.			15.9000	(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	61.2100 (1b)	x	2.5500 (2b)	=	156.0855	(1b) - (3b)
First floor	62.4500 (1c)	x	2.9100 (2c)	=	181.7295	(1c) - (3c)
Second floor	42.2500 (1d)	x	2.4000 (2d)	=	101.4000	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	165.9100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	439.2150	(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							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.0911	(8)
Pressure test			Yes	
Measured/design AP50			3.0000	
Infiltration rate			0.2411	(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) =		0.1868	(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	0.2382	0.2335	0.2289	0.2055	0.2008	0.1775	0.1775	0.1728	0.1868	0.2008	0.2102	0.2195	(22b)
Effective ac	0.5284	0.5273	0.5262	0.5211	0.5202	0.5158	0.5158	0.5149	0.5175	0.5202	0.5221	0.5241	(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 = 1.20)			35.4300	1.1450	40.5687			(27)
Door			2.1000	1.0000	2.1000			(26)
Window glazed part (Uw = 1.20)			3.3000	1.1450	3.7786			(27)
Window opaque part			3.9400	1.2000	4.7280			(26)
Rooflights (Uw = 1.70)			5.6400	1.5918	8.9775			(27a)
Ground Floor			61.2100	0.1200	7.3452	75.0000	4590.7500	(28a)
Exposed floor			6.3800	0.2000	1.2760	20.0000	127.6000	(28b)
External Wall	184.8200	44.7700	140.0500	0.1900	26.6095	60.0000	8403.0000	(29a)
Sloping	49.9700	5.6400	44.3300	0.1300	5.7629	9.0000	398.9700	(30)
Flat roof	18.2100		18.2100	0.1500	2.7315	9.0000	163.8900	(30)
Total net area of external elements Aum(A, m2)			320.5900					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	103.8780			(33)
Party Wall			67.5100	0.0000	0.0000	45.0000	3037.9500	(32)
GF Timber			68.1000			9.0000	612.9000	(32c)
FF Timber			115.3000			9.0000	1037.7000	(32c)
SF Timber			48.9200			9.0000	440.2800	(32c)
Internal Floor 1			56.0700			18.0000	1009.2600	(32d)
Internal Floor 2			49.3800			18.0000	888.8400	(32d)
Internal Ceiling 1			56.0700			9.0000	504.6300	(32e)
Internal Ceiling 2			49.3800			9.0000	444.4200	(32e)
Heat capacity Cm = Sum(A x k)				(28)...(30) + (32) + (32a)...(32e) =			21660.1900	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							130.5539	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							23.8153	(36)
Total fabric heat loss					(33) + (36) =		127.6933	(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	76.5827	76.4230	76.2665	75.5313	75.3938	74.7535	74.7535	74.6349	75.0001	75.3938	75.6720	75.9629	(38)
Heat transfer coeff	204.2760	204.1163	203.9598	203.2246	203.0871	202.4467	202.4467	202.3282	202.6934	203.0871	203.3653	203.6562	(39)
Average = Sum(39)m / 12 =												203.2239	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2312	1.2303	1.2293	1.2249	1.2241	1.2202	1.2202	1.2195	1.2217	1.2241	1.2258	1.2275	(40)
HLP (average)												1.2249	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Assumed occupancy												2.9571	(42)
Average daily hot water use (litres/day)												104.4302	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	114.8732	110.6960	106.5188	102.3416	98.1644	93.9871	93.9871	98.1644	102.3416	106.5188	110.6960	114.8732	(44)
Energy conte	170.3536	148.9923	153.7468	134.0401	128.6147	110.9847	102.8437	118.0146	119.4241	139.1772	151.9228	164.9784	(45)
Energy content (annual)										Total = Sum(45)m =		1643.0931	(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)
Heat gains from water heating, kWh/month													
	36.2001	31.6609	32.6712	28.4835	27.3306	23.5843	21.8543	25.0781	25.3776	29.5752	32.2836	35.0579	(65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	147.8530	147.8530	147.8530	147.8530	147.8530	147.8530	147.8530	147.8530	147.8530	147.8530	147.8530	147.8530	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	30.0754	26.7127	21.7242	16.4467	12.2941	10.3792	11.2151	14.5778	19.5662	24.8438	28.9964	30.9113	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	337.3547	340.8554	332.0338	313.2536	289.5470	267.2662	252.3812	248.8805	257.7021	276.4823	300.1889	322.4698	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.7853	37.7853	37.7853	37.7853	37.7853	37.7853	37.7853	37.7853	37.7853	37.7853	37.7853	37.7853	(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)													
	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	(71)
Water heating gains (Table 5)													
	48.6561	47.1144	43.9129	39.5605	36.7347	32.7559	29.3740	33.7071	35.2467	39.7516	44.8383	47.1208	(72)
Total internal gains													
	483.4422	482.0384	465.0268	436.6166	405.9317	377.7571	360.3262	364.5213	379.8709	408.4336	441.3795	467.8578	(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	13.4200	10.6334	0.5000	0.7000	0.7700	34.6119	(74)
East	7.3300	19.6403	0.5000	0.7000	0.7700	34.9183	(76)
West	14.6800	19.6403	0.5000	0.7000	0.7700	69.9318	(80)
East	2.1400	19.6403	0.5000	1.0000	0.7700	14.5635	(76)
South	1.1600	46.7521	0.5000	1.0000	0.7700	18.7915	(78)
South	5.6400	42.0754	0.5000	0.0000	1.0000	118.6525	(82)

Solar gains	291.4694	549.7298	873.5138	1252.9059	1535.3013	1575.8924	1498.2834	1283.8968	1006.5232	642.2282	359.2975	242.5835	(83)
Total gains	774.9116	1031.7683	1338.5406	1689.5225	1941.2330	1953.6495	1858.6096	1648.4181	1386.3941	1050.6618	800.6770	710.4413	(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	29.4539	29.4769	29.4995	29.6063	29.6263	29.7200	29.7200	29.7374	29.6838	29.6263	29.5858	29.5435	
alpha	2.9636	2.9651	2.9666	2.9738	2.9751	2.9813	2.9813	2.9825	2.9789	2.9751	2.9724	2.9696	
util living area													
	0.9904	0.9777	0.9455	0.8677	0.7381	0.5816	0.4498	0.5148	0.7519	0.9329	0.9830	0.9925	(86)
MIT	18.6508	18.9758	19.4960	20.1161	20.5941	20.8580	20.9512	20.9268	20.6827	19.9922	19.1848	18.5840	(87)
Th 2	19.8951	19.8958	19.8966	19.9001	19.9008	19.9039	19.9039	19.9044	19.9027	19.9008	19.8994	19.8981	(88)
util rest of house													
	0.9885	0.9733	0.9347	0.8418	0.6886	0.5038	0.3487	0.4096	0.6842	0.9142	0.9790	0.9910	(89)
MIT 2	17.7451	18.0679	18.5798	19.1762	19.6080	19.8241	19.8854	19.8743	19.6999	19.0742	18.2806	17.6807	(90)
Living area fraction									fLA = Living area / (4) =			0.2565	(91)
MIT	17.9774	18.3008	18.8148	19.4173	19.8609	20.0893	20.1588	20.1442	19.9520	19.3096	18.5125	17.9123	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.9774	18.3008	18.8148	19.4173	19.8609	20.0893	20.1588	20.1442	19.9520	19.3096	18.5125	17.9123	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9837	0.9647	0.9213	0.8285	0.6866	0.5178	0.3732	0.4340	0.6877	0.9014	0.9719	0.9871	(94)
Useful gains	762.3151	995.3254	1233.2338	1399.7571	1332.8317	1011.6185	693.6889	715.3708	953.3672	947.0233	778.1734	701.3090	(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													
	2793.9665	2735.3145	2511.7221	2137.3678	1657.3763	1111.2867	720.4600	757.5615	1186.1587	1768.8119	2320.9077	2792.6026	(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													
	1511.5487	1169.2727	951.1953	531.0797	241.4612	0.0000	0.0000	0.0000	0.0000	611.4107	1110.7687	1555.9225	(98)
Space heating												7682.6595	(98)
Space heating per m2											(98) / (4) =	46.3062	(99)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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	1902.9994	1498.1059	1537.6940	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8173	0.8715	0.8340	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1555.3922	1305.5704	1282.3962	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	2318.6376	2208.7311	1977.2140	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	549.5367	671.9516	516.9445	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												1738.4327	(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	137.3842	167.9879	129.2361	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												434.6082	(107)
Space cooling per m2												2.6195	(108)
Energy for space heating												46.3062	(99)
Energy for space cooling												2.6195	(108)
Total												48.9257	(109)
Dwelling Fabric Energy Efficiency (DFEE)												48.9	(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	61.2100 (1b)	x	2.5500 (2b)	=	156.0855	(1b) - (3b)
First floor	62.4500 (1c)	x	2.9100 (2c)	=	181.7295	(1c) - (3c)
Second floor	42.2500 (1d)	x	2.4000 (2d)	=	101.4000	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	165.9100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	439.2150	(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							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.0911	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.3411	(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) =		0.2643	(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	0.3370	0.3304	0.3238	0.2908	0.2842	0.2511	0.2511	0.2445	0.2643	0.2842	0.2974	0.3106	(22b)
Effective ac	0.5568	0.5546	0.5524	0.5423	0.5404	0.5315	0.5315	0.5299	0.5349	0.5404	0.5442	0.5482	(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			6.0400	1.0000	6.0400			(26)
TER Opening Type (Uw = 1.40)			30.9500	1.3258	41.0322			(27)
TER Room Window (Uw = 1.70)			4.5000	1.5918	7.1629			(27a)
Ground Floor			61.2100	0.1300	7.9573			(28a)
Exposed floor			6.3800	0.1300	0.8294			(28b)
External Wall	184.8200	36.9900	147.8300	0.1800	26.6094			(29a)
Sloping	49.9700	4.5000	45.4700	0.1300	5.9111			(30)
Flat roof	18.2100		18.2100	0.1300	2.3673			(30)
Total net area of external elements Aum(A, m2)			320.5900					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	97.9096			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							23.4426	(36)
Total fabric heat loss					(33) + (36) =		121.3522	(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	80.7019	80.3823	80.0690	78.5974	78.3220	77.0403	77.0403	76.8030	77.5340	78.3220	78.8790	79.4613	(38)
Heat transfer coeff	202.0541	201.7345	201.4212	199.9496	199.6743	198.3926	198.3926	198.1552	198.8862	199.6743	200.2313	200.8136	(39)
Average = Sum(39)m / 12 =												199.9483	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2179	1.2159	1.2140	1.2052	1.2035	1.1958	1.1958	1.1944	1.1988	1.2035	1.2069	1.2104	(40)
HLP (average)												1.2052	(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	2.9571	(42)
Average daily hot water use (litres/day)	104.4302	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	114.8732	110.6960	106.5188	102.3416	98.1644	93.9871	93.9871	98.1644	102.3416	106.5188	110.6960	114.8732	(44)
Energy conte	170.3536	148.9923	153.7468	134.0401	128.6147	110.9847	102.8437	118.0146	119.4241	139.1772	151.9228	164.9784	(45)
Energy content (annual)										Total = Sum(45)m =		1643.0931	(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)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 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)
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
36.2001 31.6609 32.6712 28.4835 27.3306 23.5843 21.8543 25.0781 25.3776 29.5752 32.2836 35.0579 (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	147.8530	147.8530	147.8530	147.8530	147.8530	147.8530	147.8530	147.8530	147.8530	147.8530	147.8530	147.8530	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
30.0893 26.7251 21.7343 16.4543 12.2997 10.3840 11.2202 14.5845 19.5753 24.8553 29.0098 30.9256 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
337.3547 340.8554 332.0338 313.2536 289.5470 267.2662 252.3812 248.8805 257.7021 276.4823 300.1889 322.4698 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
37.7853 37.7853 37.7853 37.7853 37.7853 37.7853 37.7853 37.7853 37.7853 37.7853 37.7853 37.7853 (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)
-118.2824 -118.2824 -118.2824 -118.2824 -118.2824 -118.2824 -118.2824 -118.2824 -118.2824 -118.2824 -118.2824 -118.2824 (71)
Water heating gains (Table 5)
48.6561 47.1144 43.9129 39.5605 36.7347 32.7559 29.3740 33.7071 35.2467 39.7516 44.8383 47.1208 (72)
Total internal gains
483.4561 482.0508 465.0369 436.6242 405.9374 377.7619 360.3313 364.5280 379.8800 408.4451 441.3929 467.8721 (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	10.7200	10.6334	0.6300	0.7000	0.7700	34.8368	(74)
East	7.5700	19.6403	0.6300	0.7000	0.7700	45.4376	(76)
South	0.9300	46.7521	0.6300	0.7000	0.7700	13.2879	(78)
West	11.7300	19.6403	0.6300	0.7000	0.7700	70.4072	(80)
South	4.5000	42.0754	0.6300	0.7000	1.0000	75.1487	(82)

Solar gains	239.1182	453.7914	727.6272	1053.1116	1298.1016	1335.5653	1268.5199	1082.0803	841.6061	531.9306	295.2796	198.6754	(83)
Total gains	722.5742	935.8422	1192.6641	1489.7358	1704.0390	1713.3272	1628.8512	1446.6083	1221.4861	940.3756	736.6725	666.5474	(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	57.0220	57.1123	57.2012	57.6222	57.7016	58.0744	58.0744	58.1440	57.9302	57.7016	57.5411	57.3743	
alpha	4.8015	4.8075	4.8134	4.8415	4.8468	4.8716	4.8716	4.8763	4.8620	4.8468	4.8361	4.8250	
util living area	0.9995	0.9982	0.9920	0.9610	0.8625	0.6872	0.5237	0.6039	0.8739	0.9881	0.9988	0.9997	(86)
MIT	19.5171	19.7058	20.0278	20.4464	20.7829	20.9482	20.9888	20.9787	20.8289	20.3568	19.8529	19.4841	(87)
Th 2	19.9057	19.9073	19.9088	19.9159	19.9172	19.9234	19.9234	19.9245	19.9210	19.9172	19.9145	19.9117	(88)
util rest of house	0.9993	0.9976	0.9890	0.9457	0.8129	0.5926	0.4018	0.4755	0.8064	0.9815	0.9983	0.9996	(89)
MIT 2	18.5464	18.7360	19.0576	19.4710	19.7739	19.9005	19.9207	19.9186	19.8241	19.3917	18.8890	18.5182	(90)
Living area fraction									fLA = Living area / (4) =			0.2565	(91)
MIT	18.7953	18.9847	19.3064	19.7212	20.0327	20.1692	20.1946	20.1905	20.0818	19.6392	19.1362	18.7659	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7953	18.9847	19.3064	19.7212	20.0327	20.1692	20.1946	20.1905	20.0818	19.6392	19.1362	18.7659	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9991	0.9968	0.9867	0.9424	0.8189	0.6156	0.4334	0.5088	0.8183	0.9792	0.9977	0.9994	(94)
Useful gains	721.9172	932.8251	1176.8380	1403.8547	1395.4691	1054.7797	705.9170	736.0052	999.5336	920.8338	735.0132	666.1377	(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	2928.8411	2841.3794	2579.4803	2163.6918	1663.8288	1104.8885	713.1447	751.1041	1189.6994	1804.8953	2410.0216	2925.0316	(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	1641.9514	1282.5485	1043.5658	547.0828	199.6596	0.0000	0.0000	0.0000	0.0000	657.7417	1206.0060	1680.6171	(98)
Space heating												8259.1728	(98)
Space heating per m2											(98) / (4) =	49.7810	(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	1864.8900	1468.1049	1505.9795	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8704	0.9265	0.8894	0.0000	0.0000	0.0000	0.0000	(101)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1623.1763	1360.1647	1339.4427	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	2072.8595	1973.7193	1770.6367	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	323.7719	456.4846	320.8083	0.0000	0.0000	0.0000	0.0000 (104)
Space cooling												1101.0648 (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	80.9430	114.1211	80.2021	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												275.2662 (107)
Space cooling per m2												1.6591 (108)
Energy for space heating												49.7810 (99)
Energy for space cooling												1.6591 (108)
Total												51.4402 (109)
Target Fabric Energy Efficiency (TFEE)												59.2 (109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	61.2100	(1b)	x 2.5500	(2b) =	156.0855	(1b) - (3b)
First floor	62.4500	(1c)	x 2.9100	(2c) =	181.7295	(1c) - (3c)
Second floor	42.2500	(1d)	x 2.4000	(2d) =	101.4000	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	165.9100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		439.2150	(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		3.0000	
Infiltration rate		0.1500	(18)
Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7750	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1163	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.1221	0.1163	0.1163	0.1075	0.1075	0.0959	0.0988	0.0930	0.0959	0.1017	0.1017	0.1104	(22b)
Mechanical extract ventilation - decentralised													
If mechanical ventilation:												0.5000	(23a)
Effective ac	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	(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 = 1.20)			35.4300	1.1450	40.5687			(27)
Door			2.1000	1.0000	2.1000			(26)
Window glazed part (Uw = 1.20)			3.3000	1.1450	3.7786			(27)
Window opaque part			3.9400	1.2000	4.7280			(26)
Rooflights (Uw = 1.70)			5.6400	1.5918	8.9775			(27a)
Ground Floor			61.2100	0.1200	7.3452	75.0000	4590.7500	(28a)
Exposed floor			6.3800	0.2000	1.2760	20.0000	127.6000	(28b)
External Wall	184.8200	44.7700	140.0500	0.1900	26.6095	60.0000	8403.0000	(29a)
Sloping	49.9700	5.6400	44.3300	0.1300	5.7629	9.0000	398.9700	(30)
Flat roof	18.2100		18.2100	0.1500	2.7315	9.0000	163.8900	(30)
Total net area of external elements Aum(A, m2)			320.5900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		103.8780			(33)
Party Wall			67.5100	0.0000	0.0000	45.0000	3037.9500	(32)
GF Timber			68.1000			9.0000	612.9000	(32c)
FF Timber			115.3000			9.0000	1037.7000	(32c)
SF Timber			48.9200			9.0000	440.2800	(32c)
Internal Floor 1			56.0700			18.0000	1009.2600	(32d)
Internal Floor 2			49.3800			18.0000	888.8400	(32d)
Internal Ceiling 1			56.0700			18.0000	1009.2600	(32e)
Internal Ceiling 2			49.3800			18.0000	888.8400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	22609.2400 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		136.2741 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		23.8153 (36)
Total fabric heat loss	(33) + (36) =	127.6933 (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	72.4705	72.4705	72.4705	72.4705	72.4705	72.4705	72.4705	72.4705	72.4705	72.4705	72.4705	72.4705	(38)
Heat transfer coeff	200.1638	200.1638	200.1638	200.1638	200.1638	200.1638	200.1638	200.1638	200.1638	200.1638	200.1638	200.1638	(39)
Average = Sum(39)m / 12 =												200.1638	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2065	1.2065	1.2065	1.2065	1.2065	1.2065	1.2065	1.2065	1.2065	1.2065	1.2065	1.2065	(40)
HLP (average)												1.2065	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF HEAT DEMAND 09 Jan 2014

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4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.9571	(42)
Average daily hot water use (litres/day)												104.4302	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	114.8732	110.6960	106.5188	102.3416	98.1644	93.9871	93.9871	98.1644	102.3416	106.5188	110.6960	114.8732	(44)
Energy conte	170.3536	148.9923	153.7468	134.0401	128.6147	110.9847	102.8437	118.0146	119.4241	139.1772	151.9228	164.9784	(45)
Energy content (annual)										Total = Sum(45)m =		1643.0931	(45)
Distribution loss (46)m = 0.15 x (45)m	25.5530	22.3489	23.0620	20.1060	19.2922	16.6477	15.4265	17.7022	17.9136	20.8766	22.7884	24.7468	(46)
Water storage loss:													
Store volume												250.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.6700	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.9018	(55)
Total storage loss	27.9558	25.2504	27.9558	27.0540	27.9558	27.0540	27.9558	27.9558	27.0540	27.9558	27.0540	27.9558	(56)
If cylinder contains dedicated solar storage	27.9558	25.2504	27.9558	27.0540	27.9558	27.0540	27.9558	27.9558	27.0540	27.9558	27.0540	27.9558	(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	221.5718	195.2539	204.9650	183.6061	179.8329	160.5507	154.0619	169.2328	168.9901	190.3954	201.4888	216.1966	(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	221.5718	195.2539	204.9650	183.6061	179.8329	160.5507	154.0619	169.2328	168.9901	190.3954	201.4888	216.1966	(64)
								Total per year (kWh/year) = Sum(64)m =				2246.1461	(64)
RHI water heating demand												2246	(64)
Heat gains from water heating, kWh/month	97.6171	86.5492	92.0954	84.2211	83.7390	76.5552	75.1701	80.2144	79.3613	87.2510	90.1671	95.8299	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	177.4236	177.4236	177.4236	177.4236	177.4236	177.4236	177.4236	177.4236	177.4236	177.4236	177.4236	177.4236	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	75.1886	66.7818	54.3106	41.1166	30.7352	25.9479	28.0376	36.4444	48.9156	62.1096	72.4910	77.2783	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	503.5145	508.7395	495.5729	467.5427	432.1598	398.9047	376.6883	371.4634	384.6300	412.6601	448.0431	481.2981	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.6994	55.6994	55.6994	55.6994	55.6994	55.6994	55.6994	55.6994	55.6994	55.6994	55.6994	55.6994	(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)	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	(71)
Water heating gains (Table 5)	131.2058	128.7935	123.7841	116.9738	112.5524	106.3267	101.0350	107.8151	110.2240	117.2728	125.2321	128.8036	(72)
Total internal gains	827.7495	822.1554	791.5082	743.4738	693.2879	649.0199	623.6016	633.5635	661.6102	709.8831	763.6069	805.2206	(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	13.4200	11.9814	0.5000	0.7000	0.7700	38.9998	(74)
East	7.3300	22.3313	0.5000	0.7000	0.7700	39.7027	(76)
West	14.6800	22.3313	0.5000	0.7000	0.7700	79.5136	(80)
East	2.1400	22.3313	0.5000	1.0000	0.7700	16.5589	(76)
South	1.1600	50.9848	0.5000	1.0000	0.7700	20.4928	(78)
South	5.6400	47.1663	0.5000	0.0000	1.0000	133.0089	(82)

Solar gains	328.2767	558.0293	877.2151	1297.3236	1548.4938	1700.6005	1599.5308	1402.0307	1096.0047	696.5325	414.7810	270.4408	(83)
Total gains	1156.0263	1380.1846	1668.7232	2040.7974	2241.7817	2349.6205	2223.1324	2035.5942	1757.6149	1406.4157	1178.3879	1075.6614	(84)

