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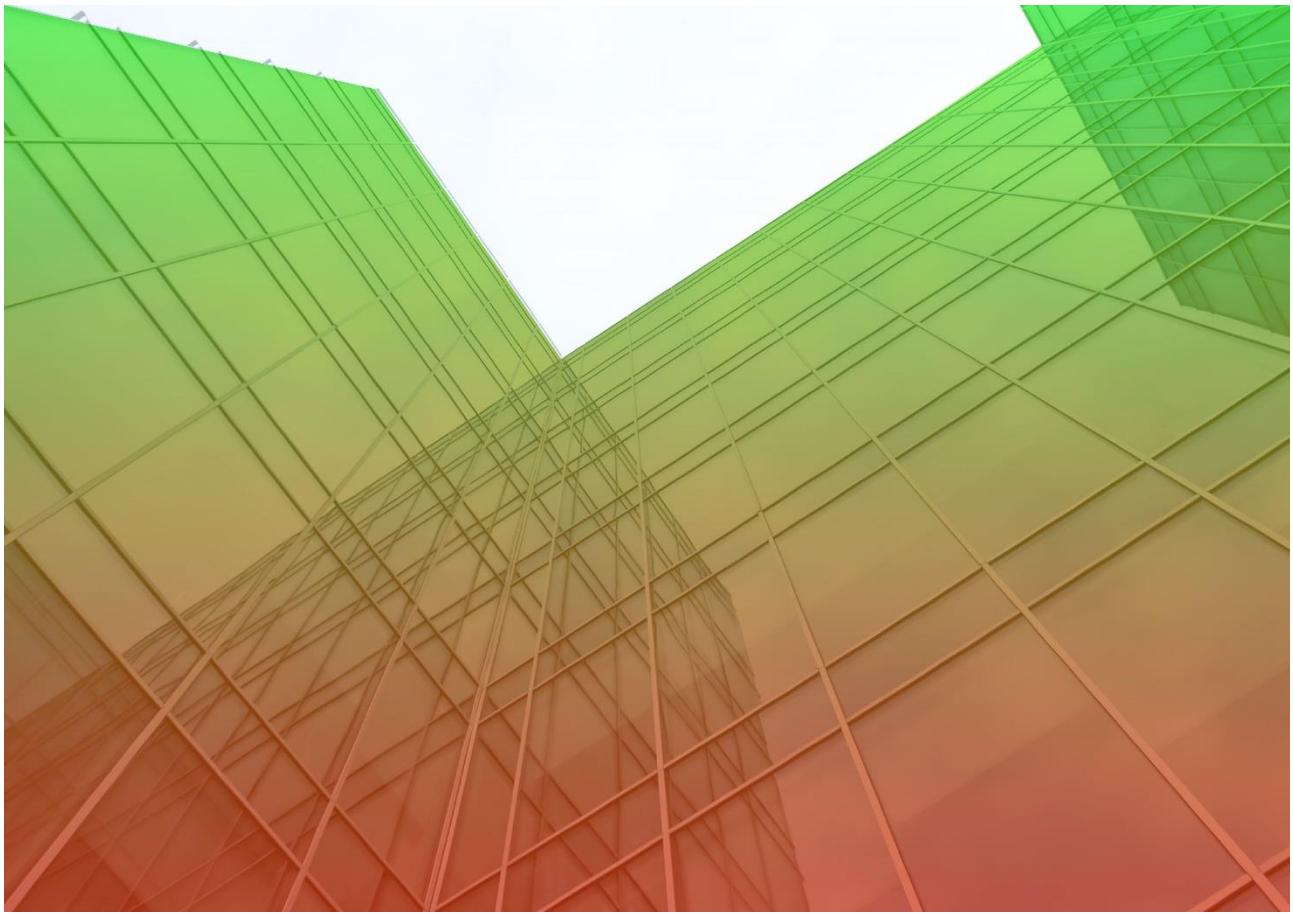
Energy Statement

Borders Lane Play Fields, Loughton

On Behalf of Fairview New Homes (Epping Forest) No. 2 Limited



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Preface

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Executive Summary

This Energy Statement describes the details of the energy strategy for the proposed residential development at Border Lane Play Fields, Loughton in response to national and local energy and sustainability policies.

The overarching objective of the proposed strategy is to use an energy efficient design to achieve compliance with the regulatory requirements. The energy strategy measures are summarised and presented in the table below.