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7. Mean internal temperature (heating season)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
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)													
tau	31.3760	31.3760	31.3760	31.3760	31.3760	31.3760	31.3760	31.3760	31.3760	31.3760	31.3760	31.3760	
alpha	3.0917	3.0917	3.0917	3.0917	3.0917	3.0917	3.0917	3.0917	3.0917	3.0917	3.0917	3.0917	
util living area	0.9717	0.9522	0.9015	0.7867	0.6178	0.4079	0.2752	0.3086	0.5844	0.8525	0.9508	0.9766	(86)
MIT	19.2085	19.4616	19.9404	20.4638	20.8119	20.9632	20.9924	20.9892	20.8835	20.4061	19.7110	19.1451	(87)
Th 2	19.9148	19.9148	19.9148	19.9148	19.9148	19.9148	19.9148	19.9148	19.9148	19.9148	19.9148	19.9148	(88)
util rest of house	0.9661	0.9430	0.8827	0.7488	0.5556	0.3260	0.1807	0.2067	0.4975	0.8151	0.9394	0.9718	(89)
MIT 2	17.5594	17.9221	18.5997	19.3077	19.7384	19.8923	19.9127	19.9115	19.8265	19.2548	18.2865	17.4683	(90)
Living area fraction									fLA = Living area / (4) =			0.2565	(91)
MIT	17.9823	18.3169	18.9436	19.6042	20.0137	20.1669	20.1896	20.1879	20.0976	19.5501	18.6518	17.8983	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.9823	18.3169	18.9436	19.6042	20.0137	20.1669	20.1896	20.1879	20.0976	19.5501	18.6518	17.8983	(93)

CALCULATION OF HEAT DEMAND 09 Jan 2014

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9520	0.9249	0.8620	0.7366	0.5617	0.3455	0.2049	0.2328	0.5131	0.8001	0.9215	0.9592	(94)
Useful gains	1100.5549	1276.4930	1438.4361	1503.3183	1259.1016	811.8602	455.5336	473.8136	901.8145	1125.2611	1085.9406	1031.7405	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	2578.5788	2545.4721	2310.6023	1942.4349	1403.8849	834.0644	458.2954	477.9701	980.3170	1591.3164	2132.1062	2561.7656	(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	1099.6498	852.7540	648.8917	316.1640	107.7188	0.0000	0.0000	0.0000	0.0000	346.7451	753.2393	1138.3387	(98)
Space heating												5263.5013	(98)
RHI space heating demand												5264	(98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	61.2100	(1b)	x 2.5500	(2b) =	156.0855	(1b) - (3b)
First floor	62.4500	(1c)	x 2.9100	(2c) =	181.7295	(1c) - (3c)
Second floor	42.2500	(1d)	x 2.4000	(2d) =	101.4000	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	165.9100					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	439.2150	(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		3.0000	
Infiltration rate		0.1500	(18)
Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7750	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1163	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.1482	0.1453	0.1424	0.1279	0.1250	0.1104	0.1104	0.1075	0.1163	0.1250	0.1308	0.1366	(22b)
Mechanical extract ventilation - decentralised													
If mechanical ventilation:												0.5000	(23a)
Effective ac	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	(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 = 1.20)			35.4300	1.1450	40.5687			(27)
Door			2.1000	1.0000	2.1000			(26)
Window glazed part (Uw = 1.20)			3.3000	1.1450	3.7786			(27)
Window opaque part			3.9400	1.2000	4.7280			(26)
Rooflights (Uw = 1.70)			5.6400	1.5918	8.9775			(27a)
Ground Floor			61.2100	0.1200	7.3452	75.0000	4590.7500	(28a)
Exposed floor			6.3800	0.2000	1.2760	20.0000	127.6000	(28b)
External Wall	184.8200	44.7700	140.0500	0.1900	26.6095	60.0000	8403.0000	(29a)
Sloping	49.9700	5.6400	44.3300	0.1300	5.7629	9.0000	398.9700	(30)
Flat roof	18.2100		18.2100	0.1500	2.7315	9.0000	163.8900	(30)
Total net area of external elements Aum(A, m2)			320.5900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		103.8780			(33)
Party Wall			67.5100	0.0000	0.0000	45.0000	3037.9500	(32)
GF Timber			68.1000			9.0000	612.9000	(32c)
FF Timber			115.3000			9.0000	1037.7000	(32c)
SF Timber			48.9200			9.0000	440.2800	(32c)
Internal Floor 1			56.0700			18.0000	1009.2600	(32d)
Internal Floor 2			49.3800			18.0000	888.8400	(32d)
Internal Ceiling 1			56.0700			18.0000	1009.2600	(32e)
Internal Ceiling 2			49.3800			18.0000	888.8400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	22609.2400 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		136.2741 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		23.8153 (36)
Total fabric heat loss	(33) + (36) =	127.6933 (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	72.4705	72.4705	72.4705	72.4705	72.4705	72.4705	72.4705	72.4705	72.4705	72.4705	72.4705	72.4705	(38)
Heat transfer coeff	200.1638	200.1638	200.1638	200.1638	200.1638	200.1638	200.1638	200.1638	200.1638	200.1638	200.1638	200.1638	(39)
Average = Sum(39)m / 12 =												200.1638	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2065	1.2065	1.2065	1.2065	1.2065	1.2065	1.2065	1.2065	1.2065	1.2065	1.2065	1.2065	(40)
HLP (average)												1.2065	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

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4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.9571	(42)
Average daily hot water use (litres/day)												104.4302	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	114.8732	110.6960	106.5188	102.3416	98.1644	93.9871	93.9871	98.1644	102.3416	106.5188	110.6960	114.8732	(44)
Energy conte	170.3536	148.9923	153.7468	134.0401	128.6147	110.9847	102.8437	118.0146	119.4241	139.1772	151.9228	164.9784	(45)
Energy content (annual)										Total = Sum(45)m =		1643.0931	(45)
Distribution loss (46)m = 0.15 x (45)m													
	25.5530	22.3489	23.0620	20.1060	19.2922	16.6477	15.4265	17.7022	17.9136	20.8766	22.7884	24.7468	(46)
Water storage loss:													
Store volume												250.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.6700	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.9018	(55)
Total storage loss													
	27.9558	25.2504	27.9558	27.0540	27.9558	27.0540	27.9558	27.9558	27.0540	27.9558	27.0540	27.9558	(56)
If cylinder contains dedicated solar storage													
	27.9558	25.2504	27.9558	27.0540	27.9558	27.0540	27.9558	27.9558	27.0540	27.9558	27.0540	27.9558	(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													
	221.5718	195.2539	204.9650	183.6061	179.8329	160.5507	154.0619	169.2328	168.9901	190.3954	201.4888	216.1966	(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													
	221.5718	195.2539	204.9650	183.6061	179.8329	160.5507	154.0619	169.2328	168.9901	190.3954	201.4888	216.1966	(64)
										Total per year (kWh/year) = Sum(64)m =		2246.1461	(64)
Heat gains from water heating, kWh/month													
	97.6171	86.5492	92.0954	84.2211	83.7390	76.5552	75.1701	80.2144	79.3613	87.2510	90.1671	95.8299	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	177.4236	177.4236	177.4236	177.4236	177.4236	177.4236	177.4236	177.4236	177.4236	177.4236	177.4236	177.4236	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	75.1886	66.7818	54.3106	41.1166	30.7352	25.9479	28.0376	36.4444	48.9156	62.1096	72.4910	77.2783	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	503.5145	508.7395	495.5729	467.5427	432.1598	398.9047	376.6883	371.4634	384.6300	412.6601	448.0431	481.2981	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.6994	55.6994	55.6994	55.6994	55.6994	55.6994	55.6994	55.6994	55.6994	55.6994	55.6994	55.6994	(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)													
	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	(71)
Water heating gains (Table 5)													
	131.2058	128.7935	123.7841	116.9738	112.5524	106.3267	101.0350	107.8151	110.2240	117.2728	125.2321	128.8036	(72)
Total internal gains													
	827.7495	822.1554	791.5082	743.4738	693.2879	649.0199	623.6016	633.5635	661.6102	709.8831	763.6069	805.2206	(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	13.4200	10.6334	0.5000	0.7000	0.7700	34.6119	(74)
East	7.3300	19.6403	0.5000	0.7000	0.7700	34.9183	(76)
West	14.6800	19.6403	0.5000	0.7000	0.7700	69.9318	(80)
East	2.1400	19.6403	0.5000	1.0000	0.7700	14.5635	(76)
South	1.1600	46.7521	0.5000	1.0000	0.7700	18.7915	(78)
South	5.6400	42.0754	0.5000	0.0000	1.0000	118.6525	(82)

Solar gains	291.4694	549.7298	873.5138	1252.9059	1535.3013	1575.8924	1498.2834	1283.8968	1006.5232	642.2282	359.2975	242.5835	(83)
Total gains	1119.2190	1371.8852	1665.0219	1996.3797	2228.5892	2224.9123	2121.8850	1917.4603	1668.1334	1352.1113	1122.9044	1047.8042	(84)

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7. Mean internal temperature (heating season)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
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)													
tau	31.3760	31.3760	31.3760	31.3760	31.3760	31.3760	31.3760	31.3760	31.3760	31.3760	31.3760	31.3760	
alpha	3.0917	3.0917	3.0917	3.0917	3.0917	3.0917	3.0917	3.0917	3.0917	3.0917	3.0917	3.0917	
util living area													
	0.9772	0.9578	0.9147	0.8231	0.6840	0.5263	0.3986	0.4530	0.6803	0.8886	0.9630	0.9811	(86)
MIT	19.0433	19.3395	19.8000	20.3225	20.7066	20.9042	20.9696	20.9546	20.7857	20.2343	19.5203	18.9688	(87)
Th 2	19.9148	19.9148	19.9148	19.9148	19.9148	19.9148	19.9148	19.9148	19.9148	19.9148	19.9148	19.9148	(88)
util rest of house													
	0.9728	0.9499	0.8990	0.7917	0.6317	0.4513	0.3067	0.3563	0.6078	0.8609	0.9547	0.9775	(89)
MIT 2	17.3195	17.7457	18.4007	19.1195	19.6134	19.8389	19.8987	19.8888	19.7237	19.0223	18.0124	17.2118	(90)
Living area fraction										fLA = Living area / (4) =		0.2565	(91)
MIT	17.7616	18.1545	18.7596	19.4280	19.8938	20.1121	20.1734	20.1622	19.9960	19.3331	18.3991	17.6624	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.7616	18.1545	18.7596	19.4280	19.8938	20.1121	20.1734	20.1622	19.9960	19.3331	18.3991	17.6624	(93)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9603	0.9326	0.8782	0.7756	0.6306	0.4656	0.3292	0.3792	0.6137	0.8426	0.9387	0.9663	(94)
Useful gains	1074.7370	1279.4425	1462.1651	1548.4682	1405.2961	1035.8972	698.6276	727.0587	1023.7909	1139.2651	1054.0914	1012.5412	(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													
	2694.5304	2653.0613	2453.9234	2107.3267	1640.0934	1103.3182	715.2589	753.0513	1180.1752	1748.0500	2261.6788	2694.6850	(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													
	1205.1263	923.0718	737.8682	402.3781	174.6892	0.0000	0.0000	0.0000	0.0000	452.9360	869.4629	1251.5150	(98)
Space heating												6017.0476	(98)
Space heating per m2											(98) / (4) =	36.2669	(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 %)	93.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	6435.3450	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1205.1263	923.0718	737.8682	402.3781	174.6892	0.0000	0.0000	0.0000	0.0000	452.9360	869.4629	1251.5150	(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)													
	1288.9051	987.2426	789.1638	430.3510	186.8334	0.0000	0.0000	0.0000	0.0000	484.4235	929.9069	1338.5188	(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													
	221.5718	195.2539	204.9650	183.6061	179.8329	160.5507	154.0619	169.2328	168.9901	190.3954	201.4888	216.1966	(64)
Efficiency of water heater												79.8000	(216)
(217)m	88.6539	88.4298	87.9367	86.8511	84.7366	79.8000	79.8000	79.8000	79.8000	87.0458	88.2732	88.7472	(217)
Fuel for water heating, kWh/month													
	249.9291	220.8011	233.0823	211.4033	212.2258	201.1914	193.0600	212.0712	211.7670	218.7302	228.2561	243.6096	(219)
Water heating fuel used												2636.1269	(219)
Annual totals kWh/year													
Space heating fuel - main system												6435.3450	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
(MEVDecentralised, Database: total watage = 6.2785, total flow = 37.0000, SFP = 0.1697)													
mechanical ventilation fans (SFP = 0.1697)												90.9266	(230a)
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												165.9266	(231)
Electricity for lighting (calculated in Appendix L)												531.1413	(232)
Total delivered energy for all uses												9768.5399	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	6435.3450	3.4800	223.9500	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2636.1269	3.4800	91.7372	(247)
Mechanical ventilation fans	90.9266	13.1900	11.9932	(249)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	531.1413	13.1900	70.0575	(250)
Additional standing charges			120.0000	(251)
Total energy cost			527.6305	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):	0.4200	(256)
Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] =	1.0507	(257)
SAP value	85.3426	
SAP rating (Section 12)	85	(258)
SAP band	B	

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	6435.3450	0.2160	1390.0345	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2636.1269	0.2160	569.4034	(264)
Space and water heating			1959.4379	(265)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Pumps and fans	165.9266	0.5190	86.1159 (267)
Energy for lighting	531.1413	0.5190	275.6624 (268)
Total kg/year			2321.2162 (272)
CO2 emissions per m2			13.9900 (273)
EI value			85.2523
EI rating			85 (274)
EI band			B

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8499 = 4.095, stars = 4
Water heating environmental impact	0.216 / 0.8499 = 0.2541, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	61.2100	(1b)	x 2.5500	(2b) =	156.0855	(1b) - (3b)
First floor	62.4500	(1c)	x 2.9100	(2c) =	181.7295	(1c) - (3c)
Second floor	42.2500	(1d)	x 2.4000	(2d) =	101.4000	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	165.9100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		439.2150	(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		3.0000	
Infiltration rate		0.1500	(18)
Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7750	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1163	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.1221	0.1163	0.1163	0.1075	0.1075	0.0959	0.0988	0.0930	0.0959	0.1017	0.1017	0.1104	(22b)
Mechanical extract ventilation - decentralised													
If mechanical ventilation:												0.5000	(23a)
Effective ac	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	(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 = 1.20)			35.4300	1.1450	40.5687			(27)
Door			2.1000	1.0000	2.1000			(26)
Window glazed part (Uw = 1.20)			3.3000	1.1450	3.7786			(27)
Window opaque part			3.9400	1.2000	4.7280			(26)
Rooflights (Uw = 1.70)			5.6400	1.5918	8.9775			(27a)
Ground Floor			61.2100	0.1200	7.3452	75.0000	4590.7500	(28a)
Exposed floor			6.3800	0.2000	1.2760	20.0000	127.6000	(28b)
External Wall	184.8200	44.7700	140.0500	0.1900	26.6095	60.0000	8403.0000	(29a)
Sloping	49.9700	5.6400	44.3300	0.1300	5.7629	9.0000	398.9700	(30)
Flat roof	18.2100		18.2100	0.1500	2.7315	9.0000	163.8900	(30)
Total net area of external elements Aum(A, m2)			320.5900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		103.8780			(33)
Party Wall			67.5100	0.0000	0.0000	45.0000	3037.9500	(32)
GF Timber			68.1000			9.0000	612.9000	(32c)
FF Timber			115.3000			9.0000	1037.7000	(32c)
SF Timber			48.9200			9.0000	440.2800	(32c)
Internal Floor 1			56.0700			18.0000	1009.2600	(32d)
Internal Floor 2			49.3800			18.0000	888.8400	(32d)
Internal Ceiling 1			56.0700			18.0000	1009.2600	(32e)
Internal Ceiling 2			49.3800			18.0000	888.8400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	22609.2400 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		136.2741 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		23.8153 (36)
Total fabric heat loss	(33) + (36) =	127.6933 (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	72.4705	72.4705	72.4705	72.4705	72.4705	72.4705	72.4705	72.4705	72.4705	72.4705	72.4705	72.4705	(38)
Heat transfer coeff	200.1638	200.1638	200.1638	200.1638	200.1638	200.1638	200.1638	200.1638	200.1638	200.1638	200.1638	200.1638	(39)
Average = Sum(39)m / 12 =												200.1638	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2065	1.2065	1.2065	1.2065	1.2065	1.2065	1.2065	1.2065	1.2065	1.2065	1.2065	1.2065	(40)
HLP (average)												1.2065	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.9571	(42)
Average daily hot water use (litres/day)												104.4302	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	114.8732	110.6960	106.5188	102.3416	98.1644	93.9871	93.9871	98.1644	102.3416	106.5188	110.6960	114.8732	(44)
Energy conte	170.3536	148.9923	153.7468	134.0401	128.6147	110.9847	102.8437	118.0146	119.4241	139.1772	151.9228	164.9784	(45)
Energy content (annual)										Total = Sum(45)m =		1643.0931	(45)
Distribution loss (46)m = 0.15 x (45)m	25.5530	22.3489	23.0620	20.1060	19.2922	16.6477	15.4265	17.7022	17.9136	20.8766	22.7884	24.7468	(46)
Water storage loss:													
Store volume												250.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.6700	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.9018	(55)
Total storage loss	27.9558	25.2504	27.9558	27.0540	27.9558	27.0540	27.9558	27.9558	27.0540	27.9558	27.0540	27.9558	(56)
If cylinder contains dedicated solar storage	27.9558	25.2504	27.9558	27.0540	27.9558	27.0540	27.9558	27.9558	27.0540	27.9558	27.0540	27.9558	(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	221.5718	195.2539	204.9650	183.6061	179.8329	160.5507	154.0619	169.2328	168.9901	190.3954	201.4888	216.1966	(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	221.5718	195.2539	204.9650	183.6061	179.8329	160.5507	154.0619	169.2328	168.9901	190.3954	201.4888	216.1966	(64)
									Total per year (kWh/year) = Sum(64)m =			2246.1461	(64)
Heat gains from water heating, kWh/month	97.6171	86.5492	92.0954	84.2211	83.7390	76.5552	75.1701	80.2144	79.3613	87.2510	90.1671	95.8299	(65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	177.4236	177.4236	177.4236	177.4236	177.4236	177.4236	177.4236	177.4236	177.4236	177.4236	177.4236	177.4236	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	75.1886	66.7818	54.3106	41.1166	30.7352	25.9479	28.0376	36.4444	48.9156	62.1096	72.4910	77.2783	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	503.5145	508.7395	495.5729	467.5427	432.1598	398.9047	376.6883	371.4634	384.6300	412.6601	448.0431	481.2981	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.6994	55.6994	55.6994	55.6994	55.6994	55.6994	55.6994	55.6994	55.6994	55.6994	55.6994	55.6994	(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)	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	(71)
Water heating gains (Table 5)	131.2058	128.7935	123.7841	116.9738	112.5524	106.3267	101.0350	107.8151	110.2240	117.2728	125.2321	128.8036	(72)
Total internal gains	827.7495	822.1554	791.5082	743.4738	693.2879	649.0199	623.6016	633.5635	661.6102	709.8831	763.6069	805.2206	(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	13.4200	11.9814	0.5000	0.7000	0.7700	38.9998	(74)
East	7.3300	22.3313	0.5000	0.7000	0.7700	39.7027	(76)
West	14.6800	22.3313	0.5000	0.7000	0.7700	79.5136	(80)
East	2.1400	22.3313	0.5000	1.0000	0.7700	16.5589	(76)
South	1.1600	50.9848	0.5000	1.0000	0.7700	20.4928	(78)
South	5.6400	47.1663	0.5000	0.0000	1.0000	133.0089	(82)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	328.2767	558.0293	877.2151	1297.3236	1548.4938	1700.6005	1599.5308	1402.0307	1096.0047	696.5325	414.7810	270.4408	(83)
Total gains	1156.0263	1380.1846	1668.7232	2040.7974	2241.7817	2349.6205	2223.1324	2035.5942	1757.6149	1406.4157	1178.3879	1075.6614	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	31.3760	31.3760	31.3760	31.3760	31.3760	31.3760	31.3760	31.3760	31.3760	31.3760	31.3760	31.3760	
alpha	3.0917	3.0917	3.0917	3.0917	3.0917	3.0917	3.0917	3.0917	3.0917	3.0917	3.0917	3.0917	
util living area	0.9717	0.9522	0.9015	0.7867	0.6178	0.4079	0.2752	0.3086	0.5844	0.8525	0.9508	0.9766	(86)
MIT	19.2085	19.4616	19.9404	20.4638	20.8119	20.9632	20.9924	20.9892	20.8835	20.4061	19.7110	19.1451	(87)
Th 2	19.9148	19.9148	19.9148	19.9148	19.9148	19.9148	19.9148	19.9148	19.9148	19.9148	19.9148	19.9148	(88)
util rest of house	0.9661	0.9430	0.8827	0.7488	0.5556	0.3260	0.1807	0.2067	0.4975	0.8151	0.9394	0.9718	(89)
MIT 2	17.5594	17.9221	18.5997	19.3077	19.7384	19.8923	19.9127	19.9115	19.8265	19.2548	18.2865	17.4683	(90)
Living area fraction									fLA = Living area / (4) =			0.2565	(91)
MIT	17.9823	18.3169	18.9436	19.6042	20.0137	20.1669	20.1896	20.1879	20.0976	19.5501	18.6518	17.8983	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.9823	18.3169	18.9436	19.6042	20.0137	20.1669	20.1896	20.1879	20.0976	19.5501	18.6518	17.8983	(93)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9520	0.9249	0.8620	0.7366	0.5617	0.3455	0.2049	0.2328	0.5131	0.8001	0.9215	0.9592	(94)
Useful gains	1100.5549	1276.4930	1438.4361	1503.3183	1259.1016	811.8602	455.5336	473.8136	901.8145	1125.2611	1085.9406	1031.7405	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W													
	2578.5788	2545.4721	2310.6023	1942.4349	1403.8849	834.0644	458.2954	477.9701	980.3170	1591.3164	2132.1062	2561.7656	(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													
	1099.6498	852.7540	648.8917	316.1640	107.7188	0.0000	0.0000	0.0000	0.0000	346.7451	753.2393	1138.3387	(98)
Space heating												5263.5013	(98)
Space heating per m2											(98) / (4) =	31.7250	(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 %)	93.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	5629.4132	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1099.6498	852.7540	648.8917	316.1640	107.7188	0.0000	0.0000	0.0000	0.0000	346.7451	753.2393	1138.3387	(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)													
	1176.0960	912.0363	694.0018	338.1433	115.2073	0.0000	0.0000	0.0000	0.0000	370.8504	805.6035	1217.4745	(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													
	221.5718	195.2539	204.9650	183.6061	179.8329	160.5507	154.0619	169.2328	168.9901	190.3954	201.4888	216.1966	(64)
Efficiency of water heater												79.8000	(216)
(217)m	88.5097	88.2943	87.6779	86.2512	83.4982	79.8000	79.8000	79.8000	79.8000	86.3939	88.0095	88.6038	(217)
Fuel for water heating, kWh/month													
	250.3361	221.1400	233.7703	212.8737	215.3735	201.1914	193.0600	212.0712	211.7670	220.3807	228.9398	244.0038	(219)
Water heating fuel used												2644.9073	(219)
Annual totals kWh/year													
Space heating fuel - main system												5629.4132	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
(MEVDecentralised, Database: total watage = 6.2785, total flow = 37.0000, SFP = 0.1697)													
mechanical ventilation fans (SFP = 0.1697)												90.9266	(230a)
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												165.9266	(231)
Electricity for lighting (calculated in Appendix L)												531.1413	(232)
Total delivered energy for all uses												8971.3884	(238)

10a. Fuel costs - using BEDF prices (491)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	5629.4132	3.6300	204.3477	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2644.9073	3.6300	96.0101	(247)
Mechanical ventilation fans	90.9266	19.4400	17.6761	(249)
Pumps and fans for heating	75.0000	19.4400	14.5800	(249)
Energy for lighting	531.1413	19.4400	103.2539	(250)
Additional standing charges			95.0000	(251)
Total energy cost			530.8678	(255)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	5629.4132	0.2160	1215.9532	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2644.9073	0.2160	571.3000	(264)
Space and water heating			1787.2532	(265)
Pumps and fans	165.9266	0.5190	86.1159	(267)
Energy for lighting	531.1413	0.5190	275.6624	(268)
Total kg/year			2149.0315	(272)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Space heating - main system 1	5629.4132	1.2200	6867.8840 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2644.9073	1.2200	3226.7869 (264)
Space and water heating			10094.6709 (265)
Pumps and fans	165.9266	3.0700	509.3948 (267)
Energy for lighting	531.1413	3.0700	1630.6039 (268)
Primary energy kWh/year			12234.6696 (272)
Primary energy kWh/m2/year			73.7428 (273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 85
Current environmental impact rating: B 85

(For testing purposes):

A	Not considered
B	Not considered
C	Not considered
D	Not considered
E Low energy lighting	Already installed
F	Not considered
G	Not considered
H	Not considered
I	Not considered
J	Not considered
K	Not considered
M	Not considered
N Solar water heating	Recommended
O	Not considered
P	Not considered
R	Not considered
S	Not considered
T	Not considered
U Solar photovoltaic panels	Recommended
A2	Not considered
A3	Not considered
T2	Not considered
W	Not considered
X	Not considered
Y	Not considered
J2	Not considered
Q2	Not considered
Z1	Not considered
Z2	Not considered
Z3	Not considered
Z4	Not considered
Z5	Not considered
V2 Wind turbine	Not applicable
L2	Not considered
Q3	Not considered
O3	Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.1	-£ 39	-265 kg (12.3%)
U Solar photovoltaic panels	+ 6.3	-£ 355	-947 kg (50.2%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£39	1.59 kg/m²	B 86	B 87
Solar photovoltaic panels	£355	5.71 kg/m²	A 93	A 93
Total Savings	£394	7.30 kg/m²		

Potential energy efficiency rating: A 93
Potential environmental impact rating: A 93

Fuel prices for cost data on this page from database revision number 491 TEST (28 Feb 2022)
Recommendation texts revision number 4.9c (22 Feb 2014)

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

	Current	Potential	Saving
Electricity	£136	£145	-£10
Mains gas	£395	£347	£49
Space heating	£332	£333	-£1
Water heating	£96	£56	£40
Lighting	£103	£103	£0
Generated (PV)	-£0	-£355	£355
Total cost of fuels	£531	£137	£394
Total cost of uses	£531	£137	£394
Delivered energy	54 kWh/m²	35 kWh/m²	19 kWh/m²
Carbon dioxide emissions	2.1 tonnes	0.9 tonnes	1.2 tonnes
CO2 emissions per m²	13 kg/m²	6 kg/m²	7 kg/m²
Primary energy	74 kWh/m²	31 kWh/m²	43 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	61.2100	(1b)	x 2.5500	(2b) =	156.0855	(1b) - (3b)
First floor	62.4500	(1c)	x 2.9100	(2c) =	181.7295	(1c) - (3c)
Second floor	42.2500	(1d)	x 2.4000	(2d) =	101.4000	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	165.9100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		439.2150	(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			3.0000	
Infiltration rate			0.1500	(18)
Number of sides sheltered			3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.7750	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.1163	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.1482	0.1453	0.1424	0.1279	0.1250	0.1104	0.1104	0.1075	0.1163	0.1250	0.1308	0.1366	(22b)
Mechanical extract ventilation - decentralised													
If mechanical ventilation:												0.5000	(23a)
Effective ac	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	(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 = 1.20)			35.4300	1.1450	40.5687			(27)
Door			2.1000	1.0000	2.1000			(26)
Window glazed part (Uw = 1.20)			3.3000	1.1450	3.7786			(27)
Window opaque part			3.9400	1.2000	4.7280			(26)
Rooflights (Uw = 1.70)			5.6400	1.5918	8.9775			(27a)
Ground Floor			61.2100	0.1200	7.3452	75.0000	4590.7500	(28a)
Exposed floor			6.3800	0.2000	1.2760	20.0000	127.6000	(28b)
External Wall	184.8200	44.7700	140.0500	0.1900	26.6095	60.0000	8403.0000	(29a)
Sloping	49.9700	5.6400	44.3300	0.1300	5.7629	9.0000	398.9700	(30)
Flat roof	18.2100		18.2100	0.1500	2.7315	9.0000	163.8900	(30)
Total net area of external elements Aum(A, m2)			320.5900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		103.8780			(33)
Party Wall			67.5100	0.0000	0.0000	45.0000	3037.9500	(32)
GF Timber			68.1000			9.0000	612.9000	(32c)
FF Timber			115.3000			9.0000	1037.7000	(32c)
SF Timber			48.9200			9.0000	440.2800	(32c)
Internal Floor 1			56.0700			18.0000	1009.2600	(32d)
Internal Floor 2			49.3800			18.0000	888.8400	(32d)
Internal Ceiling 1			56.0700			18.0000	1009.2600	(32e)
Internal Ceiling 2			49.3800			18.0000	888.8400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	22609.2400 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		136.2741 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		23.8153 (36)
Total fabric heat loss	(33) + (36) =	127.6933 (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	72.4705	72.4705	72.4705	72.4705	72.4705	72.4705	72.4705	72.4705	72.4705	72.4705	72.4705	72.4705	(38)
Heat transfer coeff	200.1638	200.1638	200.1638	200.1638	200.1638	200.1638	200.1638	200.1638	200.1638	200.1638	200.1638	200.1638	(39)
Average = Sum(39)m / 12 =												200.1638	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2065	1.2065	1.2065	1.2065	1.2065	1.2065	1.2065	1.2065	1.2065	1.2065	1.2065	1.2065	(40)
HLP (average)												1.2065	(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												2.9571	(42)
Average daily hot water use (litres/day)												104.4302	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	114.8732	110.6960	106.5188	102.3416	98.1644	93.9871	93.9871	98.1644	102.3416	106.5188	110.6960	114.8732	(44)
Energy conte	170.3536	148.9923	153.7468	134.0401	128.6147	110.9847	102.8437	118.0146	119.4241	139.1772	151.9228	164.9784	(45)
Energy content (annual)										Total = Sum(45)m =		1643.0931	(45)
Distribution loss (46)m = 0.15 x (45)m	25.5530	22.3489	23.0620	20.1060	19.2922	16.6477	15.4265	17.7022	17.9136	20.8766	22.7884	24.7468	(46)
Water storage loss:													
Store volume												250.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.6700	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.9018	(55)
Total storage loss	27.9558	25.2504	27.9558	27.0540	27.9558	27.0540	27.9558	27.9558	27.0540	27.9558	27.0540	27.9558	(56)
If cylinder contains dedicated solar storage	19.5691	17.6753	19.5691	18.9378	19.5691	18.9378	19.5691	19.5691	18.9378	19.5691	18.9378	19.5691	(57)
Primary loss	23.2624	21.0112	21.8667	15.7584	10.4681	9.9053	10.2355	11.1660	17.1091	21.8667	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month	213.1851	187.6788	195.1825	168.7363	158.6519	139.8278	132.6482	148.7496	155.4710	180.6130	193.3726	207.8098	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1079.5246	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1813.6014	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.1038	(H8)
Utilisation factor												0.5959	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												127.5000	(H13)
Daily hot water demand												104.4302	(H14)
Volume ratio Veff/V												1.2209	(H15)
Solar storage volume factor												1.0000	(H16)
Solar input												-950.2040	(H17)
Solar input	-27.5540	-45.9797	-78.3088	-104.9492	-129.6559	-127.4724	-125.7878	-109.9014	-86.0748	-58.7790	-32.6830	-23.0580	(63)
								Solar input (sum of months) = Sum(63)m =				-950.2040	(63)
Output from w/h	185.6310	141.6991	116.8737	63.7872	28.9960	12.3554	6.8604	38.8482	69.3961	121.8340	160.6896	184.7518	(64)
								Total per year (kWh/year) = Sum(64)m =				1131.7226	(64)
Heat gains from water heating, kWh/month	90.9077	80.4891	84.2694	72.3253	66.7941	59.9769	58.0391	63.8279	68.5460	79.4250	83.6742	89.1205	(65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	177.4236	177.4236	177.4236	177.4236	177.4236	177.4236	177.4236	177.4236	177.4236	177.4236	177.4236	177.4236	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	75.1886	66.7818	54.3106	41.1166	30.7352	25.9479	28.0376	36.4444	48.9156	62.1096	72.4910	77.2783	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	503.5145	508.7395	495.5729	467.5427	432.1598	398.9047	376.6883	371.4634	384.6300	412.6601	448.0431	481.2981	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.6994	55.6994	55.6994	55.6994	55.6994	55.6994	55.6994	55.6994	55.6994	55.6994	55.6994	55.6994	(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)	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	(71)
Water heating gains (Table 5)	122.1878	119.7755	113.2653	100.4518	89.7770	83.3012	78.0096	85.7901	95.2028	106.7540	116.2141	119.7856	(72)
Total internal gains	818.7315	813.1374	780.9894	726.9518	670.5125	625.9945	600.5762	611.5386	646.5890	699.3643	754.5889	796.2026	(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	13.4200	10.6334	0.5000	0.7000	0.7700	34.6119	(74)
East	7.3300	19.6403	0.5000	0.7000	0.7700	34.9183	(76)
West	14.6800	19.6403	0.5000	0.7000	0.7700	69.9318	(80)
East	2.1400	19.6403	0.5000	1.0000	0.7700	14.5635	(76)
South	1.1600	46.7521	0.5000	1.0000	0.7700	18.7915	(78)
South	5.6400	42.0754	0.5000	0.0000	1.0000	118.6525	(82)

Solar gains	291.4694	549.7298	873.5138	1252.9059	1535.3013	1575.8924	1498.2834	1283.8968	1006.5232	642.2282	359.2975	242.5835	(83)
Total gains	1110.2010	1362.8672	1654.5031	1979.8577	2205.8138	2201.8869	2098.8596	1895.4354	1653.1122	1341.5925	1113.8864	1038.7862	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)	21.0000	(85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)		

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	31.3760	31.3760	31.3760	31.3760	31.3760	31.3760	31.3760	31.3760	31.3760	31.3760	31.3760	31.3760	
alpha	3.0917	3.0917	3.0917	3.0917	3.0917	3.0917	3.0917	3.0917	3.0917	3.0917	3.0917	3.0917	
util living area	0.9776	0.9584	0.9159	0.8257	0.6882	0.5306	0.4025	0.4575	0.6841	0.8904	0.9638	0.9816	(86)
MIT	19.0361	19.3328	19.7934	20.3152	20.7012	20.9020	20.9688	20.9534	20.7822	20.2282	19.5134	18.9615	(87)
Th 2	19.9148	19.9148	19.9148	19.9148	19.9148	19.9148	19.9148	19.9148	19.9148	19.9148	19.9148	19.9148	(88)
util rest of house	0.9733	0.9507	0.9004	0.7946	0.6360	0.4554	0.3099	0.3601	0.6117	0.8630	0.9556	0.9780	(89)
MIT 2	17.3092	17.7362	18.3915	19.1101	19.6074	19.8369	19.8983	19.8880	19.7202	19.0143	18.0027	17.2012	(90)
Living area fraction										fLA = Living area / (4) =		0.2565	(91)
MIT	17.7521	18.1456	18.7510	19.4192	19.8879	20.1101	20.1728	20.1613	19.9926	19.3257	18.3902	17.6527	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.7521	18.1456	18.7510	19.4192	19.8879	20.1101	20.1728	20.1613	19.9926	19.3257	18.3902	17.6527	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9610	0.9335	0.8796	0.7783	0.6346	0.4696	0.3326	0.3831	0.6173	0.8446	0.9398	0.9670	(94)
Useful gains	1066.8838	1272.2865	1455.2303	1541.0015	1399.9190	1033.9146	698.0397	726.1280	1020.5483	1133.1476	1046.7852	1004.5246	(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	2692.6164	2651.2986	2452.2146	2105.5561	1638.9192	1102.9204	715.1450	752.8695	1179.4779	1746.5608	2259.8831	2692.7385	(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	1209.5451	926.6961	741.7563	406.4793	177.8161	0.0000	0.0000	0.0000	0.0000	456.3794	873.4305	1256.0311	(98)
Space heating												6048.1340	(98)
Space heating per m2											(98) / (4) =	36.4543	(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 %)	93.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	6468.5925	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1209.5451	926.6961	741.7563	406.4793	177.8161	0.0000	0.0000	0.0000	0.0000	456.3794	873.4305	1256.0311	(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)	1293.6311	991.1189	793.3223	434.7373	190.1776	0.0000	0.0000	0.0000	0.0000	488.1063	934.1502	1343.3488	(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	185.6310	141.6991	116.8737	63.7872	28.9960	12.3554	6.8604	38.8482	69.3961	121.8340	160.6896	184.7518	(64)
Efficiency of water heater												79.8000	(216)
(217)m	88.9138	88.9187	88.8779	88.8834	88.8301	79.8000	79.8000	79.8000	79.8000	88.0134	88.6529	88.9703	(217)
Fuel for water heating, kWh/month	208.7765	159.3580	131.4992	71.7650	32.6421	15.4830	8.5970	48.6820	86.9626	138.4266	181.2570	207.6557	(219)
Water heating fuel used												1291.1047	(219)
Annual totals kWh/year													
Space heating fuel - main system												6468.5925	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
(MEVDecentralised, Database: total watage = 6.2785, total flow = 37.0000, SFP = 0.1697)													
mechanical ventilation fans (SFP = 0.1697)												90.9266	(230a)
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												215.9266	(231)
Electricity for lighting (calculated in Appendix L)												531.1413	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1080 * 0.80) =										-1727.2394		-1727.2394	(233)
Total delivered energy for all uses												6779.5258	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	6468.5925	3.4800	225.1070	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1291.1047	3.4800	44.9304	(247)
Mechanical ventilation fans	90.9266	13.1900	11.9932	(249)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	531.1413	13.1900	70.0575	(250)
Additional standing charges			120.0000	(251)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Energy saving/generation technologies				
PV Unit	-1727.2394	13.1900	-227.8229	(252)
Total energy cost			260.7529	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.5193	(257)
SAP value		92.7564	
SAP rating (Section 12)		93	(258)
SAP band		A	

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	6468.5925	0.2160	1397.2160	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1291.1047	0.2160	278.8786	(264)
Space and water heating			1676.0946	(265)
Pumps and fans	215.9266	0.5190	112.0659	(267)
Energy for lighting	531.1413	0.5190	275.6624	(268)
Energy saving/generation technologies				
PV Unit	-1727.2394	0.5190	-896.4372	(269)
Total kg/year			1167.3856	(272)
CO2 emissions per m2			7.0400	(273)
EI value			92.5831	
EI rating			93	(274)
EI band			A	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	61.2100	(1b)	x 2.5500	(2b) =	156.0855	(1b) - (3b)
First floor	62.4500	(1c)	x 2.9100	(2c) =	181.7295	(1c) - (3c)
Second floor	42.2500	(1d)	x 2.4000	(2d) =	101.4000	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	165.9100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		439.2150	(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		3.0000	
Infiltration rate		0.1500	(18)
Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7750	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1163	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.1221	0.1163	0.1163	0.1075	0.1075	0.0959	0.0988	0.0930	0.0959	0.1017	0.1017	0.1104	(22b)
Mechanical extract ventilation - decentralised													
If mechanical ventilation:												0.5000	(23a)
Effective ac	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	(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 = 1.20)			35.4300	1.1450	40.5687			(27)
Door			2.1000	1.0000	2.1000			(26)
Window glazed part (Uw = 1.20)			3.3000	1.1450	3.7786			(27)
Window opaque part			3.9400	1.2000	4.7280			(26)
Rooflights (Uw = 1.70)			5.6400	1.5918	8.9775			(27a)
Ground Floor			61.2100	0.1200	7.3452	75.0000	4590.7500	(28a)
Exposed floor			6.3800	0.2000	1.2760	20.0000	127.6000	(28b)
External Wall	184.8200	44.7700	140.0500	0.1900	26.6095	60.0000	8403.0000	(29a)
Sloping	49.9700	5.6400	44.3300	0.1300	5.7629	9.0000	398.9700	(30)
Flat roof	18.2100		18.2100	0.1500	2.7315	9.0000	163.8900	(30)
Total net area of external elements Aum(A, m2)			320.5900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		103.8780			(33)
Party Wall			67.5100	0.0000	0.0000	45.0000	3037.9500	(32)
GF Timber			68.1000			9.0000	612.9000	(32c)
FF Timber			115.3000			9.0000	1037.7000	(32c)
SF Timber			48.9200			9.0000	440.2800	(32c)
Internal Floor 1			56.0700			18.0000	1009.2600	(32d)
Internal Floor 2			49.3800			18.0000	888.8400	(32d)
Internal Ceiling 1			56.0700			18.0000	1009.2600	(32e)
Internal Ceiling 2			49.3800			18.0000	888.8400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	22609.2400 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		136.2741 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		23.8153 (36)
Total fabric heat loss	(33) + (36) =	127.6933 (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	72.4705	72.4705	72.4705	72.4705	72.4705	72.4705	72.4705	72.4705	72.4705	72.4705	72.4705	72.4705	(38)
Heat transfer coeff	200.1638	200.1638	200.1638	200.1638	200.1638	200.1638	200.1638	200.1638	200.1638	200.1638	200.1638	200.1638	(39)
Average = Sum(39)m / 12 =												200.1638	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2065	1.2065	1.2065	1.2065	1.2065	1.2065	1.2065	1.2065	1.2065	1.2065	1.2065	1.2065	(40)
HLP (average)												1.2065	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Assumed occupancy												2.9571	(42)
Average daily hot water use (litres/day)												104.4302	(43)
Daily hot water use	114.8732	110.6960	106.5188	102.3416	98.1644	93.9871	93.9871	98.1644	102.3416	106.5188	110.6960	114.8732	(44)
Energy conte	170.3536	148.9923	153.7468	134.0401	128.6147	110.9847	102.8437	118.0146	119.4241	139.1772	151.9228	164.9784	(45)
Energy content (annual)										Total = Sum(45)m =		1643.0931	(45)
Distribution loss (46)m = 0.15 x (45)m	25.5530	22.3489	23.0620	20.1060	19.2922	16.6477	15.4265	17.7022	17.9136	20.8766	22.7884	24.7468	(46)
Water storage loss:													
Store volume												250.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.6700	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.9018	(55)
Total storage loss	27.9558	25.2504	27.9558	27.0540	27.9558	27.0540	27.9558	27.9558	27.0540	27.9558	27.0540	27.9558	(56)
If cylinder contains dedicated solar storage	19.5691	17.6753	19.5691	18.9378	19.5691	18.9378	19.5691	19.5691	18.9378	19.5691	18.9378	19.5691	(57)
Primary loss	23.2624	21.0112	21.8667	15.7584	10.4681	9.9053	10.2355	11.1660	17.1091	21.8667	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month	213.1851	187.6788	195.1825	168.7363	158.6519	139.8278	132.6482	148.7496	155.4710	180.6130	193.3726	207.8098	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1140.0998	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1915.3676	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.1657	(H8)
Utilisation factor												0.5759	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												127.5000	(H13)
Daily hot water demand												104.4302	(H14)
Volume ratio Veff/V												1.2209	(H15)
Solar storage volume factor												1.0000	(H16)
Solar input												-969.9574	(H17)
Solar input	-29.8548	-44.8717	-75.5697	-104.4604	-125.8054	-132.4047	-129.2254	-115.3991	-90.0694	-61.2725	-36.2893	-24.7349	(63)
								Solar input (sum of months) = Sum(63)m =				-969.9574	(63)
Output from w/h	183.3303	142.8071	119.6128	64.2760	32.8464	7.4231	3.4227	33.3505	65.4016	119.3404	157.0833	183.0749	(64)
									Total per year (kWh/year) = Sum(64)m =			1111.9691	(64)
Heat gains from water heating, kWh/month	90.9077	80.4891	84.2694	72.3253	66.7941	59.9769	58.0391	63.8279	68.5460	79.4250	83.6742	89.1205	(65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	177.4236	177.4236	177.4236	177.4236	177.4236	177.4236	177.4236	177.4236	177.4236	177.4236	177.4236	177.4236	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	75.1886	66.7818	54.3106	41.1166	30.7352	25.9479	28.0376	36.4444	48.9156	62.1096	72.4910	77.2783	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	503.5145	508.7395	495.5729	467.5427	432.1598	398.9047	376.6883	371.4634	384.6300	412.6601	448.0431	481.2981	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.6994	55.6994	55.6994	55.6994	55.6994	55.6994	55.6994	55.6994	55.6994	55.6994	55.6994	55.6994	(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)	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	(71)
Water heating gains (Table 5)	122.1878	119.7755	113.2653	100.4518	89.7770	83.3012	78.0096	85.7901	95.2028	106.7540	116.2141	119.7856	(72)
Total internal gains	818.7315	813.1374	780.9894	726.9518	670.5125	625.9945	600.5762	611.5386	646.5890	699.3643	754.5889	796.2026	(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	13.4200	11.9814	0.5000	0.7000	0.7700	38.9998	(74)
East	7.3300	22.3313	0.5000	0.7000	0.7700	39.7027	(76)
West	14.6800	22.3313	0.5000	0.7000	0.7700	79.5136	(80)
East	2.1400	22.3313	0.5000	1.0000	0.7700	16.5589	(76)
South	1.1600	50.9848	0.5000	1.0000	0.7700	20.4928	(78)
South	5.6400	47.1663	0.5000	0.0000	1.0000	133.0089	(82)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	328.2767	558.0293	877.2151	1297.3236	1548.4938	1700.6005	1599.5308	1402.0307	1096.0047	696.5325	414.7810	270.4408	(83)
Total gains	1147.0083	1371.1666	1658.2044	2024.2754	2219.0064	2326.5950	2200.1069	2013.5693	1742.5937	1395.8969	1169.3699	1066.6434	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)	21.0000	(85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)		