Energy Hierarchy	Energy Strategy Measures
Energy Demand Reduction and Energy Supply	**Passive design** • Compact building form and layouts • Optimised design to enable controlled solar gain and improve direct and indirect natural lighting **Building Fabric** • Use of optimal building fabric standards • Design with low air permeability rates **Energy Efficiency** • Energy efficient lighting and appropriate controls • Energy Efficient mechanical ventilation • High efficiency individual gas boilers

The development will reduce CO_2 emissions by incorporating a range of passive design and energy efficiency measures throughout the site, including improved building fabric standards, energy efficient mechanical ventilation and lighting. The energy strategy proposes energy efficient individual gas-fired boilers to supply hot water and space heating for each dwelling. The modelling demonstrates that the measures proposed ensure the site has the potential to reduce regulated CO_2 emissions below the minimum baseline.

The proposed energy strategy for the development:

- Complies with Part L 2013 (with 2016 amendments) Building Regulations and meets TFEE requirements
- Includes optimal building fabric standards, energy efficient design of building services and energy efficient appliances
- Includes high efficiency boilers designed to meet the hot water and space heating demands of the units.

1 Introduction

1.1 Background

Low Energy Consultancy Limited (LEC) has been instructed by Fairview New Homes (Epping Forest) No. 1 Limited (Fairview) to prepare an Energy Statement focusing on the proposed energy strategy for the redevelopment of the former Epping Forest College (Site B), Borders Lane, IG10 3SA site. This statement has been prepared to support the full planning application in response to local and national legislation.

To support the planning application this document identifies and describes the energy efficiency design and the preferred options for achieving a reduction in carbon emissions to satisfy policy.

In order to achieve the energy and sustainability objectives defined by national, regional and local policies, an assessment has been carried out to identify the most appropriate and viable strategies and technologies to achieve the required energy reductions.

1.2 Description of the Development

The proposal is for the redevelopment of the site to provide 285 residential dwellings (Use Class C3) comprising 19 semi-detached and attached houses and 266 apartments in a series of blocks ranging from 2 to 5 stories in height, a new Wellness Centre (Use Class D2), creation of a new public park, landscape amenity areas, car parking, secure cycle parking and other associated development. The site location plan is presented in Figure 1.2.

Figure 1.2 Site location plan

2 Planning Policies

2.1 National Planning Policy Framework

The National Planning Policy Framework (NPPF) document sets out the Government's planning policies for England and was updated in February 2019.

The NPPF is designed to consolidate all policy statements, circulars and guidance documents into a single, simpler National Planning Policy Framework, making the planning system more user-friendly and transparent. The framework's primary objective is a sustainable development, therefore focussing on the 3 pillars of sustainability. The framework is split into three sections; planning for prosperity (Economic), planning for people (Social) and planning for places (Environmental), each of which outlines guidance to tackle issues such as housing, transport infrastructure, climate change, business and economic development, etc.

In regard to climate change, the NPPF supports a reduction in greenhouse gas emissions and the delivery of renewable and low carbon energy. Climate change is covered in Section 10 '*Meeting the challenge of climate change, flooding and coastal change*'. In summary the framework advises:

To support the move to a low carbon future, local planning authorities should:

- plan for new developments in locations and ways which reduce greenhouse gas emissions;
- actively support energy efficiency improvements to existing buildings; and
- adopting nationally described standards when setting any local requirement for a building's sustainability.

In determining planning applications, local planning authorities should expect a new development to:

- comply with adopted Local 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
- take account of landform, layout, building orientation, massing and landscaping to minimise energy consumption.

2.2 Epping Forest Planning Policies

2.2.1 The adopted Local Plan (1998) and adopted Alterations (2006)

Policy CP4 – Energy Conservation

All new built development should incorporate principles of energy conservation in relation to the design, massing, siting, orientation and layout of buildings. Appropriate measures to utilise renewable energy resources and new energy saving/generating technologies as may become available, should be provided within new buildings or developments where appropriate. These principles should also apply to the conversion or re-use of existing sites and buildings.

Policy CP5 – Sustainable Building

Planning permission may be refused for proposals which the Council believes do not do enough to conserve energy, make the most efficient use of water and other resources, recycle waste or protect environmental features and local amenities. Where possible, proposals for new development, or for the conversion or re-use of sites and buildings should incorporate measures which:

1. reduce fuel use and greenhouse gas emissions (e.g. heat recovery, passive solar gain, cycle parking/storage, links with footpath and cycle networks to encourage sustainable transport);
2. minimise overall energy use and input of raw materials (e.g. building form, orientation, thermal mass, fenestration, natural ventilation, landscaping to create shelterbelts, use/reuse of construction materials);
3. encourage efficient use of water and recycling of waste (e.g. enable use of greywater and collection of rainwater, incorporation of water efficient appliances within the development, provision of facilities and space for waste recycling and composting);
4. incorporate renewable energy facilities or schemes;
5. adopt methods to protect wildlife habitats, trees and other landscape features during construction and which minimise disturbance to adjoining landowners and local amenities.