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	31.3760	31.3760	31.3760	31.3760	31.3760	31.3760	31.3760	31.3760	31.3760	31.3760	31.3760	31.3760	
alpha	3.0917	3.0917	3.0917	3.0917	3.0917	3.0917	3.0917	3.0917	3.0917	3.0917	3.0917	3.0917	
util living area	0.9723	0.9529	0.9028	0.7896	0.6222	0.4115	0.2780	0.3118	0.5880	0.8546	0.9517	0.9771	(86)
MIT	19.2014	19.4550	19.9341	20.4576	20.8080	20.9623	20.9922	20.9889	20.8815	20.4009	19.7044	19.1379	(87)
Th 2	19.9148	19.9148	19.9148	19.9148	19.9148	19.9148	19.9148	19.9148	19.9148	19.9148	19.9148	19.9148	(88)
util rest of house	0.9668	0.9438	0.8842	0.7519	0.5600	0.3290	0.1825	0.2089	0.5010	0.8175	0.9405	0.9724	(89)
MIT 2	17.5493	17.9129	18.5911	19.3000	19.7345	19.8917	19.9126	19.9114	19.8247	19.2482	18.2773	17.4580	(90)
Living area fraction										fLA = Living area / (4) =		0.2565	(91)
MIT	17.9730	18.3084	18.9355	19.5968	20.0098	20.1662	20.1895	20.1877	20.0957	19.5438	18.6433	17.8888	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.9730	18.3084	18.9355	19.5968	20.0098	20.1662	20.1895	20.1877	20.0957	19.5438	18.6433	17.8888	(93)

---

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9528	0.9259	0.8635	0.7395	0.5658	0.3486	0.2070	0.2352	0.5165	0.8024	0.9228	0.9599	(94)
Useful gains	1092.9163	1269.5208	1431.8831	1496.9525	1255.4161	811.1630	455.4305	473.6545	900.0215	1120.0374	1079.0440	1023.9156	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	2576.7096	2543.7524	2308.9937	1940.9572	1403.1106	833.9294	458.2745	477.9383	979.9509	1590.0679	2130.4058	2559.8576	(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	1103.9422	856.2836	652.5703	319.6834	109.8847	0.0000	0.0000	0.0000	0.0000	349.7027	756.9805	1142.7409	(98)
Space heating												5291.7884	(98)
Space heating per m2											(98) / (4) =	31.8955	(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 %)	93.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	5659.6667	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1103.9422	856.2836	652.5703	319.6834	109.8847	0.0000	0.0000	0.0000	0.0000	349.7027	756.9805	1142.7409	(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)	1180.6869	915.8114	697.9361	341.9074	117.5238	0.0000	0.0000	0.0000	0.0000	374.0136	809.6048	1222.1828	(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	183.3303	142.8071	119.6128	64.2760	32.8464	7.4231	3.4227	33.3505	65.4016	119.3404	157.0833	183.0749	(64)
Efficiency of water heater												79.8000	(216)
(217)m	88.8042	88.7981	88.6586	88.5132	87.7911	79.8000	79.8000	79.8000	79.8000	87.5144	88.4616	88.8548	(217)
Fuel for water heating, kWh/month	206.4433	160.8222	134.9140	72.6174	37.4143	9.3021	4.2891	41.7926	81.9569	136.3666	177.5723	206.0382	(219)
Water heating fuel used												1269.5291	(219)
Annual totals kWh/year													
Space heating fuel - main system												5659.6667	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
(MEVDecentralised, Database: total watage = 6.2785, total flow = 37.0000, SFP = 0.1697)													
mechanical ventilation fans (SFP = 0.1697)												90.9266	(230a)
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												215.9266	(231)
Electricity for lighting (calculated in Appendix L)												531.1413	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1140 * 0.80) =										-1824.1596		-1824.1596	(233)
Total delivered energy for all uses												5852.1041	(238)

10a. Fuel costs - using BEDF prices (491)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	5659.6667	3.6300	205.4459	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1269.5291	3.6300	46.0839	(247)
Mechanical ventilation fans	90.9266	19.4400	17.6761	(249)
Pumps and fans for heating	75.0000	19.4400	14.5800	(249)
Pump for solar water heating	50.0000	19.4400	9.7200	(249)
Energy for lighting	531.1413	19.4400	103.2539	(250)
Additional standing charges			95.0000	(251)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Energy saving/generation technologies				
PV Unit	-1824.1596	19.4400	-354.6166	(252)
Total energy cost			137.1432	(255)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	5659.6667	0.2160	1222.4880	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1269.5291	0.2160	274.2183	(264)
Space and water heating			1496.7063	(265)
Pumps and fans	215.9266	0.5190	112.0659	(267)
Energy for lighting	531.1413	0.5190	275.6624	(268)
Energy saving/generation technologies				
PV Unit	-1824.1596	0.5190	-946.7389	(269)
Total kg/year			937.6957	(272)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	5659.6667	1.2200	6904.7934	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1269.5291	1.2200	1548.8255	(264)
Space and water heating			8453.6188	(265)
Pumps and fans	215.9266	3.0700	662.8948	(267)
Energy for lighting	531.1413	3.0700	1630.6039	(268)
Energy saving/generation technologies				
PV Unit	-1824.1596	3.0700	-5600.1701	(269)
Primary energy kWh/year			5146.9475	(272)
Primary energy kWh/m2/year			31.0225	(273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Designed) 9.92

Overheating Calculation Input Data

Dwelling type	EndTerrace House
Number of storeys	3
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	East
Overshading	Average or unknown
Thermal mass parameter	136.3 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	579.76	(P1)
Transmission heat loss coefficient	127.69	(37)
Summer heat loss coefficient	707.46	(P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
North	0.000	1.000	None
East	0.000	1.000	None
South	0.000	1.000	None
West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer	
North	1.000	0.90	1.000	0.900	(P8)
East	1.000	0.90	1.000	0.900	(P8)
South	1.000	0.90	1.000	0.900	(P8)
South	1.000	1.00	1.000	1.000	(P8)
West	1.000	0.90	1.000	0.900	(P8)

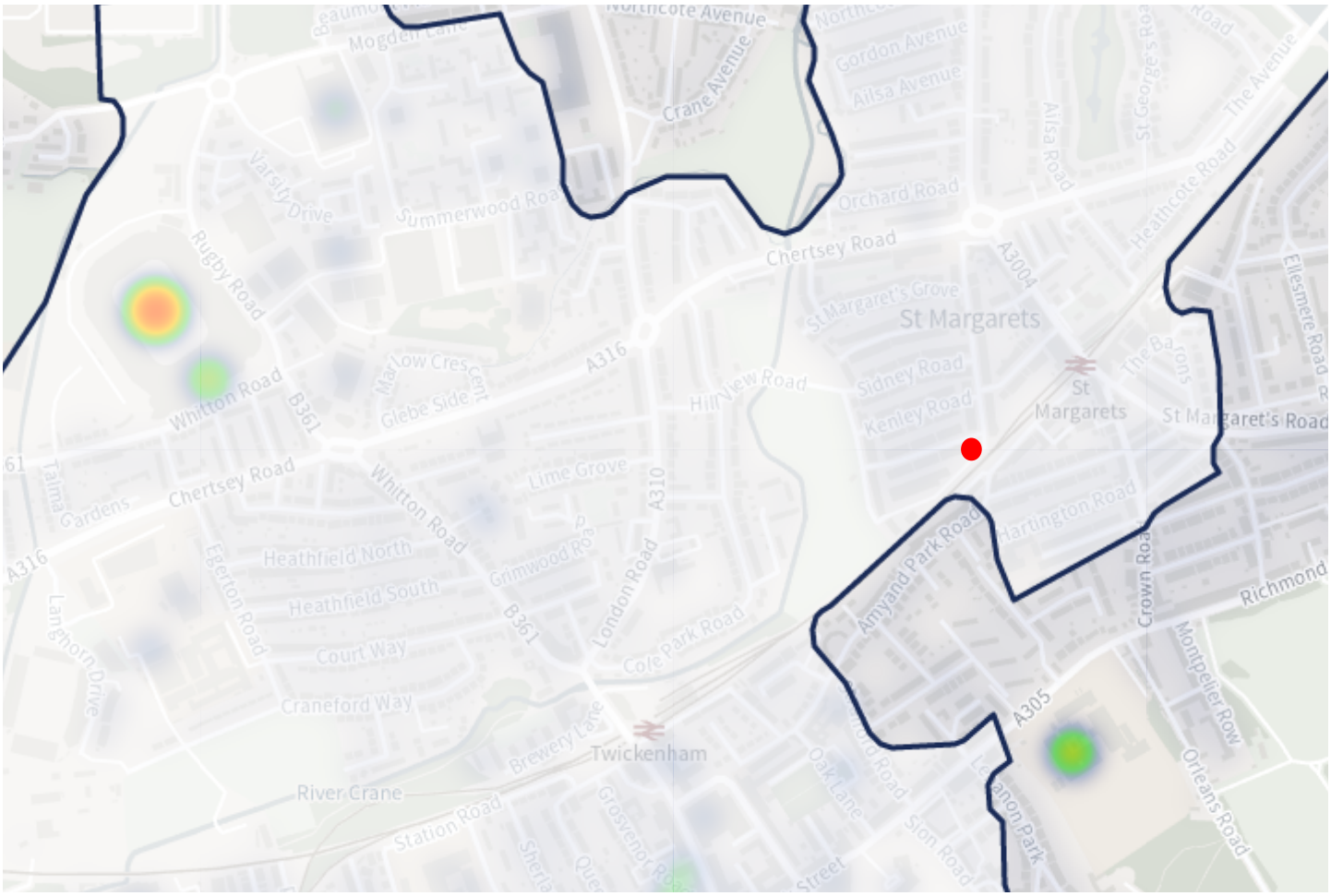
[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North	13.4200	81.1852	0.5000	0.7000	0.9000	308.8747
East	7.3300	117.5071	0.5000	0.7000	0.9000	244.1862
West	14.6800	117.5071	0.5000	0.7000	0.9000	489.0386
East	2.1400	117.5071	0.5000	1.0000	0.9000	101.8434
South	1.1600	112.2060	0.5000	1.0000	0.9000	52.7144
South	5.6400	204.1575	0.5000	0.0000	1.0000	575.7241
total:						1772.3813

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

	Jun	Jul	Aug	
Solar gains	1885	1772	1552	(P3/P4)
Internal gains	646	621	631	
Total summer gains	2531	2393	2183	(P5)
Summer gain/loss ratio	3.58	3.38	3.08	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 136.3)	1.05	1.05	1.05	
Threshold temperature	20.62	22.33	21.93	(P7)
Likelihood of high internal temperature	Slight	Medium	Slight	

Assessment of likelihood of high internal temperature: Medium

6 Appendix B: Extract from the London Heat Map



Layers shown on map

Existing heat networks, proposed heat networks, heat network priority areas (areas with blue border)

Filters applied to map

None

7 Appendix C: Location of the proposed ASHPs and cylinders

Revision Date Description

Project
St Margarets Business Centre
Richmond, London

Drawing Title
GA Plan
Proposed Level GF

Drawing Number WP-0780-A-0100-P-00

Revision

Scale @ A3 1:200

Revision Date

Drawing Purpose
PLANNING

WIMSHURST PELLERITI

The Mews,
6 Putney Common, SW15 1HL

0208 780 2206
Info@wp.uk.com
wimshurst-pelleriti.com

8 Appendix D: DER/TER calculation printout for Unit 01 for the ‘be green’ scenario

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

Design SAP
elmhurst energy

Property Reference	01	**Issued on Date**	31/03/2022
Assessment Reference	01	**Prop Type Ref**	Unit 01
Property	Unit 01, St Margaret's Business Park, St Margaret's, Twickenham		

SAP Rating	87 B	**DER**	11.61	**TER**	23.60
Environmental	89 B	**% DER<TER**	50.81		
CO_2 Emissions (t/year)	1.66	**DFEE**	48.93	**TFEE**	59.16
General Requirements Compliance	Pass	**% DFEE<TFEE**	17.29		

Assessor Details	Mr. George Jones, Erban Consulting Limited, Tel: 01626 369277, george.jones@erbanconsulting.co.uk	**Assessor ID**	K945-0001
Client			

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

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

DWELLING AS DESIGNED

End-Terrace House, total floor area 166 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) 23.60 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 11.61 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)59.2 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)48.9 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.19 (max. 0.30)	0.19 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.13 (max. 0.25)	0.20 (max. 0.70)	OK
Roof	0.14 (max. 0.20)	0.15 (max. 0.35)	OK
Openings	1.25 (max. 2.00)	1.70 (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: 3.00 (design value)
Maximum 10.0 OK

4 Heating efficiency
Main heating system: Heat pump with radiators or underfloor - Electric
Mitsubishi Ecodan 8.5 kW PUHZ-W85VAA

Secondary heating system: None

5 Cylinder insulation
Hot water storage: Measured cylinder loss: 1.67 kWh/day
Permitted by DBSCG 2.56 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 extract system (decentralised)
Specific fan power: 0.1300 0.1100
Maximum 0.7 OK

9 Summertime temperature
Overheating risk (Thames Valley): Medium OK
Based on:
Overshading: Average
Windows facing North: 13.42 m², No overhang
Windows facing East: 9.47 m², No overhang
Windows facing South: 1.16 m², No overhang
Windows facing West: 14.68 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

10 Key features
Party wall U-value 0.00 W/m²K
Floor U-value 0.12 W/m²K
Door U-value 1.00 W/m²K
Air permeability 3.0 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	61.2100	(1b)	x 2.5500	(2b) =	156.0855	(1b) - (3b)
First floor	62.4500	(1c)	x 2.9100	(2c) =	181.7295	(1c) - (3c)
Second floor	42.2500	(1d)	x 2.4000	(2d) =	101.4000	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	165.9100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		439.2150	(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		3.0000	
Infiltration rate		0.1500	(18)
Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7750	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1163	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.1482	0.1453	0.1424	0.1279	0.1250	0.1104	0.1104	0.1075	0.1163	0.1250	0.1308	0.1366	(22b)
Mechanical extract ventilation - decentralised													
If mechanical ventilation:												0.5000	(23a)
Effective ac	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	(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 = 1.20)			35.4300	1.1450	40.5687			(27)
Door			2.1000	1.0000	2.1000			(26)
Window glazed part (Uw = 1.20)			3.3000	1.1450	3.7786			(27)
Window opaque part			3.9400	1.2000	4.7280			(26)
Rooflights (Uw = 1.70)			5.6400	1.5918	8.9775			(27a)
Ground Floor			61.2100	0.1200	7.3452	75.0000	4590.7500	(28a)
Exposed floor			6.3800	0.2000	1.2760	20.0000	127.6000	(28b)
External Wall	184.8200	44.7700	140.0500	0.1900	26.6095	60.0000	8403.0000	(29a)
Sloping	49.9700	5.6400	44.3300	0.1300	5.7629	9.0000	398.9700	(30)
Flat roof	18.2100		18.2100	0.1500	2.7315	9.0000	163.8900	(30)
Total net area of external elements Aum(A, m2)			320.5900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		103.8780			(33)
Party Wall			67.5100	0.0000	0.0000	45.0000	3037.9500	(32)
GF Timber			68.1000			9.0000	612.9000	(32c)
FF Timber			115.3000			9.0000	1037.7000	(32c)
SF Timber			48.9200			9.0000	440.2800	(32c)
Internal Floor 1			56.0700			18.0000	1009.2600	(32d)
Internal Floor 2			49.3800			18.0000	888.8400	(32d)
Internal Ceiling 1			56.0700			18.0000	1009.2600	(32e)
Internal Ceiling 2			49.3800			18.0000	888.8400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	22609.2400 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		136.2741 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		23.8153 (36)
Total fabric heat loss	(33) + (36) =	127.6933 (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	72.4705	72.4705	72.4705	72.4705	72.4705	72.4705	72.4705	72.4705	72.4705	72.4705	72.4705	72.4705	(38)
Heat transfer coeff	200.1638	200.1638	200.1638	200.1638	200.1638	200.1638	200.1638	200.1638	200.1638	200.1638	200.1638	200.1638	(39)
Average = Sum(39)m / 12 =												200.1638	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2065	1.2065	1.2065	1.2065	1.2065	1.2065	1.2065	1.2065	1.2065	1.2065	1.2065	1.2065	(40)
HLP (average)												1.2065	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.9571	(42)
Average daily hot water use (litres/day)												104.4302	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	114.8732	110.6960	106.5188	102.3416	98.1644	93.9871	93.9871	98.1644	102.3416	106.5188	110.6960	114.8732	(44)
Energy conte	170.3536	148.9923	153.7468	134.0401	128.6147	110.9847	102.8437	118.0146	119.4241	139.1772	151.9228	164.9784	(45)
Energy content (annual)										Total = Sum(45)m =		1643.0931	(45)
Distribution loss (46)m = 0.15 x (45)m	25.5530	22.3489	23.0620	20.1060	19.2922	16.6477	15.4265	17.7022	17.9136	20.8766	22.7884	24.7468	(46)
Water storage loss:													
Store volume												250.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.6700	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.9018	(55)
Total storage loss	27.9558	25.2504	27.9558	27.0540	27.9558	27.0540	27.9558	27.9558	27.0540	27.9558	27.0540	27.9558	(56)
If cylinder contains dedicated solar storage	27.9558	25.2504	27.9558	27.0540	27.9558	27.0540	27.9558	27.9558	27.0540	27.9558	27.0540	27.9558	(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	221.5718	195.2539	204.9650	183.6061	179.8329	160.5507	154.0619	169.2328	168.9901	190.3954	201.4888	216.1966	(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	221.5718	195.2539	204.9650	183.6061	179.8329	160.5507	154.0619	169.2328	168.9901	190.3954	201.4888	216.1966	(64)
									Total per year (kWh/year) = Sum(64)m =			2246.1461	(64)
Heat gains from water heating, kWh/month	97.6171	86.5492	92.0954	84.2211	83.7390	76.5552	75.1701	80.2144	79.3613	87.2510	90.1671	95.8299	(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	147.8530	147.8530	147.8530	147.8530	147.8530	147.8530	147.8530	147.8530	147.8530	147.8530	147.8530	147.8530	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	30.0754	26.7127	21.7242	16.4467	12.2941	10.3792	11.2151	14.5778	19.5662	24.8438	28.9964	30.9113	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	337.3547	340.8554	332.0338	313.2536	289.5470	267.2662	252.3812	248.8805	257.7021	276.4823	300.1889	322.4698	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.7853	37.7853	37.7853	37.7853	37.7853	37.7853	37.7853	37.7853	37.7853	37.7853	37.7853	37.7853	(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)	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	(71)
Water heating gains (Table 5)	131.2058	128.7935	123.7841	116.9738	112.5524	106.3267	101.0350	107.8151	110.2240	117.2728	125.2321	128.8036	(72)
Total internal gains	565.9919	563.7176	544.8980	514.0300	481.7493	451.3279	431.9872	438.6292	454.8483	485.9548	521.7733	549.5405	(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	13.4200	10.6334	0.5000	0.7000	0.7700	34.6119	(74)
East	7.3300	19.6403	0.5000	0.7000	0.7700	34.9183	(76)
West	14.6800	19.6403	0.5000	0.7000	0.7700	69.9318	(80)
East	2.1400	19.6403	0.5000	1.0000	0.7700	14.5635	(76)
South	1.1600	46.7521	0.5000	1.0000	0.7700	18.7915	(78)
South	5.6400	42.0754	0.5000	0.0000	1.0000	118.6525	(82)

Solar gains	291.4694	549.7298	873.5138	1252.9059	1535.3013	1575.8924	1498.2834	1283.8968	1006.5232	642.2282	359.2975	242.5835	(83)
Total gains	857.4613	1113.4474	1418.4118	1766.9359	2017.0506	2027.2203	1930.2706	1722.5260	1461.3715	1128.1830	881.0708	792.1241	(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	31.3760	31.3760	31.3760	31.3760	31.3760	31.3760	31.3760	31.3760	31.3760	31.3760	31.3760	31.3760	
alpha	3.0917	3.0917	3.0917	3.0917	3.0917	3.0917	3.0917	3.0917	3.0917	3.0917	3.0917	3.0917	
util living area	0.9889	0.9752	0.9410	0.8592	0.7245	0.5655	0.4334	0.4957	0.7339	0.9250	0.9803	0.9912	(86)
Tweekday	17.0102	17.4619	18.1728	18.9784	19.5515	19.8203	19.8941	19.8807	19.6683	18.8389	17.7416	16.9054	
Tweekend	19.5969	19.7982	20.1183	20.4917	20.7749	20.9243	20.9752	20.9623	20.8264	20.4161	19.9210	19.5503	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	0	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	0	0	0	0	0	0	0	0	0	0	0	0	
MIT	18.8345	19.1410	19.6392	20.2063	20.6526	20.8837	20.9617	20.9419	20.7289	20.0989	19.3151	18.7627	(87)
Th 2	19.9148	19.9148	19.9148	19.9148	19.9148	19.9148	19.9148	19.9148	19.9148	19.9148	19.9148	19.9148	(88)
util rest of house	0.9866	0.9703	0.9292	0.8319	0.6738	0.4882	0.3353	0.3929	0.6641	0.9042	0.9756	0.9894	(89)
Tweekday	17.0102	17.4619	18.1728	18.9784	19.5515	19.8203	19.8941	19.8807	19.6683	18.8389	17.7416	16.9054	
Tweekend	17.0102	17.4619	18.1728	18.9784	19.5515	19.8203	19.8941	19.8807	19.6683	18.8389	17.7416	16.9054	
MIT 2	17.0102	17.4619	18.1728	18.9784	19.5515	19.8203	19.8941	19.8807	19.6683	18.8389	17.7416	16.9054	(90)
Living area fraction										fLA = Living area / (4) =		0.2565	(91)

MIT	17.4781	17.8925	18.5489	19.2933	19.8339	20.0930	20.1679	20.1528	19.9403	19.1620	18.1452	17.3817	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.4781	17.8925	18.5489	19.2933	19.8339	20.0930	20.1679	20.1528	19.9403	19.1620	18.1452	17.3817	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9789	0.9571	0.9099	0.8134	0.6697	0.5016	0.3590	0.4165	0.6659	0.8855	0.9642	0.9829	(94)
Useful gains	839.3466	1065.7331	1290.6581	1437.2402	1350.7939	1016.8470	693.0081	717.4970	973.1507	999.0012	849.5119	778.5942	(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	2637.7759	2600.6283	2411.7502	2080.3718	1628.1098	1099.5071	714.1715	751.1817	1169.0235	1713.8060	2210.8460	2638.5053	(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	1338.0313	1031.4496	834.0926	463.0548	206.3230	0.0000	0.0000	0.0000	0.0000	531.8148	980.1605	1383.7739	(98)
Space heating												6768.7005	(98)
Space heating per m2											(98) / (4) =	40.7974	(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 %)	295.3198	(206)
Efficiency of secondary/supplementary heating system, %	100.0000	(208)
Space heating requirement	2291.9904	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1338.0313	1031.4496	834.0926	463.0548	206.3230	0.0000	0.0000	0.0000	0.0000	531.8148	980.1605	1383.7739	(98)
Space heating efficiency (main heating system 1)	295.3198	295.3198	295.3198	295.3198	295.3198	0.0000	0.0000	0.0000	0.0000	295.3198	295.3198	295.3198	(210)
Space heating fuel (main heating system)	453.0788	349.2653	282.4371	156.7978	69.8643	0.0000	0.0000	0.0000	0.0000	180.0810	331.8981	468.5680	(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	221.5718	195.2539	204.9650	183.6061	179.8329	160.5507	154.0619	169.2328	168.9901	190.3954	201.4888	216.1966	(64)
Efficiency of water heater												281.6750	(216)
(217)m	281.6750	281.6750	281.6750	281.6750	281.6750	281.6750	281.6750	281.6750	281.6750	281.6750	281.6750	281.6750	(217)
Fuel for water heating, kWh/month	78.6622	69.3189	72.7665	65.1837	63.8441	56.9986	54.6949	60.0809	59.9947	67.5940	71.5324	76.7539	(219)
Water heating fuel used												797.4247	(219)
Annual totals kWh/year													
Space heating fuel - main system												2291.9904	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
(MEVDecentralised, Database: total watage = 6.2785, total flow = 37.0000, SFP = 0.1697)													
mechanical ventilation fans (SFP = 0.1697)												90.9266	(230a)
Total electricity for the above, kWh/year												90.9266	(231)
Electricity for lighting (calculated in Appendix L)												531.1413	(232)
Total delivered energy for all uses												3711.4831	(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	2291.9904	0.5190	1189.5430	(261)
Space heating - secondary	0.0000	0.5190	0.0000	(263)
Water heating (other fuel)	797.4247	0.5190	413.8634	(264)
Space and water heating			1603.4064	(265)
Pumps and fans	90.9266	0.5190	47.1909	(267)
Energy for lighting	531.1413	0.5190	275.6624	(268)
Total CO2, kg/year			1926.2597	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			11.6100	(273)

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

DER		11.6100	ZC1
Total Floor Area	TFA	165.9100	
Assumed number of occupants	N	2.9571	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		12.0493	ZC2
CO2 emissions from cooking, equation (L16)		1.1450	ZC3
Total CO2 emissions		24.8043	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		24.8043	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	61.2100 (1b)	x	2.5500 (2b)	=	156.0855	(1b) - (3b)
First floor	62.4500 (1c)	x	2.9100 (2c)	=	181.7295	(1c) - (3c)
Second floor	42.2500 (1d)	x	2.4000 (2d)	=	101.4000	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	165.9100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	439.2150	(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							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.0911	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.3411	(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) =		0.2643	(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	0.3370	0.3304	0.3238	0.2908	0.2842	0.2511	0.2511	0.2445	0.2643	0.2842	0.2974	0.3106	(22b)
Effective ac	0.5568	0.5546	0.5524	0.5423	0.5404	0.5315	0.5315	0.5299	0.5349	0.5404	0.5442	0.5482	(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			6.0400	1.0000	6.0400			(26)
TER Opening Type (Uw = 1.40)			30.9500	1.3258	41.0322			(27)
TER Room Window (Uw = 1.70)			4.5000	1.5918	7.1629			(27a)
Ground Floor			61.2100	0.1300	7.9573			(28a)
Exposed floor			6.3800	0.1300	0.8294			(28b)
External Wall	184.8200	36.9900	147.8300	0.1800	26.6094			(29a)
Sloping	49.9700	4.5000	45.4700	0.1300	5.9111			(30)
Flat roof	18.2100		18.2100	0.1300	2.3673			(30)
Total net area of external elements Aum(A, m2)			320.5900					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	97.9096			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							23.4426	(36)
Total fabric heat loss					(33) + (36) =		121.3522	(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	80.7019	80.3823	80.0690	78.5974	78.3220	77.0403	77.0403	76.8030	77.5340	78.3220	78.8790	79.4613	(38)
Heat transfer coeff	202.0541	201.7345	201.4212	199.9496	199.6743	198.3926	198.3926	198.1552	198.8862	199.6743	200.2313	200.8136	(39)
Average = Sum(39)m / 12 =												199.9483	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2179	1.2159	1.2140	1.2052	1.2035	1.1958	1.1958	1.1944	1.1988	1.2035	1.2069	1.2104	(40)
HLP (average)												1.2052	(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	2.9571	(42)
Average daily hot water use (litres/day)	104.4302	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	114.8732	110.6960	106.5188	102.3416	98.1644	93.9871	93.9871	98.1644	102.3416	106.5188	110.6960	114.8732	(44)
Energy conte	170.3536	148.9923	153.7468	134.0401	128.6147	110.9847	102.8437	118.0146	119.4241	139.1772	151.9228	164.9784	(45)
Energy content (annual)										Total = Sum(45)m =		1643.0931	(45)
Distribution loss (46)m = 0.15 x (45)m	25.5530	22.3489	23.0620	20.1060	19.2922	16.6477	15.4265	17.7022	17.9136	20.8766	22.7884	24.7468	(46)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Water storage loss:
Store volume 250.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): 1.8903 (48)
Temperature factor from Table 2b 0.5400 (49)
Enter (49) or (54) in (55) 1.0208 (55)
Total storage loss

	31.6444	28.5820	31.6444	30.6236	31.6444	30.6236	31.6444	31.6444	30.6236	31.6444	30.6236	31.6444 (56)

If cylinder contains dedicated solar storage

	31.6444	28.5820	31.6444	30.6236	31.6444	30.6236	31.6444	31.6444	30.6236	31.6444	30.6236	31.6444 (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

	225.2604	198.5856	208.6535	187.1758	183.5215	164.1203	157.7504	172.9214	172.5597	194.0840	205.0584	219.8852 (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

	225.2604	198.5856	208.6535	187.1758	183.5215	164.1203	157.7504	172.9214	172.5597	194.0840	205.0584	219.8852 (64)

Total per year (kWh/year) = Sum(64)m = 2289.5762 (64)

Heat gains from water heating, kWh/month

	100.5680	89.2145	95.0462	87.0768	86.6898	79.4109	78.1209	83.1653	82.2170	90.2019	93.0228	98.7807 (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	147.8530	147.8530	147.8530	147.8530	147.8530	147.8530	147.8530	147.8530	147.8530	147.8530	147.8530	147.8530	(66)

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

	30.0893	26.7251	21.7343	16.4543	12.2997	10.3840	11.2202	14.5845	19.5753	24.8553	29.0098	30.9256 (67)

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

	337.3547	340.8554	332.0338	313.2536	289.5470	267.2662	252.3812	248.8805	257.7021	276.4823	300.1889	322.4698 (68)

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

	37.7853	37.7853	37.7853	37.7853	37.7853	37.7853	37.7853	37.7853	37.7853	37.7853	37.7853	37.7853 (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)

	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824 (71)

Water heating gains (Table 5)

	135.1720	132.7597	127.7503	120.9400	116.5186	110.2929	105.0013	111.7813	114.1903	121.2391	129.1984	132.7698 (72)

Total internal gains

	572.9720	570.6961	551.8743	521.0038	488.7213	458.2989	438.9586	445.6022	461.8235	492.9326	528.7530	556.5211 (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	10.7200	10.6334	0.6300	0.7000	0.7700	34.8368	(74)
East	7.5700	19.6403	0.6300	0.7000	0.7700	45.4376	(76)
South	0.9300	46.7521	0.6300	0.7000	0.7700	13.2879	(78)
West	11.7300	19.6403	0.6300	0.7000	0.7700	70.4072	(80)
South	4.5000	42.0754	0.6300	0.7000	1.0000	75.1487	(82)

Solar gains	239.1182	453.7914	727.6272	1053.1116	1298.1016	1335.5653	1268.5199	1082.0803	841.6061	531.9306	295.2796	198.6754	(83)
Total gains	812.0902	1024.4876	1279.5015	1574.1154	1786.8229	1793.8643	1707.4784	1527.6824	1303.4296	1024.8631	824.0325	755.1964	(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	57.0220	57.1123	57.2012	57.6222	57.7016	58.0744	58.0744	58.1440	57.9302	57.7016	57.5411	57.3743	
alpha	4.8015	4.8075	4.8134	4.8415	4.8468	4.8716	4.8716	4.8763	4.8620	4.8468	4.8361	4.8250	
util living area	0.9992	0.9973	0.9893	0.9525	0.8445	0.6636	0.5015	0.5763	0.8500	0.9832	0.9980	0.9994	(86)
MIT	19.5670	19.7548	20.0741	20.4844	20.8049	20.9555	20.9907	20.9825	20.8517	20.4007	19.9014	19.5337	(87)
Th 2	19.9057	19.9073	19.9088	19.9159	19.9172	19.9234	19.9234	19.9245	19.9210	19.9172	19.9145	19.9117	(88)
util rest of house	0.9989	0.9964	0.9854	0.9347	0.7918	0.5696	0.3838	0.4516	0.7768	0.9742	0.9972	0.9992	(89)
MIT 2	17.9877	18.2633	18.7286	19.3156	19.7317	19.8951	19.9201	19.9176	19.8017	19.2095	18.4833	17.9431	(90)
Living area fraction										fLA = Living area / (4) =		0.2565	(91)
MIT	18.3927	18.6458	19.0737	19.6154	20.0069	20.1670	20.1947	20.1907	20.0710	19.5150	18.8470	18.3510	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.3927	18.6458	19.0737	19.6154	20.0069	20.1670	20.1947	20.1907	20.0710	19.5150	18.8470	18.3510	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9983	0.9947	0.9811	0.9286	0.7967	0.5920	0.4142	0.4837	0.7886	0.9696	0.9959	0.9988	(94)
Useful gains	810.6842	1019.0850	1255.3784	1461.6714	1423.6050	1062.0333	707.2211	738.9802	1027.9270	993.6943	820.6699	754.2691	(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	2847.4958	2773.0024	2532.6107	2142.5356	1658.6784	1104.4568	713.1610	751.1481	1187.5425	1780.0940	2352.1160	2841.7210	(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	1515.3878	1178.6325	950.2608	490.2222	174.8946	0.0000	0.0000	0.0000	0.0000	585.0814	1102.6412	1553.0643	(98)
Space heating												7550.1849	(98)
Space heating per m2											(98) / (4) =	45.5077	(99)

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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 %)												93.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												8075.0640	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1515.3878	1178.6325	950.2608	490.2222	174.8946	0.0000	0.0000	0.0000	0.0000	585.0814	1102.6412	1553.0643	(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)													
	1620.7356	1260.5695	1016.3217	524.3019	187.0530	0.0000	0.0000	0.0000	0.0000	625.7555	1179.2954	1661.0313	(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													
	225.2604	198.5856	208.6535	187.1758	183.5215	164.1203	157.7504	172.9214	172.5597	194.0840	205.0584	219.8852	(64)
Efficiency of water heater												79.8000	(216)
(217)m	88.9564	88.7834	88.3667	87.2668	84.6858	79.8000	79.8000	79.8000	79.8000	87.5750	88.6364	89.0196	(217)
Fuel for water heating, kWh/month													
	253.2256	223.6741	236.1223	214.4868	216.7087	205.6646	197.6823	216.6935	216.2402	221.6203	231.3480	247.0075	(219)
Water heating fuel used												2680.4738	(219)
Annual totals kWh/year													
Space heating fuel - main system												8075.0640	(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)												531.3868	(232)
Total delivered energy for all uses												11361.9246	(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	8075.0640	0.2160	1744.2138	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2680.4738	0.2160	578.9823	(264)
Space and water heating			2323.1962	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	531.3868	0.5190	275.7898	(268)
Total CO2, kg/m2/year			2637.9109	(272)
Emissions per m2 for space and water heating			14.0027	(272a)
Fuel factor (electricity)			1.5500	
Emissions per m2 for lighting			1.6623	(272b)
Emissions per m2 for pumps and fans			0.2346	(272c)
Target Carbon Dioxide Emission Rate (TER) = (14.0027 * 1.55) + 1.6623 + 0.2346, rounded to 2 d.p.			23.6000	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	61.2100	(1b)	x 2.5500	(2b) =	156.0855	(1b) - (3b)
First floor	62.4500	(1c)	x 2.9100	(2c) =	181.7295	(1c) - (3c)
Second floor	42.2500	(1d)	x 2.4000	(2d) =	101.4000	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	165.9100					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	439.2150	(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							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.0911	(8)
Pressure test			Yes	
Measured/design AP50			3.0000	
Infiltration rate			0.2411	(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) =		0.1868	(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	0.2382	0.2335	0.2289	0.2055	0.2008	0.1775	0.1775	0.1728	0.1868	0.2008	0.2102	0.2195	(22b)
Effective ac	0.5284	0.5273	0.5262	0.5211	0.5202	0.5158	0.5158	0.5149	0.5175	0.5202	0.5221	0.5241	(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 = 1.20)			35.4300	1.1450	40.5687			(27)
Door			2.1000	1.0000	2.1000			(26)
Window glazed part (Uw = 1.20)			3.3000	1.1450	3.7786			(27)
Window opaque part			3.9400	1.2000	4.7280			(26)
Rooflights (Uw = 1.70)			5.6400	1.5918	8.9775			(27a)
Ground Floor			61.2100	0.1200	7.3452	75.0000	4590.7500	(28a)
Exposed floor			6.3800	0.2000	1.2760	20.0000	127.6000	(28b)
External Wall	184.8200	44.7700	140.0500	0.1900	26.6095	60.0000	8403.0000	(29a)
Sloping	49.9700	5.6400	44.3300	0.1300	5.7629	9.0000	398.9700	(30)
Flat roof	18.2100		18.2100	0.1500	2.7315	9.0000	163.8900	(30)
Total net area of external elements Aum(A, m2)			320.5900					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	103.8780			(33)
Party Wall			67.5100	0.0000	0.0000	45.0000	3037.9500	(32)
GF Timber			68.1000			9.0000	612.9000	(32c)
FF Timber			115.3000			9.0000	1037.7000	(32c)
SF Timber			48.9200			9.0000	440.2800	(32c)
Internal Floor 1			56.0700			18.0000	1009.2600	(32d)
Internal Floor 2			49.3800			18.0000	888.8400	(32d)
Internal Ceiling 1			56.0700			9.0000	504.6300	(32e)
Internal Ceiling 2			49.3800			9.0000	444.4200	(32e)
Heat capacity Cm = Sum(A x k)				(28)...(30) + (32) + (32a)...(32e) =	21660.1900			(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							130.5539	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							23.8153	(36)
Total fabric heat loss					(33) + (36) =		127.6933	(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	76.5827	76.4230	76.2665	75.5313	75.3938	74.7535	74.7535	74.6349	75.0001	75.3938	75.6720	75.9629	(38)
Heat transfer coeff	204.2760	204.1163	203.9598	203.2246	203.0871	202.4467	202.4467	202.3282	202.6934	203.0871	203.3653	203.6562	(39)
Average = Sum(39)m / 12 =												203.2239	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2312	1.2303	1.2293	1.2249	1.2241	1.2202	1.2202	1.2195	1.2217	1.2241	1.2258	1.2275	(40)
HLP (average)												1.2249	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Assumed occupancy												2.9571	(42)
Average daily hot water use (litres/day)												104.4302	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	114.8732	110.6960	106.5188	102.3416	98.1644	93.9871	93.9871	98.1644	102.3416	106.5188	110.6960	114.8732	(44)
Energy conte	170.3536	148.9923	153.7468	134.0401	128.6147	110.9847	102.8437	118.0146	119.4241	139.1772	151.9228	164.9784	(45)
Energy content (annual)										Total = Sum(45)m =		1643.0931	(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)
Heat gains from water heating, kWh/month													
	36.2001	31.6609	32.6712	28.4835	27.3306	23.5843	21.8543	25.0781	25.3776	29.5752	32.2836	35.0579	(65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	147.8530	147.8530	147.8530	147.8530	147.8530	147.8530	147.8530	147.8530	147.8530	147.8530	147.8530	147.8530	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	30.0754	26.7127	21.7242	16.4467	12.2941	10.3792	11.2151	14.5778	19.5662	24.8438	28.9964	30.9113	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	337.3547	340.8554	332.0338	313.2536	289.5470	267.2662	252.3812	248.8805	257.7021	276.4823	300.1889	322.4698	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.7853	37.7853	37.7853	37.7853	37.7853	37.7853	37.7853	37.7853	37.7853	37.7853	37.7853	37.7853	(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)													
	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	(71)
Water heating gains (Table 5)													
	48.6561	47.1144	43.9129	39.5605	36.7347	32.7559	29.3740	33.7071	35.2467	39.7516	44.8383	47.1208	(72)
Total internal gains													
	483.4422	482.0384	465.0268	436.6166	405.9317	377.7571	360.3262	364.5213	379.8709	408.4336	441.3795	467.8578	(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	13.4200	10.6334	0.5000	0.7000	0.7700	34.6119	(74)
East	7.3300	19.6403	0.5000	0.7000	0.7700	34.9183	(76)
West	14.6800	19.6403	0.5000	0.7000	0.7700	69.9318	(80)
East	2.1400	19.6403	0.5000	1.0000	0.7700	14.5635	(76)
South	1.1600	46.7521	0.5000	1.0000	0.7700	18.7915	(78)
South	5.6400	42.0754	0.5000	0.0000	1.0000	118.6525	(82)

Solar gains	291.4694	549.7298	873.5138	1252.9059	1535.3013	1575.8924	1498.2834	1283.8968	1006.5232	642.2282	359.2975	242.5835	(83)
Total gains	774.9116	1031.7683	1338.5406	1689.5225	1941.2330	1953.6495	1858.6096	1648.4181	1386.3941	1050.6618	800.6770	710.4413	(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	29.4539	29.4769	29.4995	29.6063	29.6263	29.7200	29.7200	29.7374	29.6838	29.6263	29.5858	29.5435	
alpha	2.9636	2.9651	2.9666	2.9738	2.9751	2.9813	2.9813	2.9825	2.9789	2.9751	2.9724	2.9696	
util living area													
	0.9904	0.9777	0.9455	0.8677	0.7381	0.5816	0.4498	0.5148	0.7519	0.9329	0.9830	0.9925	(86)
MIT	18.6508	18.9758	19.4960	20.1161	20.5941	20.8580	20.9512	20.9268	20.6827	19.9922	19.1848	18.5840	(87)
Th 2	19.8951	19.8958	19.8966	19.9001	19.9008	19.9039	19.9039	19.9044	19.9027	19.9008	19.8994	19.8981	(88)
util rest of house													
	0.9885	0.9733	0.9347	0.8418	0.6886	0.5038	0.3487	0.4096	0.6842	0.9142	0.9790	0.9910	(89)
MIT 2	17.7451	18.0679	18.5798	19.1762	19.6080	19.8241	19.8854	19.8743	19.6999	19.0742	18.2806	17.6807	(90)
Living area fraction									fLA = Living area / (4) =			0.2565	(91)
MIT	17.9774	18.3008	18.8148	19.4173	19.8609	20.0893	20.1588	20.1442	19.9520	19.3096	18.5125	17.9123	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.9774	18.3008	18.8148	19.4173	19.8609	20.0893	20.1588	20.1442	19.9520	19.3096	18.5125	17.9123	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9837	0.9647	0.9213	0.8285	0.6866	0.5178	0.3732	0.4340	0.6877	0.9014	0.9719	0.9871	(94)
Useful gains	762.3151	995.3254	1233.2338	1399.7571	1332.8317	1011.6185	693.6889	715.3708	953.3672	947.0233	778.1734	701.3090	(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													
	2793.9665	2735.3145	2511.7221	2137.3678	1657.3763	1111.2867	720.4600	757.5615	1186.1587	1768.8119	2320.9077	2792.6026	(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													
	1511.5487	1169.2727	951.1953	531.0797	241.4612	0.0000	0.0000	0.0000	0.0000	611.4107	1110.7687	1555.9225	(98)
Space heating												7682.6595	(98)
Space heating per m2											(98) / (4) =	46.3062	(99)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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	1902.9994	1498.1059	1537.6940	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8173	0.8715	0.8340	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1555.3922	1305.5704	1282.3962	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	2318.6376	2208.7311	1977.2140	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	549.5367	671.9516	516.9445	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												1738.4327	(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	137.3842	167.9879	129.2361	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												434.6082	(107)
Space cooling per m2												2.6195	(108)
Energy for space heating												46.3062	(99)
Energy for space cooling												2.6195	(108)
Total												48.9257	(109)
Dwelling Fabric Energy Efficiency (DFEE)												48.9	(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	61.2100 (1b)	x	2.5500 (2b)	=	156.0855	(1b) - (3b)
First floor	62.4500 (1c)	x	2.9100 (2c)	=	181.7295	(1c) - (3c)
Second floor	42.2500 (1d)	x	2.4000 (2d)	=	101.4000	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	165.9100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	439.2150	(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							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.0911	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.3411	(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) =		0.2643	(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	0.3370	0.3304	0.3238	0.2908	0.2842	0.2511	0.2511	0.2445	0.2643	0.2842	0.2974	0.3106	(22b)
Effective ac	0.5568	0.5546	0.5524	0.5423	0.5404	0.5315	0.5315	0.5299	0.5349	0.5404	0.5442	0.5482	(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			6.0400	1.0000	6.0400			(26)
TER Opening Type (Uw = 1.40)			30.9500	1.3258	41.0322			(27)
TER Room Window (Uw = 1.70)			4.5000	1.5918	7.1629			(27a)
Ground Floor			61.2100	0.1300	7.9573			(28a)
Exposed floor			6.3800	0.1300	0.8294			(28b)
External Wall	184.8200	36.9900	147.8300	0.1800	26.6094			(29a)
Sloping	49.9700	4.5000	45.4700	0.1300	5.9111			(30)
Flat roof	18.2100		18.2100	0.1300	2.3673			(30)
Total net area of external elements Aum(A, m2)			320.5900					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	97.9096			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							23.4426	(36)
Total fabric heat loss					(33) + (36) =		121.3522	(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	80.7019	80.3823	80.0690	78.5974	78.3220	77.0403	77.0403	76.8030	77.5340	78.3220	78.8790	79.4613	(38)
Heat transfer coeff	202.0541	201.7345	201.4212	199.9496	199.6743	198.3926	198.3926	198.1552	198.8862	199.6743	200.2313	200.8136	(39)
Average = Sum(39)m / 12 =												199.9483	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2179	1.2159	1.2140	1.2052	1.2035	1.1958	1.1958	1.1944	1.1988	1.2035	1.2069	1.2104	(40)
HLP (average)												1.2052	(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	2.9571	(42)
Average daily hot water use (litres/day)	104.4302	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	114.8732	110.6960	106.5188	102.3416	98.1644	93.9871	93.9871	98.1644	102.3416	106.5188	110.6960	114.8732	(44)
Energy conte	170.3536	148.9923	153.7468	134.0401	128.6147	110.9847	102.8437	118.0146	119.4241	139.1772	151.9228	164.9784	(45)
Energy content (annual)										Total = Sum(45)m =		1643.0931	(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)