The Council may require that proposals for new development, or for the conversion or re-use of sites or buildings, demonstrate in a 'Sustainability Report' how various aspects of sustainability (including those in criteria (i) to (v) above) have been taken into account. The report should address the siting, massing, design, orientation and layout of development, and the construction and lifecycle of buildings.

2.2.2 Draft Local Plan 2016

Draft Policy DM 20 Low Carbon and Renewable Energy

1. The incorporation of low carbon and renewable energy measures in new and existing development will be encouraged with regard to both stand-alone installations and micro renewables integrated into development.
2. Low carbon and renewable energy technologies will be permitted provided that:
   - i) they do not have any adverse impact on the integrity of any European sites, wildlife sites, protected species or habitats or the openness of the Green Belt;
   - ii) a positive assessment is provided demonstrating how any impacts on the environment and heritage assets, including cumulative landscape, noise, visual, air quality and emissions, traffic generation impacts can be avoided or mitigated through careful consideration of location, scale and design;
   - iii) the benefits of the proposal are clear with regard to the amount of heat or electricity generated and consequential reduction in greenhouse gases, and the local individual or community benefit including community ownership or shareholding of a scheme;
3. The use of combined heat and power (CHP), and/or combined cooling, heat and power (CCHP) and district heating will be encouraged in new developments.
4. All major development will be required to incorporate infrastructure for district heating, and will be expected to connect to any existing suitable systems (including systems that

will be in place at the time of construction), unless it is demonstrated that this would render development unviable.

5 Where a district heating scheme is proposed as part of a major development the Council will expect the scheme to demonstrate that the proposed heating and cooling systems (CHP/CCHP) have been selected considering the heat hierarchy in line with the following order of preference:

i) connection with existing CHP/CCHP distribution networks;
ii) site wide CHP/CCHP fed by renewables;
iii) communal CHP/CCHP fuelled by renewable energy sources;
iv) gas fired CHP/CCHP

2.3 Part L Building Regulations

The residential units will need to comply with Part L1A 2013 with 2016 amendments. Approved Document Part L1A 2013 incorporates a number of changes and additions compared to Part L1A 2010. Part L1A 2013 requires new homes to reduce their carbon emissions by a further 6% across the build mix, compared to Part L1A 2010. In addition to achieving an overall carbon emission target, (i.e. TER or Target Emission Rate), there is a further requirement to achieve or better fabric energy efficiency targets (TFEE: "Target Fabric Energy Efficiency"). This means the thermal performance of the building fabric now has its own standards which cannot be compensated by services strategy or renewable features.

2.4 Summary of Policy Requirements

This section provides a summary of the planning policy requirements which should be met by the scheme to achieve compliance.

- Comply with Part L 2013 (with 2016 amendments) Building Regulations.
- Maximise the use of energy efficiency and energy conservation measures in their design, layout and orientation to reduce the overall energy demand.
- Incorporate renewable energy where required and feasible.

3 Energy Strategy Approach

The energy supply solutions aim to match the energy profiles of the development ensuring effective use of technology and fuels. Applying these principles, Fairview is aiming to achieve the following objectives:

- Comply with the relevant regulatory requirements;
- Improve viability of the scheme by developing a technically robust and viable energy strategy;
- Improve feasibility, operation and management of the energy systems by selecting proven design methods and solutions.
- Apply building fabric energy efficiency first approach to comply with Part L1A 2013.

3.1 Energy and Carbon Assessment Methodology

Elmhurst Design SAP 2012 software, which uses the Standard Assessment Procedure (SAP) 2012 methodology to assess compliance with Part L1A, has been used to evaluate an initial CO_2 performance of representative residential dwellings. To assess the energy performance of the entire residential development, an energy and carbon assessment model has been produced.

The Elmhurst Design SAP 2012 software also calculates unregulated energy use (for appliances and cooking). These outputs have been used to report the unregulated emissions for the site.

Although the produced data by the Elmhurst Design SAP 2012 software provides estimates of possible energy and carbon performance of the residential development for assessment purposes, it is not intended to be used as a detailed design tool.

4 Baseline CO_2 Emissions

4.1 Residential Baseline

The regulated CO_2 emissions baseline is based on the Part L1A 2013 Target Emission Rate (TER) performance of representative dwellings. The baseline CO_2 performance has been determined by carrying out SAP 2012 modelling to establish the TERs of sample dwellings. The representative dwellings presented in Table 4.1 were used to carry out the SAP assessment.