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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)
Heat gains from water heating, kWh/month
36.2001 31.6609 32.6712 28.4835 27.3306 23.5843 21.8543 25.0781 25.3776 29.5752 32.2836 35.0579 (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	147.8530	147.8530	147.8530	147.8530	147.8530	147.8530	147.8530	147.8530	147.8530	147.8530	147.8530	147.8530	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
30.0893 26.7251 21.7343 16.4543 12.2997 10.3840 11.2202 14.5845 19.5753 24.8553 29.0098 30.9256 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
337.3547 340.8554 332.0338 313.2536 289.5470 267.2662 252.3812 248.8805 257.7021 276.4823 300.1889 322.4698 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
37.7853 37.7853 37.7853 37.7853 37.7853 37.7853 37.7853 37.7853 37.7853 37.7853 37.7853 37.7853 (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)
-118.2824 -118.2824 -118.2824 -118.2824 -118.2824 -118.2824 -118.2824 -118.2824 -118.2824 -118.2824 -118.2824 -118.2824 (71)
Water heating gains (Table 5)
48.6561 47.1144 43.9129 39.5605 36.7347 32.7559 29.3740 33.7071 35.2467 39.7516 44.8383 47.1208 (72)
Total internal gains
483.4561 482.0508 465.0369 436.6242 405.9374 377.7619 360.3313 364.5280 379.8800 408.4451 441.3929 467.8721 (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	10.7200	10.6334	0.6300	0.7000	0.7700	34.8368	(74)
East	7.5700	19.6403	0.6300	0.7000	0.7700	45.4376	(76)
South	0.9300	46.7521	0.6300	0.7000	0.7700	13.2879	(78)
West	11.7300	19.6403	0.6300	0.7000	0.7700	70.4072	(80)
South	4.5000	42.0754	0.6300	0.7000	1.0000	75.1487	(82)

Solar gains	239.1182	453.7914	727.6272	1053.1116	1298.1016	1335.5653	1268.5199	1082.0803	841.6061	531.9306	295.2796	198.6754	(83)
Total gains	722.5742	935.8422	1192.6641	1489.7358	1704.0390	1713.3272	1628.8512	1446.6083	1221.4861	940.3756	736.6725	666.5474	(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	57.0220	57.1123	57.2012	57.6222	57.7016	58.0744	58.0744	58.1440	57.9302	57.7016	57.5411	57.3743	
alpha	4.8015	4.8075	4.8134	4.8415	4.8468	4.8716	4.8716	4.8763	4.8620	4.8468	4.8361	4.8250	
util living area	0.9995	0.9982	0.9920	0.9610	0.8625	0.6872	0.5237	0.6039	0.8739	0.9881	0.9988	0.9997	(86)
MIT	19.5171	19.7058	20.0278	20.4464	20.7829	20.9482	20.9888	20.9787	20.8289	20.3568	19.8529	19.4841	(87)
Th 2	19.9057	19.9073	19.9088	19.9159	19.9172	19.9234	19.9234	19.9245	19.9210	19.9172	19.9145	19.9117	(88)
util rest of house	0.9993	0.9976	0.9890	0.9457	0.8129	0.5926	0.4018	0.4755	0.8064	0.9815	0.9983	0.9996	(89)
MIT 2	18.5464	18.7360	19.0576	19.4710	19.7739	19.9005	19.9207	19.9186	19.8241	19.3917	18.8890	18.5182	(90)
Living area fraction									fLA = Living area / (4) =			0.2565	(91)
MIT	18.7953	18.9847	19.3064	19.7212	20.0327	20.1692	20.1946	20.1905	20.0818	19.6392	19.1362	18.7659	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7953	18.9847	19.3064	19.7212	20.0327	20.1692	20.1946	20.1905	20.0818	19.6392	19.1362	18.7659	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9991	0.9968	0.9867	0.9424	0.8189	0.6156	0.4334	0.5088	0.8183	0.9792	0.9977	0.9994	(94)
Useful gains	721.9172	932.8251	1176.8380	1403.8547	1395.4691	1054.7797	705.9170	736.0052	999.5336	920.8338	735.0132	666.1377	(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	2928.8411	2841.3794	2579.4803	2163.6918	1663.8288	1104.8885	713.1447	751.1041	1189.6994	1804.8953	2410.0216	2925.0316	(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	1641.9514	1282.5485	1043.5658	547.0828	199.6596	0.0000	0.0000	0.0000	0.0000	657.7417	1206.0060	1680.6171	(98)
Space heating												8259.1728	(98)
Space heating per m2											(98) / (4) =	49.7810	(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	1864.8900	1468.1049	1505.9795	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8704	0.9265	0.8894	0.0000	0.0000	0.0000	0.0000	(101)

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Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1623.1763	1360.1647	1339.4427	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	2072.8595	1973.7193	1770.6367	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	323.7719	456.4846	320.8083	0.0000	0.0000	0.0000	0.0000 (104)
Space cooling												1101.0648 (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	80.9430	114.1211	80.2021	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												275.2662 (107)
Space cooling per m2												1.6591 (108)
Energy for space heating												49.7810 (99)
Energy for space cooling												1.6591 (108)
Total												51.4402 (109)
Target Fabric Energy Efficiency (TFEE)												59.2 (109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	61.2100	(1b)	x 2.5500	(2b) =	156.0855	(1b) - (3b)
First floor	62.4500	(1c)	x 2.9100	(2c) =	181.7295	(1c) - (3c)
Second floor	42.2500	(1d)	x 2.4000	(2d) =	101.4000	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	165.9100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		439.2150	(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		3.0000	
Infiltration rate		0.1500	(18)
Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7750	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1163	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.1221	0.1163	0.1163	0.1075	0.1075	0.0959	0.0988	0.0930	0.0959	0.1017	0.1017	0.1104	(22b)
Mechanical extract ventilation - decentralised													
If mechanical ventilation:												0.5000	(23a)
Effective ac	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	(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 = 1.20)			35.4300	1.1450	40.5687			(27)
Door			2.1000	1.0000	2.1000			(26)
Window glazed part (Uw = 1.20)			3.3000	1.1450	3.7786			(27)
Window opaque part			3.9400	1.2000	4.7280			(26)
Rooflights (Uw = 1.70)			5.6400	1.5918	8.9775			(27a)
Ground Floor			61.2100	0.1200	7.3452	75.0000	4590.7500	(28a)
Exposed floor			6.3800	0.2000	1.2760	20.0000	127.6000	(28b)
External Wall	184.8200	44.7700	140.0500	0.1900	26.6095	60.0000	8403.0000	(29a)
Sloping	49.9700	5.6400	44.3300	0.1300	5.7629	9.0000	398.9700	(30)
Flat roof	18.2100		18.2100	0.1500	2.7315	9.0000	163.8900	(30)
Total net area of external elements Aum(A, m2)			320.5900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		103.8780			(33)
Party Wall			67.5100	0.0000	0.0000	45.0000	3037.9500	(32)
GF Timber			68.1000			9.0000	612.9000	(32c)
FF Timber			115.3000			9.0000	1037.7000	(32c)
SF Timber			48.9200			9.0000	440.2800	(32c)
Internal Floor 1			56.0700			18.0000	1009.2600	(32d)
Internal Floor 2			49.3800			18.0000	888.8400	(32d)
Internal Ceiling 1			56.0700			18.0000	1009.2600	(32e)
Internal Ceiling 2			49.3800			18.0000	888.8400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	22609.2400 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		136.2741 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		23.8153 (36)
Total fabric heat loss	(33) + (36) =	127.6933 (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	72.4705	72.4705	72.4705	72.4705	72.4705	72.4705	72.4705	72.4705	72.4705	72.4705	72.4705	72.4705	(38)
Heat transfer coeff	200.1638	200.1638	200.1638	200.1638	200.1638	200.1638	200.1638	200.1638	200.1638	200.1638	200.1638	200.1638	(39)
Average = Sum(39)m / 12 =												200.1638	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2065	1.2065	1.2065	1.2065	1.2065	1.2065	1.2065	1.2065	1.2065	1.2065	1.2065	1.2065	(40)
HLP (average)												1.2065	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

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4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.9571	(42)
Average daily hot water use (litres/day)												104.4302	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	114.8732	110.6960	106.5188	102.3416	98.1644	93.9871	93.9871	98.1644	102.3416	106.5188	110.6960	114.8732	(44)
Energy conte	170.3536	148.9923	153.7468	134.0401	128.6147	110.9847	102.8437	118.0146	119.4241	139.1772	151.9228	164.9784	(45)
Energy content (annual)										Total = Sum(45)m =		1643.0931	(45)
Distribution loss (46)m = 0.15 x (45)m	25.5530	22.3489	23.0620	20.1060	19.2922	16.6477	15.4265	17.7022	17.9136	20.8766	22.7884	24.7468	(46)
Water storage loss:													
Store volume												250.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.6700	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.9018	(55)
Total storage loss	27.9558	25.2504	27.9558	27.0540	27.9558	27.0540	27.9558	27.9558	27.0540	27.9558	27.0540	27.9558	(56)
If cylinder contains dedicated solar storage	27.9558	25.2504	27.9558	27.0540	27.9558	27.0540	27.9558	27.9558	27.0540	27.9558	27.0540	27.9558	(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	221.5718	195.2539	204.9650	183.6061	179.8329	160.5507	154.0619	169.2328	168.9901	190.3954	201.4888	216.1966	(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	221.5718	195.2539	204.9650	183.6061	179.8329	160.5507	154.0619	169.2328	168.9901	190.3954	201.4888	216.1966	(64)
								Total per year (kWh/year) = Sum(64)m =				2246.1461	(64)
RHI water heating demand												2246	(64)
Heat gains from water heating, kWh/month	97.6171	86.5492	92.0954	84.2211	83.7390	76.5552	75.1701	80.2144	79.3613	87.2510	90.1671	95.8299	(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	177.4236	177.4236	177.4236	177.4236	177.4236	177.4236	177.4236	177.4236	177.4236	177.4236	177.4236	177.4236	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	75.1886	66.7818	54.3106	41.1166	30.7352	25.9479	28.0376	36.4444	48.9156	62.1096	72.4910	77.2783	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	503.5145	508.7395	495.5729	467.5427	432.1598	398.9047	376.6883	371.4634	384.6300	412.6601	448.0431	481.2981	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.6994	55.6994	55.6994	55.6994	55.6994	55.6994	55.6994	55.6994	55.6994	55.6994	55.6994	55.6994	(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)	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	(71)
Water heating gains (Table 5)	131.2058	128.7935	123.7841	116.9738	112.5524	106.3267	101.0350	107.8151	110.2240	117.2728	125.2321	128.8036	(72)
Total internal gains	824.7495	819.1554	788.5082	740.4738	690.2879	646.0199	620.6016	630.5635	658.6102	706.8831	760.6069	802.2206	(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	13.4200	11.9814	0.5000	0.7000	0.7700	38.9998	(74)
East	7.3300	22.3313	0.5000	0.7000	0.7700	39.7027	(76)
West	14.6800	22.3313	0.5000	0.7000	0.7700	79.5136	(80)
East	2.1400	22.3313	0.5000	1.0000	0.7700	16.5589	(76)
South	1.1600	50.9848	0.5000	1.0000	0.7700	20.4928	(78)
South	5.6400	47.1663	0.5000	0.0000	1.0000	133.0089	(82)

Solar gains	328.2767	558.0293	877.2151	1297.3236	1548.4938	1700.6005	1599.5308	1402.0307	1096.0047	696.5325	414.7810	270.4408	(83)
Total gains	1153.0263	1377.1846	1665.7232	2037.7974	2238.7817	2346.6205	2220.1324	2032.5942	1754.6149	1403.4157	1175.3879	1072.6614	(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	31.3760	31.3760	31.3760	31.3760	31.3760	31.3760	31.3760	31.3760	31.3760	31.3760	31.3760	31.3760	
alpha	3.0917	3.0917	3.0917	3.0917	3.0917	3.0917	3.0917	3.0917	3.0917	3.0917	3.0917	3.0917	
util living area	0.9719	0.9524	0.9018	0.7872	0.6184	0.4084	0.2756	0.3090	0.5851	0.8531	0.9511	0.9768	(86)
Tweekday	17.5561	17.9191	18.5973	19.3063	19.7379	19.8922	19.9127	19.9115	19.8261	19.2529	18.2834	17.4649	
Tweekend	19.8403	20.0040	20.3139	20.6526	20.8781	20.9761	20.9951	20.9930	20.9244	20.6151	20.1653	19.7993	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	0	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	0	0	0	0	0	0	0	0	0	0	0	0	
MIT	19.2102	19.4594	19.9410	20.4576	20.8118	20.9633	20.9924	20.9892	20.8820	20.4060	19.6966	19.1469	(87)
Th 2	19.9148	19.9148	19.9148	19.9148	19.9148	19.9148	19.9148	19.9148	19.9148	19.9148	19.9148	19.9148	(88)
util rest of house	0.9663	0.9432	0.8831	0.7494	0.5562	0.3264	0.1809	0.2070	0.4982	0.8158	0.9398	0.9720	(89)
Tweekday	17.5561	17.9191	18.5973	19.3063	19.7379	19.8922	19.9127	19.9115	19.8261	19.2529	18.2834	17.4649	
Tweekend	17.5561	17.9191	18.5973	19.3063	19.7379	19.8922	19.9127	19.9115	19.8261	19.2529	18.2834	17.4649	
MIT 2	17.5561	17.9191	18.5973	19.3063	19.7379	19.8922	19.9127	19.9115	19.8261	19.2529	18.2834	17.4649	(90)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Living area fraction												fLA = Living area / (4) =	0.2565 (91)
MIT	17.9803	18.3141	18.9419	19.6016	20.0133	20.1669	20.1896	20.1879	20.0969	19.5486	18.6459		17.8963 (92)
Temperature adjustment													0.0000
adjusted MIT	17.9803	18.3141	18.9419	19.6016	20.0133	20.1669	20.1896	20.1879	20.0969	19.5486	18.6459		17.8963 (93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9523	0.9252	0.8624	0.7371	0.5622	0.3459	0.2052	0.2331	0.5137	0.8008	0.9219	0.9594	(94)
Useful gains	1098.0271	1274.1762	1436.5949	1502.0618	1258.6361	811.7828	455.5213	473.7935	901.4178	1123.7969	1083.5888	1029.1489	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W													
	2578.1675	2544.9007	2310.2687	1941.9081	1403.8062	834.0604	458.2936	477.9671	980.1881	1591.0313	2130.9164	2561.3488	(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													
	1101.2245	853.9268	650.0133	316.6893	108.0065	0.0000	0.0000	0.0000	0.0000	347.6224	754.0759	1139.9568	(98)
Space heating												5271.5155	(98)
RHI space heating demand												5272	(98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	61.2100	(1b)	x 2.5500	(2b) =	156.0855	(1b) - (3b)
First floor	62.4500	(1c)	x 2.9100	(2c) =	181.7295	(1c) - (3c)
Second floor	42.2500	(1d)	x 2.4000	(2d) =	101.4000	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	165.9100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		439.2150	(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				3.0000	
Infiltration rate				0.1500	(18)
Number of sides sheltered				3	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.7750	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.1163	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.1482	0.1453	0.1424	0.1279	0.1250	0.1104	0.1104	0.1075	0.1163	0.1250	0.1308	0.1366	(22b)
Mechanical extract ventilation - decentralised													
If mechanical ventilation:												0.5000	(23a)
Effective ac	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	(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 = 1.20)			35.4300	1.1450	40.5687			(27)
Door			2.1000	1.0000	2.1000			(26)
Window glazed part (Uw = 1.20)			3.3000	1.1450	3.7786			(27)
Window opaque part			3.9400	1.2000	4.7280			(26)
Rooflights (Uw = 1.70)			5.6400	1.5918	8.9775			(27a)
Ground Floor			61.2100	0.1200	7.3452	75.0000	4590.7500	(28a)
Exposed floor			6.3800	0.2000	1.2760	20.0000	127.6000	(28b)
External Wall	184.8200	44.7700	140.0500	0.1900	26.6095	60.0000	8403.0000	(29a)
Sloping	49.9700	5.6400	44.3300	0.1300	5.7629	9.0000	398.9700	(30)
Flat roof	18.2100		18.2100	0.1500	2.7315	9.0000	163.8900	(30)
Total net area of external elements Aum(A, m2)			320.5900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		103.8780			(33)
Party Wall			67.5100	0.0000	0.0000	45.0000	3037.9500	(32)
GF Timber			68.1000			9.0000	612.9000	(32c)
FF Timber			115.3000			9.0000	1037.7000	(32c)
SF Timber			48.9200			9.0000	440.2800	(32c)
Internal Floor 1			56.0700			18.0000	1009.2600	(32d)
Internal Floor 2			49.3800			18.0000	888.8400	(32d)
Internal Ceiling 1			56.0700			18.0000	1009.2600	(32e)
Internal Ceiling 2			49.3800			18.0000	888.8400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	22609.2400 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		136.2741 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		23.8153 (36)
Total fabric heat loss	(33) + (36) =	127.6933 (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	72.4705	72.4705	72.4705	72.4705	72.4705	72.4705	72.4705	72.4705	72.4705	72.4705	72.4705	72.4705	(38)
Heat transfer coeff	200.1638	200.1638	200.1638	200.1638	200.1638	200.1638	200.1638	200.1638	200.1638	200.1638	200.1638	200.1638	(39)
Average = Sum(39)m / 12 =												200.1638	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2065	1.2065	1.2065	1.2065	1.2065	1.2065	1.2065	1.2065	1.2065	1.2065	1.2065	1.2065	(40)
HLP (average)												1.2065	(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												2.9571	(42)
Average daily hot water use (litres/day)												104.4302	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	114.8732	110.6960	106.5188	102.3416	98.1644	93.9871	93.9871	98.1644	102.3416	106.5188	110.6960	114.8732	(44)
Energy conte	170.3536	148.9923	153.7468	134.0401	128.6147	110.9847	102.8437	118.0146	119.4241	139.1772	151.9228	164.9784	(45)
Energy content (annual)										Total = Sum(45)m =		1643.0931	(45)
Distribution loss (46)m = 0.15 x (45)m	25.5530	22.3489	23.0620	20.1060	19.2922	16.6477	15.4265	17.7022	17.9136	20.8766	22.7884	24.7468	(46)
Water storage loss:													
Store volume												250.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.6700	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.9018	(55)
Total storage loss	27.9558	25.2504	27.9558	27.0540	27.9558	27.0540	27.9558	27.9558	27.0540	27.9558	27.0540	27.9558	(56)
If cylinder contains dedicated solar storage	27.9558	25.2504	27.9558	27.0540	27.9558	27.0540	27.9558	27.9558	27.0540	27.9558	27.0540	27.9558	(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	221.5718	195.2539	204.9650	183.6061	179.8329	160.5507	154.0619	169.2328	168.9901	190.3954	201.4888	216.1966	(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	221.5718	195.2539	204.9650	183.6061	179.8329	160.5507	154.0619	169.2328	168.9901	190.3954	201.4888	216.1966	(64)
									Total per year (kWh/year) = Sum(64)m =			2246.1461	(64)
Heat gains from water heating, kWh/month	97.6171	86.5492	92.0954	84.2211	83.7390	76.5552	75.1701	80.2144	79.3613	87.2510	90.1671	95.8299	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	177.4236	177.4236	177.4236	177.4236	177.4236	177.4236	177.4236	177.4236	177.4236	177.4236	177.4236	177.4236	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	75.1886	66.7818	54.3106	41.1166	30.7352	25.9479	28.0376	36.4444	48.9156	62.1096	72.4910	77.2783	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	503.5145	508.7395	495.5729	467.5427	432.1598	398.9047	376.6883	371.4634	384.6300	412.6601	448.0431	481.2981	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.6994	55.6994	55.6994	55.6994	55.6994	55.6994	55.6994	55.6994	55.6994	55.6994	55.6994	55.6994	(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)	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	(71)
Water heating gains (Table 5)	131.2058	128.7935	123.7841	116.9738	112.5524	106.3267	101.0350	107.8151	110.2240	117.2728	125.2321	128.8036	(72)
Total internal gains	824.7495	819.1554	788.5082	740.4738	690.2879	646.0199	620.6016	630.5635	658.6102	706.8831	760.6069	802.2206	(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	13.4200	10.6334	0.5000	0.7000	0.7700	34.6119	(74)
East	7.3300	19.6403	0.5000	0.7000	0.7700	34.9183	(76)
West	14.6800	19.6403	0.5000	0.7000	0.7700	69.9318	(80)
East	2.1400	19.6403	0.5000	1.0000	0.7700	14.5635	(76)
South	1.1600	46.7521	0.5000	1.0000	0.7700	18.7915	(78)
South	5.6400	42.0754	0.5000	0.0000	1.0000	118.6525	(82)

Solar gains	291.4694	549.7298	873.5138	1252.9059	1535.3013	1575.8924	1498.2834	1283.8968	1006.5232	642.2282	359.2975	242.5835	(83)
Total gains	1116.2190	1368.8852	1662.0219	1993.3797	2225.5892	2221.9123	2118.8850	1914.4603	1665.1334	1349.1113	1119.9044	1044.8042	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	31.3760	31.3760	31.3760	31.3760	31.3760	31.3760	31.3760	31.3760	31.3760	31.3760	31.3760	31.3760	
alpha	3.0917	3.0917	3.0917	3.0917	3.0917	3.0917	3.0917	3.0917	3.0917	3.0917	3.0917	3.0917	
util living area	0.9773	0.9580	0.9151	0.8236	0.6845	0.5268	0.3991	0.4536	0.6810	0.8892	0.9633	0.9813	(86)
Tweekday	17.3161	17.7425	18.3981	19.1178	19.6126	19.8386	19.8987	19.8887	19.7230	19.0200	18.0092	17.2083	
Tweekend	19.7335	19.9251	20.2230	20.5611	20.8099	20.9379	20.9803	20.9706	20.8610	20.5039	20.0419	19.6854	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	0	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	0	0	0	0	0	0	0	0	0	0	0	0	
MIT	19.0454	19.3372	19.8009	20.3147	20.7066	20.9046	20.9696	20.9546	20.7830	20.2343	19.5040	18.9710	(87)
Th 2	19.9148	19.9148	19.9148	19.9148	19.9148	19.9148	19.9148	19.9148	19.9148	19.9148	19.9148	19.9148	(88)
util rest of house	0.9730	0.9501	0.8994	0.7923	0.6322	0.4519	0.3072	0.3568	0.6086	0.8615	0.9550	0.9776	(89)
Tweekday	17.3161	17.7425	18.3981	19.1178	19.6126	19.8386	19.8987	19.8887	19.7230	19.0200	18.0092	17.2083	
Tweekend	17.3161	17.7425	18.3981	19.1178	19.6126	19.8386	19.8987	19.8887	19.7230	19.0200	18.0092	17.2083	
MIT 2	17.3161	17.7425	18.3981	19.1178	19.6126	19.8386	19.8987	19.8887	19.7230	19.0200	18.0092	17.2083	(90)
Living area fraction										fLA = Living area / (4) =		0.2565	(91)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