Table 4.1 Representative sample dwellings

Plot Reference	Type	Location	Assumed no. of similar units
Plot 267	3B 5P	House, End terrace	13
Plot 270	2B 4P	House, End terrace	3
Plot 278	2B 4P	House, Mid terrace	3
Plot 163	1B 2P	Block C, Lower Ground Floor	2
Plot 165	1B 1P	Block C, Lower Ground Floor	1
Plot 180	2B 4P	Block C, Lower Ground Floor	2
Plot 41	2B 3P	Block A, Ground Floor	6
Plot 208	2B 4P	Block D, Ground Floor	12
Plot 141	2B 4P	Block C, Ground Floor	5
Plot 73	3B 5P	Block B, Ground Floor	2
Plot 167	1B 2P	Block C, Ground Floor	14
Plot 207	3B 5P	Block D, Ground Floor	6
Plot 96	1B 1P	Block B, Ground Floor	1
Plot 247	3B 5P	Block E, Mid Floor	12
Plot 43	2B 4P	Block A, Mid Floor	54
Plot 218	1B 2P	Block D, Mid Floor	42
Plot 244	2B 3P	Block E, Mid Floor	28

Plot Reference	Type	Location	Assumed no. of similar units
Plot 99	1B 1P	Block B, Mid Floor	4
Plot 186	3B 5P	Block C, Mid Floor	2
Plot 17	2B 4P	Block A, Top Floor	29
Plot 157	1B 2P	Block C, Top Floor	23
Plot 260	3B 5P	Block E, Top Floor	8
Plot 120	2B 3P	Block B, Top Floor	11
Plot 107	1B 1P	Block B, Top Floor	2
Total			**285**

The SAP assessment summary reports for the sample dwellings are provided in Appendix B. The TER results of the SAP assessments from the representative dwellings have been extrapolated using a weighted average method to predict the residential CO_2 emissions baseline.

Since SAP and therefore TERs do not include the energy use for appliances and cooking, the unregulated CO_2 emissions have been calculated separately. The regulated, unregulated and total baseline CO_2 emissions for the residential units are summarised in Table 4.2.

Table 4.2 Residential baseline CO_2 emissions

	CO_2 emissions (tonnes/year)		
	Regulated	**Unregulated**	**Total**
Residential Baseline	323.4	363.6	687.0

5 Energy Demand Reduction and Energy Supply

The key focus for the proposed energy strategy is to reduce the energy demands of the development as far as practically possible and viable by implementing various energy demand reduction measures. The aim is to achieve Part L 2013 Building Regulations compliance without contribution from low carbon or renewable energy sources.

The proposed design of the development follows sustainable design principals and standards, aiming to use natural resources efficiently and reduce energy consumption.

A range of measures to reduce CO_2 emissions and increase resilience to climate change are proposed including good building fabric standards as well as energy efficient Mechanical and Electrical (M&E) systems and lighting.

5.1 Passive Design

The form of development is very compact, where houses are typically attached to at least one other house (reducing heat loss) with all other residential units comprised of apartments arranged in 3 courtyard blocks and 2 small linear blocks. The energy demands of such compact forms will be inherently lower and therefore the proposed development is more efficient.

The development will incorporate passive solar design measures. The proposed windows will aim to maximise daylight and at the same time minimise solar gain. The glazing specification will be selected to provide a balance of solar control and access to passive solar gain.

Openable windows are proposed, albeit they will not be essential to provide a fresh air supply. Nonetheless, they will provide a further allowance to residents and occupiers to control their indoor environment. The openable windows can also be used for purge ventilation.

5.2 Building Fabric

In order to achieve the Part L 2013 TER and TFEE targets, good building fabric standards will be used.

The minimum building fabric requirements for Part L1A 2013 and the proposed specification for individual building elements of the development are presented in Table 5.1.

Table 5.1: Proposed fabric energy efficiency targets for individual building elements

Element	U-values (W/m^2K)		
	Part L1A 2013 minimum fabric requirements	**Proposed specification for flats**	**Proposed specification for Houses**
External walls	0.30	0.22	0.20
Roofs	0.20	0.16	0.11

Element	U-values (W/m²K)		
	Part L1A 2013 minimum fabric requirements	**Proposed specification for flats**	**Proposed specification for Houses**
Ground floors	0.25	0.20	0.20
Windows [1]	2.00	1.30	1.30
Airtightness	10 ($m^3/(hm^2)$ at 50 Pa)	4 ($m^3/(hm^2)$ at 50 Pa)	4 ($m^3/(hm^2)$ at 50 Pa)
Thermal Bridging	Default - 0.15	ACD	ACD
g-value [1]	0.67	0.50-0.55	0.60-0.65

[1] Glazing performance will be reviewed alongside acoustic performance as the design is developed. For the SAP modelling purposes, g-value of 0.50 was used for flats and g-value of 0.60 for houses.

Implementing these (or similar) building fabric standards will help to deliver substantial reductions in CO_2 emissions compared with the current building performance and meet the TFEE targets. The proposed specification should be viewed as guidance.

5.3 Infiltration and Ventilation

Air tightness standards will conform to and exceed Approved Document Part L requirements. An improved design air permeability rate together with the need to achieve the energy and CO_2 emission reduction targets will require provision of mechanical ventilation.

It is proposed to provide appropriate energy efficient mechanical ventilation systems such as continuous Mechanical Extract Ventilation (MEV) to meet the fresh air supply requirements.

It is recommended to select MEV with low Specific Fan Powers (SFP). This can be achieved by using systems with high efficiency fan motors and 45/90° radius bends and turning vanes in ductwork.

Additionally, all dwellings will have openable windows and therefore the ability to naturally ventilate should the occupant desire.

A more detailed ventilation strategy will be developed during detailed design with the aim to specify the most appropriate ventilation systems and achieve a pleasant indoor environment.

5.4 Cooling

It is not proposed to provide cooling to the residential dwellings.

5.5 Lighting

The proposed windows aim to maximise daylight and minimise the need for artificial lighting. The electricity consumption associated with lighting will be further reduced by the provision of 100% energy efficient lighting within the dwellings.

5.6 Energy Efficient Appliances

Unregulated energy demand and the associated CO_2 emissions can be reduced by providing energy efficient white goods. It is difficult to quantify savings but it is assumed that these measures can reduce the unregulated CO_2 emissions associated with the residential development by circa 6-10%. These savings have not been accounted for in this report.

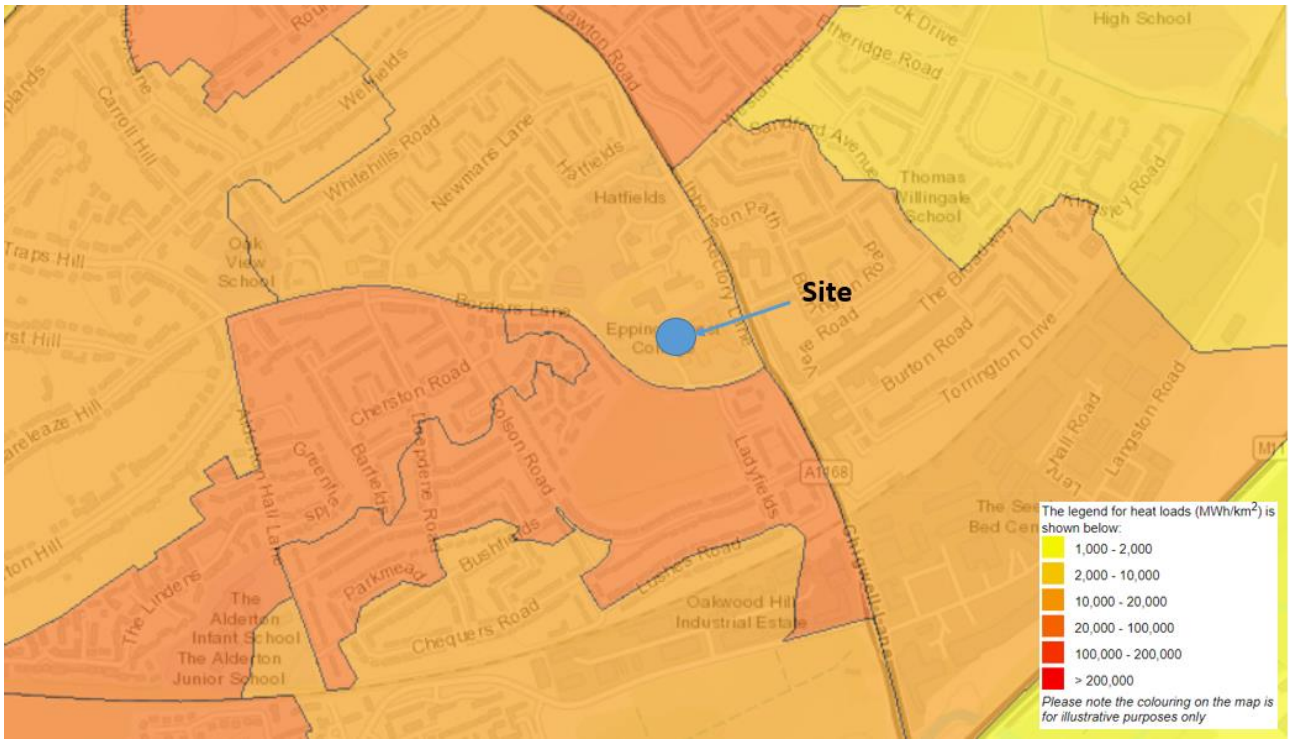
5.7 Energy Supply Options Assessment

5.7.1 Connection to Existing District Heating Networks

An investigation using google maps and other publically available sources was carried out to identify existing and planned district heating networks in the vicinity of the site. The site is largely surrounded by low rise residential buildings. The outcome of the investigation indicated that there are no existing or planned district heating networks around the site. According to the UK CHP Development Map the site is situated in an area of low heat load demand as indicated in Figure 5.1.