MIT	17.7596	18.1515	18.7579	19.4248	19.8932	20.1120	20.1733	20.1621	19.9948	19.3314	18.3926	17.6604	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.7596	18.1515	18.7579	19.4248	19.8932	20.1120	20.1733	20.1621	19.9948	19.3314	18.3926	17.6604	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9605	0.9329	0.8786	0.7761	0.6311	0.4661	0.3297	0.3797	0.6144	0.8432	0.9390	0.9666	(94)
Useful gains	1072.1360	1277.0644	1460.2143	1547.0057	1404.6141	1035.6698	698.5555	726.9385	1023.0854	1137.5454	1051.6127	1009.8842	(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	2694.1235	2652.4755	2453.5777	2106.6783	1639.9747	1103.3019	715.2479	753.0323	1179.9330	1747.7164	2260.3648	2694.2760	(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	1206.7587	924.2762	739.0624	402.9642	175.1083	0.0000	0.0000	0.0000	0.0000	453.9672	870.3015	1253.1875	(98)
Space heating												6025.6260	(98)
Space heating per m2											(98) / (4) =	36.3186	(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 %)	295.3198	(206)
Efficiency of secondary/supplementary heating system, %	100.0000	(208)
Space heating requirement	2040.3735	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1206.7587	924.2762	739.0624	402.9642	175.1083	0.0000	0.0000	0.0000	0.0000	453.9672	870.3015	1253.1875	(98)
Space heating efficiency (main heating system 1)	295.3198	295.3198	295.3198	295.3198	295.3198	0.0000	0.0000	0.0000	0.0000	295.3198	295.3198	295.3198	(210)
Space heating fuel (main heating system)	408.6278	312.9747	250.2584	136.4501	59.2945	0.0000	0.0000	0.0000	0.0000	153.7206	294.6980	424.3494	(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	221.5718	195.2539	204.9650	183.6061	179.8329	160.5507	154.0619	169.2328	168.9901	190.3954	201.4888	216.1966	(64)
Efficiency of water heater												281.6750	(216)
(217)m	281.6750	281.6750	281.6750	281.6750	281.6750	281.6750	281.6750	281.6750	281.6750	281.6750	281.6750	281.6750	(217)
Fuel for water heating, kWh/month	78.6622	69.3189	72.7665	65.1837	63.8441	56.9986	54.6949	60.0809	59.9947	67.5940	71.5324	76.7539	(219)
Water heating fuel used												797.4247	(219)
Annual totals kWh/year													
Space heating fuel - main system												2040.3735	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
(MEVDecentralised, Database: total watage = 6.2785, total flow = 37.0000, SFP = 0.1697)													
mechanical ventilation fans (SFP = 0.1697)												90.9266	(230a)
Total electricity for the above, kWh/year												90.9266	(231)
Electricity for lighting (calculated in Appendix L)												531.1413	(232)
Total delivered energy for all uses												3459.8662	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2040.3735	13.1900	269.1253	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	797.4247	13.1900	105.1803	(247)
Mechanical ventilation fans	90.9266	13.1900	11.9932	(249)
Pumps and fans for heating	0.0000	0.0000	0.0000	(249)
Energy for lighting	531.1413	13.1900	70.0575	(250)
Additional standing charges			0.0000	(251)
Total energy cost			456.3563	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):	0.4200	(256)
Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] =	0.9088	(257)
SAP value	87.3226	
SAP rating (Section 12)	87	(258)
SAP band	B	

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

	Energy	Emission factor	Emissions	

CALCULATION OF ENERGY RATINGS 09 Jan 2014

	kWh/year	kg CO2/kWh	kg CO2/year	
Space heating - main system 1	2040.3735	0.5190	1058.9538	(261)
Space heating - secondary	0.0000	0.5190	0.0000	(263)
Water heating (other fuel)	797.4247	0.5190	413.8634	(264)
Space and water heating			1472.8173	(265)
Pumps and fans	90.9266	0.5190	47.1909	(267)
Energy for lighting	531.1413	0.5190	275.6624	(268)
Total kg/year			1795.6705	(272)
CO2 emissions per m2			10.8200	(273)
EI value			88.5913	
EI rating			89	(274)
EI band			B	

Calculation of stars for heating and DHW

Main heating energy efficiency	13.19 × (1 + 0.29 × 0.00) / 2.9532 = 4.466, stars = 4
Main heating environmental impact	0.519 × (1 + 0.29 × 0.00) / 2.9532 = 0.1757, stars = 5
Water heating energy efficiency	13.19 / 2.8168 = 4.683, stars = 4
Water heating environmental impact	0.519 / 2.8168 = 0.1843, stars = 5

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	61.2100	(1b)	x 2.5500	(2b) =	156.0855	(1b) - (3b)
First floor	62.4500	(1c)	x 2.9100	(2c) =	181.7295	(1c) - (3c)
Second floor	42.2500	(1d)	x 2.4000	(2d) =	101.4000	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	165.9100					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	439.2150	(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		3.0000	
Infiltration rate		0.1500	(18)
Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7750	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1163	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.1221	0.1163	0.1163	0.1075	0.1075	0.0959	0.0988	0.0930	0.0959	0.1017	0.1017	0.1104	(22b)
Mechanical extract ventilation - decentralised													
If mechanical ventilation:												0.5000	(23a)
Effective ac	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	(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 = 1.20)			35.4300	1.1450	40.5687			(27)
Door			2.1000	1.0000	2.1000			(26)
Window glazed part (Uw = 1.20)			3.3000	1.1450	3.7786			(27)
Window opaque part			3.9400	1.2000	4.7280			(26)
Rooflights (Uw = 1.70)			5.6400	1.5918	8.9775			(27a)
Ground Floor			61.2100	0.1200	7.3452	75.0000	4590.7500	(28a)
Exposed floor			6.3800	0.2000	1.2760	20.0000	127.6000	(28b)
External Wall	184.8200	44.7700	140.0500	0.1900	26.6095	60.0000	8403.0000	(29a)
Sloping	49.9700	5.6400	44.3300	0.1300	5.7629	9.0000	398.9700	(30)
Flat roof	18.2100		18.2100	0.1500	2.7315	9.0000	163.8900	(30)
Total net area of external elements Aum(A, m2)			320.5900					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	103.8780			(33)
Party Wall			67.5100	0.0000	0.0000	45.0000	3037.9500	(32)
GF Timber			68.1000			9.0000	612.9000	(32c)
FF Timber			115.3000			9.0000	1037.7000	(32c)
SF Timber			48.9200			9.0000	440.2800	(32c)
Internal Floor 1			56.0700			18.0000	1009.2600	(32d)
Internal Floor 2			49.3800			18.0000	888.8400	(32d)
Internal Ceiling 1			56.0700			18.0000	1009.2600	(32e)
Internal Ceiling 2			49.3800			18.0000	888.8400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	22609.2400 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		136.2741 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		23.8153 (36)
Total fabric heat loss	(33) + (36) =	127.6933 (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	72.4705	72.4705	72.4705	72.4705	72.4705	72.4705	72.4705	72.4705	72.4705	72.4705	72.4705	72.4705	(38)
Heat transfer coeff	200.1638	200.1638	200.1638	200.1638	200.1638	200.1638	200.1638	200.1638	200.1638	200.1638	200.1638	200.1638	(39)
Average = Sum(39)m / 12 =												200.1638	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2065	1.2065	1.2065	1.2065	1.2065	1.2065	1.2065	1.2065	1.2065	1.2065	1.2065	1.2065	(40)
HLP (average)												1.2065	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

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4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.9571	(42)
Average daily hot water use (litres/day)												104.4302	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	114.8732	110.6960	106.5188	102.3416	98.1644	93.9871	93.9871	98.1644	102.3416	106.5188	110.6960	114.8732	(44)
Energy conte	170.3536	148.9923	153.7468	134.0401	128.6147	110.9847	102.8437	118.0146	119.4241	139.1772	151.9228	164.9784	(45)
Energy content (annual)										Total = Sum(45)m =		1643.0931	(45)
Distribution loss (46)m = 0.15 x (45)m	25.5530	22.3489	23.0620	20.1060	19.2922	16.6477	15.4265	17.7022	17.9136	20.8766	22.7884	24.7468	(46)
Water storage loss:													
Store volume												250.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.6700	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.9018	(55)
Total storage loss	27.9558	25.2504	27.9558	27.0540	27.9558	27.0540	27.9558	27.9558	27.0540	27.9558	27.0540	27.9558	(56)
If cylinder contains dedicated solar storage	27.9558	25.2504	27.9558	27.0540	27.9558	27.0540	27.9558	27.9558	27.0540	27.9558	27.0540	27.9558	(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	221.5718	195.2539	204.9650	183.6061	179.8329	160.5507	154.0619	169.2328	168.9901	190.3954	201.4888	216.1966	(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	221.5718	195.2539	204.9650	183.6061	179.8329	160.5507	154.0619	169.2328	168.9901	190.3954	201.4888	216.1966	(64)
									Total per year (kWh/year) = Sum(64)m =			2246.1461	(64)
Heat gains from water heating, kWh/month	97.6171	86.5492	92.0954	84.2211	83.7390	76.5552	75.1701	80.2144	79.3613	87.2510	90.1671	95.8299	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	177.4236	177.4236	177.4236	177.4236	177.4236	177.4236	177.4236	177.4236	177.4236	177.4236	177.4236	177.4236	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	75.1886	66.7818	54.3106	41.1166	30.7352	25.9479	28.0376	36.4444	48.9156	62.1096	72.4910	77.2783	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	503.5145	508.7395	495.5729	467.5427	432.1598	398.9047	376.6883	371.4634	384.6300	412.6601	448.0431	481.2981	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.6994	55.6994	55.6994	55.6994	55.6994	55.6994	55.6994	55.6994	55.6994	55.6994	55.6994	55.6994	(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)	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	(71)
Water heating gains (Table 5)	131.2058	128.7935	123.7841	116.9738	112.5524	106.3267	101.0350	107.8151	110.2240	117.2728	125.2321	128.8036	(72)
Total internal gains	824.7495	819.1554	788.5082	740.4738	690.2879	646.0199	620.6016	630.5635	658.6102	706.8831	760.6069	802.2206	(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	13.4200	11.9814	0.5000	0.7000	0.7700	38.9998	(74)
East	7.3300	22.3313	0.5000	0.7000	0.7700	39.7027	(76)
West	14.6800	22.3313	0.5000	0.7000	0.7700	79.5136	(80)
East	2.1400	22.3313	0.5000	1.0000	0.7700	16.5589	(76)
South	1.1600	50.9848	0.5000	1.0000	0.7700	20.4928	(78)
South	5.6400	47.1663	0.5000	0.0000	1.0000	133.0089	(82)

Solar gains	328.2767	558.0293	877.2151	1297.3236	1548.4938	1700.6005	1599.5308	1402.0307	1096.0047	696.5325	414.7810	270.4408	(83)
Total gains	1153.0263	1377.1846	1665.7232	2037.7974	2238.7817	2346.6205	2220.1324	2032.5942	1754.6149	1403.4157	1175.3879	1072.6614	(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	31.3760	31.3760	31.3760	31.3760	31.3760	31.3760	31.3760	31.3760	31.3760	31.3760	31.3760	31.3760	
alpha	3.0917	3.0917	3.0917	3.0917	3.0917	3.0917	3.0917	3.0917	3.0917	3.0917	3.0917	3.0917	
util living area	0.9719	0.9524	0.9018	0.7872	0.6184	0.4084	0.2756	0.3090	0.5851	0.8531	0.9511	0.9768	(86)
Tweekday	17.5561	17.9191	18.5973	19.3063	19.7379	19.8922	19.9127	19.9115	19.8261	19.2529	18.2834	17.4649	
Tweekend	19.8403	20.0040	20.3139	20.6526	20.8781	20.9761	20.9951	20.9930	20.9244	20.6151	20.1653	19.7993	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	0	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	0	0	0	0	0	0	0	0	0	0	0	0	
MIT	19.2102	19.4594	19.9410	20.4576	20.8118	20.9633	20.9924	20.9892	20.8820	20.4060	19.6966	19.1469	(87)
Th 2	19.9148	19.9148	19.9148	19.9148	19.9148	19.9148	19.9148	19.9148	19.9148	19.9148	19.9148	19.9148	(88)
util rest of house	0.9663	0.9432	0.8831	0.7494	0.5562	0.3264	0.1809	0.2070	0.4982	0.8158	0.9398	0.9720	(89)
Tweekday	17.5561	17.9191	18.5973	19.3063	19.7379	19.8922	19.9127	19.9115	19.8261	19.2529	18.2834	17.4649	
Tweekend	17.5561	17.9191	18.5973	19.3063	19.7379	19.8922	19.9127	19.9115	19.8261	19.2529	18.2834	17.4649	
MIT 2	17.5561	17.9191	18.5973	19.3063	19.7379	19.8922	19.9127	19.9115	19.8261	19.2529	18.2834	17.4649	(90)
Living area fraction										fLA = Living area / (4) =		0.2565	(91)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

MIT	17.9803	18.3141	18.9419	19.6016	20.0133	20.1669	20.1896	20.1879	20.0969	19.5486	18.6459	17.8963	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.9803	18.3141	18.9419	19.6016	20.0133	20.1669	20.1896	20.1879	20.0969	19.5486	18.6459	17.8963	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9523	0.9252	0.8624	0.7371	0.5622	0.3459	0.2052	0.2331	0.5137	0.8008	0.9219	0.9594	(94)
Useful gains	1098.0271	1274.1762	1436.5949	1502.0618	1258.6361	811.7828	455.5213	473.7935	901.4178	1123.7969	1083.5888	1029.1489	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	2578.1675	2544.9007	2310.2687	1941.9081	1403.8062	834.0604	458.2936	477.9671	980.1881	1591.0313	2130.9164	2561.3488	(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	1101.2245	853.9268	650.0133	316.6893	108.0065	0.0000	0.0000	0.0000	0.0000	347.6224	754.0759	1139.9568	(98)
Space heating												5271.5155	(98)
Space heating per m2											(98) / (4) =	31.7733	(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 %)	295.3198	(206)
Efficiency of secondary/supplementary heating system, %	100.0000	(208)
Space heating requirement	1785.0196	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1101.2245	853.9268	650.0133	316.6893	108.0065	0.0000	0.0000	0.0000	0.0000	347.6224	754.0759	1139.9568	(98)
Space heating efficiency (main heating system 1)	295.3198	295.3198	295.3198	295.3198	295.3198	0.0000	0.0000	0.0000	0.0000	295.3198	295.3198	295.3198	(210)
Space heating fuel (main heating system)	372.8922	289.1533	220.1049	107.2361	36.5727	0.0000	0.0000	0.0000	0.0000	117.7105	255.3422	386.0076	(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	221.5718	195.2539	204.9650	183.6061	179.8329	160.5507	154.0619	169.2328	168.9901	190.3954	201.4888	216.1966	(64)
Efficiency of water heater												281.6750	(216)
(217)m	281.6750	281.6750	281.6750	281.6750	281.6750	281.6750	281.6750	281.6750	281.6750	281.6750	281.6750	281.6750	(217)
Fuel for water heating, kWh/month	78.6622	69.3189	72.7665	65.1837	63.8441	56.9986	54.6949	60.0809	59.9947	67.5940	71.5324	76.7539	(219)
Water heating fuel used												797.4247	(219)
Annual totals kWh/year													
Space heating fuel - main system												1785.0196	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
(MEVDecentralised, Database: total watage = 6.2785, total flow = 37.0000, SFP = 0.1697)													
mechanical ventilation fans (SFP = 0.1697)												90.9266	(230a)
Total electricity for the above, kWh/year												90.9266	(231)
Electricity for lighting (calculated in Appendix L)												531.1413	(232)
Total delivered energy for all uses												3204.5123	(238)

10a. Fuel costs - using BEDF prices (491)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1785.0196	19.4400	347.0078	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	797.4247	19.4400	155.0194	(247)
Mechanical ventilation fans	90.9266	19.4400	17.6761	(249)
Pumps and fans for heating	0.0000	0.0000	0.0000	(249)
Energy for lighting	531.1413	19.4400	103.2539	(250)
Additional standing charges			0.0000	(251)
Total energy cost			622.9572	(255)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	1785.0196	0.5190	926.4252	(261)
Space heating - secondary	0.0000	0.5190	0.0000	(263)
Water heating (other fuel)	797.4247	0.5190	413.8634	(264)
Space and water heating			1340.2886	(265)
Pumps and fans	90.9266	0.5190	47.1909	(267)
Energy for lighting	531.1413	0.5190	275.6624	(268)
Total kg/year			1663.1419	(272)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	1785.0196	3.0700	5480.0101	(261)
Space heating - secondary	0.0000	3.0700	0.0000	(263)
Water heating (other fuel)	797.4247	3.0700	2448.0939	(264)
Space and water heating			7928.1040	(265)
Pumps and fans	90.9266	3.0700	279.1448	(267)
Energy for lighting	531.1413	3.0700	1630.6039	(268)
Primary energy kWh/year			9837.8527	(272)
Primary energy kWh/m2/year			59.2963	(273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 87
Current environmental impact rating: B 89

(For testing purposes):

A	Not considered
B	Not considered
C	Not considered
D	Not considered
E Low energy lighting	Already installed
F	Not considered
G	Not considered
H	Not considered
I	Not considered
J	Not considered
K	Not considered
M	Not considered
N Solar water heating	Recommended
O	Not considered
P	Not considered
R	Not considered
S	Not considered
T	Not considered
U Solar photovoltaic panels	Recommended
A2	Not considered
A3	Not considered
T2	Not considered
W	Not considered
X	Not considered
Y	Not considered
J2	Not considered
Q2	Not considered
Z1	Not considered
Z2	Not considered
Z3	Not considered
Z4	Not considered
Z5	Not considered
V2 Wind turbine	Not applicable
L2	Not considered
Q3	Not considered
O3	Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.1	-£ 57	-152 kg (9.2%)
U Solar photovoltaic panels	+ 6.3	-£ 355	-947 kg (62.7%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£57	0.92 kg/m²	B 88	B 90
Solar photovoltaic panels	£355	5.71 kg/m²	A 95	A 95
Total Savings	£412	6.62 kg/m²		

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

Fuel prices for cost data on this page from database revision number 491 TEST (28 Feb 2022)
Recommendation texts revision number 4.9c (22 Feb 2014)

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

	Current	Potential	Saving
Electricity	£623	£566	£57
Space heating	£365	£365	-£0
Water heating	£155	£98	£57
Lighting	£103	£103	£0
Generated (PV)	-£0	-£355	£355
Total cost of fuels	£623	£211	£412
Total cost of uses	£623	£211	£412
Delivered energy	19 kWh/m²	7 kWh/m²	13 kWh/m²
Carbon dioxide emissions	1.7 tonnes	0.6 tonnes	1.1 tonnes
CO2 emissions per m²	10 kg/m²	3 kg/m²	7 kg/m²
Primary energy	59 kWh/m²	20 kWh/m²	39 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	61.2100	(1b)	x 2.5500	(2b) =	156.0855	(1b) - (3b)
First floor	62.4500	(1c)	x 2.9100	(2c) =	181.7295	(1c) - (3c)
Second floor	42.2500	(1d)	x 2.4000	(2d) =	101.4000	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	165.9100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		439.2150	(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			3.0000	
Infiltration rate			0.1500	(18)
Number of sides sheltered			3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.7750	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.1163	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.1482	0.1453	0.1424	0.1279	0.1250	0.1104	0.1104	0.1075	0.1163	0.1250	0.1308	0.1366	(22b)
Mechanical extract ventilation - decentralised													
If mechanical ventilation:												0.5000	(23a)
Effective ac	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	(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 = 1.20)			35.4300	1.1450	40.5687			(27)
Door			2.1000	1.0000	2.1000			(26)
Window glazed part (Uw = 1.20)			3.3000	1.1450	3.7786			(27)
Window opaque part			3.9400	1.2000	4.7280			(26)
Rooflights (Uw = 1.70)			5.6400	1.5918	8.9775			(27a)
Ground Floor			61.2100	0.1200	7.3452	75.0000	4590.7500	(28a)
Exposed floor			6.3800	0.2000	1.2760	20.0000	127.6000	(28b)
External Wall	184.8200	44.7700	140.0500	0.1900	26.6095	60.0000	8403.0000	(29a)
Sloping	49.9700	5.6400	44.3300	0.1300	5.7629	9.0000	398.9700	(30)
Flat roof	18.2100		18.2100	0.1500	2.7315	9.0000	163.8900	(30)
Total net area of external elements Aum(A, m2)			320.5900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		103.8780			(33)
Party Wall			67.5100	0.0000	0.0000	45.0000	3037.9500	(32)
GF Timber			68.1000			9.0000	612.9000	(32c)
FF Timber			115.3000			9.0000	1037.7000	(32c)
SF Timber			48.9200			9.0000	440.2800	(32c)
Internal Floor 1			56.0700			18.0000	1009.2600	(32d)
Internal Floor 2			49.3800			18.0000	888.8400	(32d)
Internal Ceiling 1			56.0700			18.0000	1009.2600	(32e)
Internal Ceiling 2			49.3800			18.0000	888.8400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	22609.2400 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		136.2741 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		23.8153 (36)
Total fabric heat loss	(33) + (36) =	127.6933 (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	72.4705	72.4705	72.4705	72.4705	72.4705	72.4705	72.4705	72.4705	72.4705	72.4705	72.4705	72.4705	(38)
Heat transfer coeff	200.1638	200.1638	200.1638	200.1638	200.1638	200.1638	200.1638	200.1638	200.1638	200.1638	200.1638	200.1638	(39)
Average = Sum(39)m / 12 =												200.1638	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2065	1.2065	1.2065	1.2065	1.2065	1.2065	1.2065	1.2065	1.2065	1.2065	1.2065	1.2065	(40)
HLP (average)												1.2065	(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												2.9571	(42)
Average daily hot water use (litres/day)												104.4302	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	114.8732	110.6960	106.5188	102.3416	98.1644	93.9871	93.9871	98.1644	102.3416	106.5188	110.6960	114.8732	(44)
Energy conte	170.3536	148.9923	153.7468	134.0401	128.6147	110.9847	102.8437	118.0146	119.4241	139.1772	151.9228	164.9784	(45)
Energy content (annual)										Total = Sum(45)m =		1643.0931	(45)
Distribution loss (46)m = 0.15 x (45)m	25.5530	22.3489	23.0620	20.1060	19.2922	16.6477	15.4265	17.7022	17.9136	20.8766	22.7884	24.7468	(46)
Water storage loss:													
Store volume												250.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.6700	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.9018	(55)
Total storage loss	27.9558	25.2504	27.9558	27.0540	27.9558	27.0540	27.9558	27.9558	27.0540	27.9558	27.0540	27.9558	(56)
If cylinder contains dedicated solar storage	27.9558	25.2504	27.9558	27.0540	27.9558	27.0540	27.9558	27.9558	27.0540	27.9558	27.0540	27.9558	(57)
Primary loss	23.2624	21.0112	21.8667	15.7584	10.4681	9.9053	10.2355	11.1660	17.1091	21.8667	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month	221.5718	195.2539	203.5692	176.8525	167.0386	147.9440	141.0349	157.1364	163.5872	188.9997	201.4888	216.1966	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1079.5246	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1813.6014	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.1038	(H8)
Utilisation factor												0.5959	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												104.4302	(H14)
Volume ratio Veff/V												0.7182	(H15)
Solar storage volume factor												0.9338	(H16)
Solar input												-887.2947	(H17)
Solar input	-25.7298	-42.9356	-73.1242	-98.0009	-121.0719	-119.0329	-117.4599	-102.6253	-80.3762	-54.8875	-30.5192	-21.5314	(63)
									Solar input (sum of months) = Sum(63)m =			-887.2947	(63)
Output from w/h	195.8420	152.3183	130.4450	78.8516	45.9667	28.9111	23.5751	54.5111	83.2110	134.1122	170.9696	194.6651	(64)
									Total per year (kWh/year) = Sum(64)m =			1293.3790	(64)
Heat gains from water heating, kWh/month	97.6171	86.5492	90.9788	78.8183	73.5035	66.4698	64.7485	70.5373	75.0390	86.1344	90.1671	95.8299	(65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	177.4236	177.4236	177.4236	177.4236	177.4236	177.4236	177.4236	177.4236	177.4236	177.4236	177.4236	177.4236	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	75.1886	66.7818	54.3106	41.1166	30.7352	25.9479	28.0376	36.4444	48.9156	62.1096	72.4910	77.2783	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	503.5145	508.7395	495.5729	467.5427	432.1598	398.9047	376.6883	371.4634	384.6300	412.6601	448.0431	481.2981	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.6994	55.6994	55.6994	55.6994	55.6994	55.6994	55.6994	55.6994	55.6994	55.6994	55.6994	55.6994	(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)	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	(71)
Water heating gains (Table 5)	131.2058	128.7935	122.2833	109.4698	98.7950	92.3192	87.0276	94.8081	104.2208	115.7720	125.2321	128.8036	(72)
Total internal gains	824.7495	819.1554	787.0074	732.9698	676.5305	632.0125	606.5942	617.5566	652.6070	705.3823	760.6069	802.2206	(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	13.4200	10.6334	0.5000	0.7000	0.7700	34.6119	(74)
East	7.3300	19.6403	0.5000	0.7000	0.7700	34.9183	(76)
West	14.6800	19.6403	0.5000	0.7000	0.7700	69.9318	(80)
East	2.1400	19.6403	0.5000	1.0000	0.7700	14.5635	(76)
South	1.1600	46.7521	0.5000	1.0000	0.7700	18.7915	(78)
South	5.6400	42.0754	0.5000	0.0000	1.0000	118.6525	(82)