Given the lack of existing nearby district heating infrastructure to connect to at present and cost effective connection options in the near future, it is proposed to provide an on-site energy supply option.

Figure 5.1 Site location plan



5.7.2 On-Site Heat Supply

The provision of an on-site communal heating system for the development has been considered. The assessment showed that, due to the relatively low heat density of this residential development (and surrounding areas), it is not well suited for a communal heating system. A small communal heating system would unnecessarily complicate the design and significantly increase the capital and operating cost of the heating system. It would take-up valuable developable space, increase materials and water use, as well as

increase energy bills for the residents which goes against the target to reduce fuel poverty. For these reasons, provision of a communal heating system is considered to be impractical and will not be taken forward.

It is proposed to consider individual (per-dwelling) heat supply systems. The most practical and cost effective solution for the development is the provision of individual gas fired boilers. Individual boilers are characterised by high efficiency operation for a wide range of loads. The exhaust gases are smokeless, very low on NOx emissions and CO_2 emissions per kWh of heat generated. The exhaust gasses are inherently dispersed reducing the environmental impact on surrounding buildings.

Reliability and maintenance requirements are well understood by the Heating, Ventilation and Air Conditioning (HVAC) trade, ensuring low costs of operation and maintenance. Consumers are also more familiar with the concept of gas central heating than they are with other heating schemes. Gas boilers can efficiently and cost effectively supply heat and hot water to the residents. Combined with the proposed energy efficiency standards, individual gas boilers can help to significantly reduce heat costs. An indicative gas boiler specification assumed at this stage for energy and carbon modelling is provided in Table 5.2.

Table 5.2: Indicative boiler specification

Boiler Parameters	Proposed Boiler Specification for Flats	Proposed Boiler Specification for Houses
Boiler type	Valliant Combi EcoFIT Sustain	Valliant Combi EcoFIT Sustain
Fuel	Natural gas	Natural gas
Heating controls	Programmer, room thermostat and TRVs	Programmer, room thermostat and TRVs
Fuel burning Type	Modulation	Modulation
Flue Type	Room Sealed	Room Sealed
Controls	Boiler interlock	Boiler interlock
Load Compensation	Yes	Yes
Flue Gas Heat Recovery	No	Yes

5.8 Summary of CO_2 Savings after Energy Demand Reduction and Energy Efficient Supply

Based on the proposed energy efficiency measures, the Dwelling Emission Rate (DER) for each representative dwelling provides an indication of the anticipated regulated CO_2 emissions for the proposed dwellings. The SAP assessment summary reports for the dwellings have been provided in Appendix B.

The performance of the development with the proposed energy efficiency measures has been calculated by extrapolating the DER results of the sampled dwellings across the entire residential development.

The assessment shows that by implementing the energy efficient design, incorporating enhanced building fabric and using an efficient heating system, the regulated CO_2 emissions can be reduced by circa 2.6 tCO_2 per annum which equates to circa 1% reduction in CO_2 emissions over the baseline. In addition, the

preliminary assessment shows that the proposed passive design measures are sufficient to achieve compliance with the TFEE target.

The regulated, unregulated and total emissions after energy demand reduction are summarised in Table 5.3.

Table 5.3: Regulated and unregulated CO_2 emissions after energy demand reduction and energy efficient supply measures

	CO_2 emissions (tonnes/year)		
	Regulated	**Unregulated**	**Total**
Residential Baseline	323.4	363.6	687.0
After energy efficient design	320.8	363.6	654.4

6 Renewable Energy

The proposed energy strategy measures suggest that contribution from renewable energy technologies are not required for compliance with the regulatory requirements. Renewable energy technologies will be considered if the detailed design identifies a shortfall in CO_2 emissions required for compliance. Solar Photovoltaic panels are considered to be the most suitable if this shortfall occurs. All other renewable energy technology options are considered to be either less suitable or unsuitable for this development, refer to Appendix A.

7 Summary and Conclusions

The overarching objective of the proposed strategy is to use an energy efficient design to achieve compliance with the regulatory requirements. The energy strategy measures are summarised and presented in Table 7.1.

Table 7.1: The Energy Strategy

Energy Hierarchy	Energy Strategy Measures
Energy Demand Reduction and Energy Supply	**Passive Design** • Compact building from and layouts • Optimised design to enable controlled solar gain and improve direct and indirect natural lighting **Building Fabric** • Use of optimal building fabric standards • Design with low air permeability rates **Energy Efficiency** • Energy efficient lighting and appropriate controls • Energy efficient mechanical ventilation • High efficiency individual gas boilers

The summary of the overall reduction in residential CO_2 emissions is presented in Table 7.2.

Table 7.2: Summary of CO_2 regulated emissions

	CO_2 emissions (tonnes/year)		
	Regulated	**Unregulated**	**Total**
Residential Baseline	323.4	363.6	687.0
After energy efficient design	320.8	363.6	654.4

The assessment shows that the proposed energy efficiency design can achieve compliance with the regulatory requirements without contribution from low carbon or renewable energy sources.

The proposed energy strategy for the development:

- Complies with Part L 2013 (with 2016 amendments) Building Regulations and meets TFEE requirements

- Includes optimal building fabric standards, energy efficient design of building services and energy efficient appliances
- Includes high efficiency boilers designed to meet the hot water demand and supply space heating

Appendix A – Renewable Energy Review

Biomass Boilers

Biomass boilers use biomass as a fuel source, which is an alternative solid fuel to the conventional fossil fuels and has carbon emissions close to zero. Various types of biomass fuel are in use, the most common being wood chips and pellets.

Although pellets are more expensive than chips, they have greater energy content per unit of weight and require a lower storage volume. Pellet boilers also require less maintenance and produce considerably less ash residue.

There are some local/regional as well as national biomass suppliers who can supply biomass for the site. Biomass would need to be delivered to site in large trucks and the arrangements for supply and storage of the biomass fuel would need careful consideration. It would also require a suitable biomass storage space which, given the space constraints on this site, will not be possible to accommodate.

Although biomass systems can achieve high CO_2 reductions, in the context of this development, the following issues prevent the installation of biomass boilers:

- Potential negative effect on air quality;
- No space availability for fuel delivery and storage;
- Significantly higher capital costs in comparison with gas boiler system;
- Requirements of additional resources for management of the operation;
- The location of the development is not suitable for large-scale biomass fuel delivery; and,
- Security of biomass supply.

Biomass boilers are therefore considered unsuitable for this development.

Air Source Heat Pumps

Air Source Heat pumps (ASHP) can be used as both a source of heating and a source for cooling. ASHP employs the same principle of operation as GSHPs, however in this instance the air is used as the heat source. If designed and installed correctly, they can provide moderate CO_2 savings.

The downside is that the air temperature, and therefore efficiency of the heat pump, is reduced in cold weather when the heat is most needed. This means that one either needs to oversize ASHPs to take into account degradation in performance or, alternatively, provide an auxiliary electric heater. Provision of an auxiliary heater reduces capital cost but adds to running costs and reduces carbon savings.

Outdoor air systems are widely implemented in the form of split systems, with indoor and outdoor units linked by refrigerant pipes running through the wall. Packaged air systems where outdoor air is ducted to an indoor package are also available.

The outdoor units should be located outside of the dwellings (e.g. on the roofs) which will have significant negative aesthetic impact on the development. Installation of the ASHPs on the roofs would require higher installation costs associated with support and access to the plant and greater need to consider noise impacts.

In addition, these technologies are much more expensive to install and to run than the gas boiler systems. This will significantly increase the project costs and cost of heat to the residents.

Due to the aforementioned issues, this arrangement is not practical or cost effective and therefore it is not recommended for this development.

Ground Source Heat Pumps

The ground can be used as both a source of heating and a source for cooling. Ground source heating involves heat pumps, drawing heat from underground, whereas ground source cooling can either use heat pumps or make use of low temperature groundwater directly. Ground Source Heat Pumps (GSHP) are a relatively mature technology and utilise the energy in the ground through a refrigeration cycle. Where GSHP are used for both heating and cooling, depending on the season, this can be a very efficient solution. GSHP can be open loop or closed loop.

Closed loop GSHP system comprises a sealed system of buried pipes normally containing brine or water/antifreeze solution. The solution is circulated continuously around a closed system.

Open Loop GSHP system uses groundwater which is taken from an aquifer to supply heating or cooling. The water is then returned to the ground (sometimes via a borehole or sometimes via storm water drainage). Open loop systems require abstraction and discharge licences from the Environment Agency (EA).

There should be sufficient area within the development to accommodate a sufficient number of boreholes to meet the heating demand with a closed-loop system. However, the ground conditions are currently unknown and may not be suitable to use an open-loop system.