Solar gains	291.4694	549.7298	873.5138	1252.9059	1535.3013	1575.8924	1498.2834	1283.8968	1006.5232	642.2282	359.2975	242.5835	(83)
Total gains	1116.2190	1368.8852	1660.5211	1985.8757	2211.8318	2207.9049	2104.8776	1901.4534	1659.1302	1347.6105	1119.9044	1044.8042	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)	21.0000	(85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)		

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	31.3760	31.3760	31.3760	31.3760	31.3760	31.3760	31.3760	31.3760	31.3760	31.3760	31.3760	31.3760	
alpha	3.0917	3.0917	3.0917	3.0917	3.0917	3.0917	3.0917	3.0917	3.0917	3.0917	3.0917	3.0917	
util living area													
	0.9773	0.9580	0.9152	0.8248	0.6871	0.5295	0.4015	0.4563	0.6825	0.8894	0.9633	0.9813	(86)
Tweekday	17.3161	17.7425	18.3968	19.1135	19.6090	19.8375	19.8984	19.8883	19.7216	19.0189	18.0092	17.2083	
Tweekend	19.7335	19.9251	20.2224	20.5590	20.8078	20.9370	20.9800	20.9701	20.8601	20.5033	20.0419	19.6854	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	0	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	0	0	0	0	0	0	0	0	0	0	0	0	
MIT	19.0454	19.3372	19.7999	20.3114	20.7033	20.9033	20.9691	20.9538	20.7816	20.2335	19.5040	18.9710	(87)
Th 2	19.9148	19.9148	19.9148	19.9148	19.9148	19.9148	19.9148	19.9148	19.9148	19.9148	19.9148	19.9148	(88)
util rest of house													
	0.9730	0.9501	0.8996	0.7936	0.6349	0.4543	0.3091	0.3590	0.6101	0.8618	0.9550	0.9776	(89)
Tweekday	17.3161	17.7425	18.3968	19.1135	19.6090	19.8375	19.8984	19.8883	19.7216	19.0189	18.0092	17.2083	
Tweekend	17.3161	17.7425	18.3968	19.1135	19.6090	19.8375	19.8984	19.8883	19.7216	19.0189	18.0092	17.2083	
MIT 2	17.3161	17.7425	18.3968	19.1135	19.6090	19.8375	19.8984	19.8883	19.7216	19.0189	18.0092	17.2083	(90)
Living area fraction										fLA = Living area / (4) =		0.2565	(91)
MIT	17.7596	18.1515	18.7566	19.4208	19.8896	20.1108	20.1730	20.1615	19.9934	19.3304	18.3926	17.6604	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.7596	18.1515	18.7566	19.4208	19.8896	20.1108	20.1730	20.1615	19.9934	19.3304	18.3926	17.6604	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9605	0.9329	0.8788	0.7773	0.6336	0.4685	0.3317	0.3820	0.6159	0.8435	0.9390	0.9666	(94)
Useful gains	1072.1360	1277.0644	1459.2255	1543.6180	1401.3707	1034.4663	698.1988	726.3904	1021.7919	1136.6735	1051.6127	1009.8842	(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													
	2694.1235	2652.4755	2453.3342	2105.8734	1639.2669	1103.0609	715.1788	752.9253	1179.6543	1747.5042	2260.3648	2694.2760	(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													
	1206.7587	924.2762	739.6168	404.8239	176.9947	0.0000	0.0000	0.0000	0.0000	454.4581	870.3015	1253.1875	(98)
Space heating												6030.4175	(98)
Space heating per m2											(98) / (4) =	36.3475	(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 %)	295.3198	(206)
Efficiency of secondary/supplementary heating system, %	100.0000	(208)
Space heating requirement	2041.9960	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1206.7587	924.2762	739.6168	404.8239	176.9947	0.0000	0.0000	0.0000	0.0000	454.4581	870.3015	1253.1875	(98)
Space heating efficiency (main heating system 1)													
	295.3198	295.3198	295.3198	295.3198	295.3198	0.0000	0.0000	0.0000	0.0000	295.3198	295.3198	295.3198	(210)
Space heating fuel (main heating system)													
	408.6278	312.9747	250.4461	137.0799	59.9333	0.0000	0.0000	0.0000	0.0000	153.8868	294.6980	424.3494	(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													
	195.8420	152.3183	130.4450	78.8516	45.9667	28.9111	23.5751	54.5111	83.2110	134.1122	170.9696	194.6651	(64)
Efficiency of water heater												281.6750	(216)
(217)m	281.6750	281.6750	281.6750	281.6750	281.6750	281.6750	281.6750	281.6750	281.6750	281.6750	281.6750	281.6750	(217)
Fuel for water heating, kWh/month													
	69.5277	54.0759	46.3105	27.9938	16.3191	10.2640	8.3696	19.3525	29.5415	47.6124	60.6975	69.1098	(219)
Water heating fuel used												459.1742	(219)
Annual totals kWh/year													
Space heating fuel - main system												2041.9960	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
(MEVDecentralised, Database: total watage = 6.2785, total flow = 37.0000, SFP = 0.1697)													
mechanical ventilation fans (SFP = 0.1697)												90.9266	(230a)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												140.9266	(231)
Electricity for lighting (calculated in Appendix L)												531.1413	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1080 * 0.80) =										-1727.2394		-1727.2394	(233)
Total delivered energy for all uses												1445.9987	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2041.9960	13.1900	269.3393	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	459.1742	13.1900	60.5651	(247)
Mechanical ventilation fans	90.9266	13.1900	11.9932	(249)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Pumps and fans for heating	0.0000	0.0000	0.0000	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	531.1413	13.1900	70.0575	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit	-1727.2394	13.1900	-227.8229	(252)
Total energy cost			190.7272	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.3798	(257)
SAP value		94.7017	
SAP rating (Section 12)		95	(258)
SAP band		A	

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	2041.9960	0.5190	1059.7959	(261)
Space heating - secondary	0.0000	0.5190	0.0000	(263)
Water heating (other fuel)	459.1742	0.5190	238.3114	(264)
Space and water heating			1298.1073	(265)
Pumps and fans	140.9266	0.5190	73.1409	(267)
Energy for lighting	531.1413	0.5190	275.6624	(268)
Energy saving/generation technologies				
PV Unit	-1727.2394	0.5190	-896.4372	(269)
Total kg/year			750.4734	(272)
CO2 emissions per m2			4.5200	(273)
EI value			95.2319	
EI rating			95	(274)
EI band			A	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	61.2100	(1b)	x 2.5500	(2b) =	156.0855	(1b) - (3b)
First floor	62.4500	(1c)	x 2.9100	(2c) =	181.7295	(1c) - (3c)
Second floor	42.2500	(1d)	x 2.4000	(2d) =	101.4000	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	165.9100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		439.2150	(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		3.0000	
Infiltration rate		0.1500	(18)
Number of sides sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7750	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1163	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.1221	0.1163	0.1163	0.1075	0.1075	0.0959	0.0988	0.0930	0.0959	0.1017	0.1017	0.1104	(22b)
Mechanical extract ventilation - decentralised													
If mechanical ventilation:												0.5000	(23a)
Effective ac	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	(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 = 1.20)			35.4300	1.1450	40.5687			(27)
Door			2.1000	1.0000	2.1000			(26)
Window glazed part (Uw = 1.20)			3.3000	1.1450	3.7786			(27)
Window opaque part			3.9400	1.2000	4.7280			(26)
Rooflights (Uw = 1.70)			5.6400	1.5918	8.9775			(27a)
Ground Floor			61.2100	0.1200	7.3452	75.0000	4590.7500	(28a)
Exposed floor			6.3800	0.2000	1.2760	20.0000	127.6000	(28b)
External Wall	184.8200	44.7700	140.0500	0.1900	26.6095	60.0000	8403.0000	(29a)
Sloping	49.9700	5.6400	44.3300	0.1300	5.7629	9.0000	398.9700	(30)
Flat roof	18.2100		18.2100	0.1500	2.7315	9.0000	163.8900	(30)
Total net area of external elements Aum(A, m2)			320.5900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		103.8780			(33)
Party Wall			67.5100	0.0000	0.0000	45.0000	3037.9500	(32)
GF Timber			68.1000			9.0000	612.9000	(32c)
FF Timber			115.3000			9.0000	1037.7000	(32c)
SF Timber			48.9200			9.0000	440.2800	(32c)
Internal Floor 1			56.0700			18.0000	1009.2600	(32d)
Internal Floor 2			49.3800			18.0000	888.8400	(32d)
Internal Ceiling 1			56.0700			18.0000	1009.2600	(32e)
Internal Ceiling 2			49.3800			18.0000	888.8400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	22609.2400 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		136.2741 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		23.8153 (36)
Total fabric heat loss	(33) + (36) =	127.6933 (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	72.4705	72.4705	72.4705	72.4705	72.4705	72.4705	72.4705	72.4705	72.4705	72.4705	72.4705	72.4705	(38)
Heat transfer coeff	200.1638	200.1638	200.1638	200.1638	200.1638	200.1638	200.1638	200.1638	200.1638	200.1638	200.1638	200.1638	(39)
Average = Sum(39)m / 12 =												200.1638	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2065	1.2065	1.2065	1.2065	1.2065	1.2065	1.2065	1.2065	1.2065	1.2065	1.2065	1.2065	(40)
HLP (average)												1.2065	(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												2.9571	(42)
Average daily hot water use (litres/day)												104.4302	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	114.8732	110.6960	106.5188	102.3416	98.1644	93.9871	93.9871	98.1644	102.3416	106.5188	110.6960	114.8732	(44)
Energy conte	170.3536	148.9923	153.7468	134.0401	128.6147	110.9847	102.8437	118.0146	119.4241	139.1772	151.9228	164.9784	(45)
Energy content (annual)										Total = Sum(45)m =		1643.0931	(45)
Distribution loss (46)m = 0.15 x (45)m	25.5530	22.3489	23.0620	20.1060	19.2922	16.6477	15.4265	17.7022	17.9136	20.8766	22.7884	24.7468	(46)
Water storage loss:													
Store volume												250.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.6700	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.9018	(55)
Total storage loss	27.9558	25.2504	27.9558	27.0540	27.9558	27.0540	27.9558	27.9558	27.0540	27.9558	27.0540	27.9558	(56)
If cylinder contains dedicated solar storage	27.9558	25.2504	27.9558	27.0540	27.9558	27.0540	27.9558	27.9558	27.0540	27.9558	27.0540	27.9558	(57)
Primary loss	23.2624	21.0112	21.8667	15.7584	10.4681	9.9053	10.2355	11.1660	17.1091	21.8667	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month	221.5718	195.2539	203.5692	176.8525	167.0386	147.9440	141.0349	157.1364	163.5872	188.9997	201.4888	216.1966	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1140.0998	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1915.3676	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.1657	(H8)
Utilisation factor												0.5759	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												104.4302	(H14)
Volume ratio Veff/V												0.7182	(H15)
Solar storage volume factor												0.9338	(H16)
Solar input												-905.7404	(H17)
Solar input	-27.8782	-41.9009	-70.5665	-97.5445	-117.4763	-123.6387	-120.6699	-107.7590	-84.1063	-57.2159	-33.8867	-23.0973	(63)
										Solar input (sum of months) = Sum(63)m =		-905.7404	(63)
Output from w/h	193.6936	153.3530	133.0027	79.3081	49.5623	24.3053	20.3650	49.3774	79.4809	131.7838	167.6021	193.0993	(64)
										Total per year (kWh/year) = Sum(64)m =		1274.9333	(64)
Heat gains from water heating, kWh/month	97.6171	86.5492	90.9788	78.8183	73.5035	66.4698	64.7485	70.5373	75.0390	86.1344	90.1671	95.8299	(65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	177.4236	177.4236	177.4236	177.4236	177.4236	177.4236	177.4236	177.4236	177.4236	177.4236	177.4236	177.4236	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	75.1886	66.7818	54.3106	41.1166	30.7352	25.9479	28.0376	36.4444	48.9156	62.1096	72.4910	77.2783	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	503.5145	508.7395	495.5729	467.5427	432.1598	398.9047	376.6883	371.4634	384.6300	412.6601	448.0431	481.2981	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.6994	55.6994	55.6994	55.6994	55.6994	55.6994	55.6994	55.6994	55.6994	55.6994	55.6994	55.6994	(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)	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	-118.2824	(71)
Water heating gains (Table 5)	131.2058	128.7935	122.2833	109.4698	98.7950	92.3192	87.0276	94.8081	104.2208	115.7720	125.2321	128.8036	(72)
Total internal gains	824.7495	819.1554	787.0074	732.9698	676.5305	632.0125	606.5942	617.5566	652.6070	705.3823	760.6069	802.2206	(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	13.4200	11.9814	0.5000	0.7000	0.7700	38.9998	(74)
East	7.3300	22.3313	0.5000	0.7000	0.7700	39.7027	(76)
West	14.6800	22.3313	0.5000	0.7000	0.7700	79.5136	(80)
East	2.1400	22.3313	0.5000	1.0000	0.7700	16.5589	(76)
South	1.1600	50.9848	0.5000	1.0000	0.7700	20.4928	(78)
South	5.6400	47.1663	0.5000	0.0000	1.0000	133.0089	(82)

Solar gains	328.2767	558.0293	877.2151	1297.3236	1548.4938	1700.6005	1599.5308	1402.0307	1096.0047	696.5325	414.7810	270.4408	(83)
Total gains	1153.0263	1377.1846	1664.2224	2030.2934	2225.0244	2332.6130	2206.1249	2019.5873	1748.6117	1401.9149	1175.3879	1072.6614	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)	21.0000	(85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)		

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	31.3760	31.3760	31.3760	31.3760	31.3760	31.3760	31.3760	31.3760	31.3760	31.3760	31.3760	31.3760	
alpha	3.0917	3.0917	3.0917	3.0917	3.0917	3.0917	3.0917	3.0917	3.0917	3.0917	3.0917	3.0917	
util living area	0.9719	0.9524	0.9020	0.7885	0.6210	0.4106	0.2772	0.3109	0.5866	0.8534	0.9511	0.9768	(86)
Tweekday	17.5561	17.9191	18.5960	19.3028	19.7355	19.8918	19.9126	19.9114	19.8254	19.2520	18.2834	17.4649	
Tweekend	19.8403	20.0040	20.3133	20.6508	20.8766	20.9758	20.9950	20.9929	20.9239	20.6147	20.1653	19.7993	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	0	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	0	0	0	0	0	0	0	0	0	0	0	0	
MIT	19.2102	19.4594	19.9401	20.4548	20.8095	20.9628	20.9923	20.9890	20.8812	20.4053	19.6966	19.1469	(87)
Th 2	19.9148	19.9148	19.9148	19.9148	19.9148	19.9148	19.9148	19.9148	19.9148	19.9148	19.9148	19.9148	(88)
util rest of house	0.9663	0.9432	0.8833	0.7508	0.5588	0.3282	0.1820	0.2083	0.4996	0.8161	0.9398	0.9720	(89)
Tweekday	17.5561	17.9191	18.5960	19.3028	19.7355	19.8918	19.9126	19.9114	19.8254	19.2520	18.2834	17.4649	
Tweekend	17.5561	17.9191	18.5960	19.3028	19.7355	19.8918	19.9126	19.9114	19.8254	19.2520	18.2834	17.4649	
MIT 2	17.5561	17.9191	18.5960	19.3028	19.7355	19.8918	19.9126	19.9114	19.8254	19.2520	18.2834	17.4649	(90)
Living area fraction										fLA = Living area / (4) =		0.2565	(91)
MIT	17.9803	18.3141	18.9407	19.5982	20.0110	20.1665	20.1895	20.1878	20.0962	19.5478	18.6459	17.8963	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.9803	18.3141	18.9407	19.5982	20.0110	20.1665	20.1895	20.1878	20.0962	19.5478	18.6459	17.8963	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9523	0.9252	0.8627	0.7384	0.5647	0.3478	0.2065	0.2346	0.5151	0.8011	0.9219	0.9594	(94)
Useful gains	1098.0271	1274.1762	1435.6606	1499.1738	1256.4136	811.3597	455.4587	473.6999	900.7026	1123.0525	1083.5888	1029.1489	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	2578.1675	2544.9007	2310.0395	1941.2364	1403.3395	833.9787	458.2810	477.9484	980.0417	1590.8535	2130.9164	2561.3488	(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	1101.2245	853.9268	650.5379	318.2851	109.3129	0.0000	0.0000	0.0000	0.0000	348.0439	754.0759	1139.9568	(98)
Space heating												5275.3637	(98)
Space heating per m2											(98) / (4) =	31.7965	(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 %)	295.3198	(206)
Efficiency of secondary/supplementary heating system, %	100.0000	(208)
Space heating requirement	1786.3227	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1101.2245	853.9268	650.5379	318.2851	109.3129	0.0000	0.0000	0.0000	0.0000	348.0439	754.0759	1139.9568	(98)
Space heating efficiency (main heating system 1)	295.3198	295.3198	295.3198	295.3198	295.3198	0.0000	0.0000	0.0000	0.0000	295.3198	295.3198	295.3198	(210)
Space heating fuel (main heating system)	372.8922	289.1533	220.2825	107.7764	37.0151	0.0000	0.0000	0.0000	0.0000	117.8532	255.3422	386.0076	(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	193.6936	153.3530	133.0027	79.3081	49.5623	24.3053	20.3650	49.3774	79.4809	131.7838	167.6021	193.0993	(64)
Efficiency of water heater												281.6750	(216)
(217)m	281.6750	281.6750	281.6750	281.6750	281.6750	281.6750	281.6750	281.6750	281.6750	281.6750	281.6750	281.6750	(217)
Fuel for water heating, kWh/month	68.7649	54.4432	47.2185	28.1559	17.5955	8.6288	7.2300	17.5299	28.2172	46.7858	59.5019	68.5539	(219)
Water heating fuel used												452.6257	(219)
Annual totals kWh/year													
Space heating fuel - main system												1786.3227	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
(MEVDecentralised, Database: total watage = 6.2785, total flow = 37.0000, SFP = 0.1697)													
mechanical ventilation fans (SFP = 0.1697)												90.9266	(230a)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												140.9266	(231)
Electricity for lighting (calculated in Appendix L)												531.1413	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1140 * 0.80) =										-1824.1596		-1824.1596	(233)
Total delivered energy for all uses												1086.8567	(238)

10a. Fuel costs - using BEDF prices (491)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1786.3227	19.4400	347.2611	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	452.6257	19.4400	87.9904	(247)
Mechanical ventilation fans	90.9266	19.4400	17.6761	(249)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Pumps and fans for heating	0.0000	0.0000	0.0000	(249)
Pump for solar water heating	50.0000	19.4400	9.7200	(249)
Energy for lighting	531.1413	19.4400	103.2539	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit	-1824.1596	19.4400	-354.6166	(252)
Total energy cost			211.2849	(255)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	1786.3227	0.5190	927.1015	(261)
Space heating - secondary	0.0000	0.5190	0.0000	(263)
Water heating (other fuel)	452.6257	0.5190	234.9127	(264)
Space and water heating			1162.0142	(265)
Pumps and fans	140.9266	0.5190	73.1409	(267)
Energy for lighting	531.1413	0.5190	275.6624	(268)
Energy saving/generation technologies				
PV Unit	-1824.1596	0.5190	-946.7389	(269)
Total kg/year			564.0786	(272)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	1786.3227	3.0700	5484.0106	(261)
Space heating - secondary	0.0000	3.0700	0.0000	(263)
Water heating (other fuel)	452.6257	3.0700	1389.5608	(264)
Space and water heating			6873.5713	(265)
Pumps and fans	140.9266	3.0700	432.6448	(267)
Energy for lighting	531.1413	3.0700	1630.6039	(268)
Energy saving/generation technologies				
PV Unit	-1824.1596	3.0700	-5600.1701	(269)
Primary energy kWh/year			3336.6499	(272)
Primary energy kWh/m2/year			20.1112	(273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Designed) 9.92

Overheating Calculation Input Data

Dwelling type	EndTerrace House
Number of storeys	3
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	East
Overshading	Average or unknown
Thermal mass parameter	136.3 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	579.76 (P1)
Transmission heat loss coefficient	127.69 (37)
Summer heat loss coefficient	707.46 (P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
North	0.000	1.000	None
East	0.000	1.000	None
South	0.000	1.000	None
West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer	
North	1.000	0.90	1.000	0.900	(P8)
East	1.000	0.90	1.000	0.900	(P8)
South	1.000	0.90	1.000	0.900	(P8)
South	1.000	1.00	1.000	1.000	(P8)
West	1.000	0.90	1.000	0.900	(P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North	13.4200	81.1852	0.5000	0.7000	0.9000	308.8747
East	7.3300	117.5071	0.5000	0.7000	0.9000	244.1862
West	14.6800	117.5071	0.5000	0.7000	0.9000	489.0386

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

East	2.1400	117.5071	0.5000	1.0000	0.9000	101.8434
South	1.1600	112.2060	0.5000	1.0000	0.9000	52.7144
South	5.6400	204.1575	0.5000	0.0000	1.0000	575.7241
total:						1772.3813

	Jun	Jul	Aug	
Solar gains	1885	1772	1552	(P3/P4)
Internal gains	646	621	631	
Total summer gains	2531	2393	2183	(P5)
Summer gain/loss ratio	3.58	3.38	3.08	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 136.3)	1.05	1.05	1.05	
Threshold temperature	20.62	22.33	21.93	(P7)
Likelihood of high internal temperature	Slight	Medium	Slight	
Assessment of likelihood of high internal temperature:	Medium			