In a closed loop system there is a network of pipes containing a working fluid of water and glycol, which is pumped around the pipes, transferring heat from the low grade heat source to the working fluid. The heat pumps transfer the low grade heat to a higher temperature, and often to a second working fluid which is then pumped around the building.

The network of pipes can be located in the energy piles, trenches, lakes and rivers.

A GSHP system is often used in mixed use developments where there is an even energy split between commercial areas requiring cooling and residential areas requiring heating. Sites with substantial simultaneous heat and cooling demands provide the greatest energy and emission saving.

It may be possible to utilise ground source energy loops on a site of this size however, the cost of the loops alone are between £1,500 and £3,000 per kW. This excludes the costs of the heat pumps themselves.

Ground source heat pumps are not recommended for residential development because there is not a simultaneous heating and cooling requirement and therefore little advantage in using this expensive technology.

Because of the above issues, GSHPs are not practical or cost effective and therefore are not recommended for this development.

Solar Thermal systems

Solar water heating systems use the energy from the sun to heat water, most commonly for domestic hot water needs. Solar heating systems use a heat collector that is usually mounted on a roof in which a fluid is heated by the sun.

The use of solar thermal panels is not very feasible for the development as the heating and hot water will be provided by gas boilers. The system will produce relatively small CO_2 savings but will have significant negative visual impacts on the scheme as well as negative impact on the cost of the heating system and its practicability. Therefore, solar thermal systems are not recommended for this development.

Wind turbines

Effective energy generation through small scale roof mounted wind turbines is not feasible due to the following:

- Location of the development in a densely populated area;
- The average wind speed at the site is estimated to be circa 5.5 m/s at 25 m above ground which is based on NOABLE Wind Map (the wind speed was taken from the Rensmart Wind Map). The wind speed is marginal for effective operation of a wind turbine;
- Issues such as noise, telecoms interference and visual impact restrict installation of wind turbines;
- Negative visual impact.
- Likely planning issues.

Therefore, wind energy is not recommended for this development.

Photovoltaics (PV)

PV panels use solar radiation and convert it into usable electricity through the application of semiconductor technology. Solar panel outputs vary depending upon orientation, inclination, solar radiation levels, cloud cover and temperature.

PV systems should ideally face south with an incline of 30°, although orientations within 45° of south and other angles can still generate outputs if panels are not over shaded. Optimum design of the PV installation is required to ensure maximum electrical output per kWp installed.

The electricity generating potential of PV panels is not dependent on development demand but on suitable available roof space for installation.

The renewable energy assessment showed that PV systems could be provided to generate renewable power. This technology works well with all the other proposed technologies (e.g. gas boilers) and can supply additional CO_2 reductions for the development.

However, the proposed energy efficiency measures are capable of achieving the regulatory requirements without renewable energy; therefore use of PV technology is not required. It is proposed to install PV technology if the design indicates that the energy efficiency measures are not sufficient to comply with the regulatory requirements without PV.

Appendix B - SAP Summary Reports of Sampled Dwellings

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

Design SAP
elmhurst energy

Property Reference	Plot 99	**Issued on Date**	13/02/2020
Assessment Reference	001	**Prop Type Ref**	GF
Property	Epping College Site B, Plot 99		

SAP Rating	84 B	**DER**	15.50	**TER**	16.53
Environmental	91 B	**% DER<TER**	6.24		
CO_2 Emissions (t/year)	0.54	**DFEE**	22.38	**TFEE**	22.54
General Requirements Compliance	Pass	**% DFEE<TFEE**	0.72		

Assessor Details	Miss Georgia Dimitriou, Georgia Dimitriou, Tel: 07599467602, erieta.dimitriou@lowenergyconsultancy.co.uk	**Assessor ID**	P864-0001
Client			

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DWELLING AS DESIGNED

Mid-floor flat, total floor area 39 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) 16.53 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 15.50 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)22.5 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)22.4 kWh/m²/yrOK

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2 Fabric U-values

Element	Average	Highest	
External wall	0.22 (max. 0.30)	0.22 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	(no floor)		
Roof	(no roof)		
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

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

---

3 Air permeability
Air permeability at 50 pascals: 4.00 (design value)
Maximum 10.0 OK

---

4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Vaillant ecoFIT sustain 835 VUW 356/6-3 (H-GB)
Combi boiler
Efficiency: 89.3% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

---

5 Cylinder insulation
Hot water storage No cylinder

---

6 Controls
Space heating controls: Programmer, room thermostat and TRVs OK

Hot water controls: No cylinder

Boiler interlock Yes OK

---

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

---

8 Mechanical ventilation
Continuous extract system
Specific fan power: 0.17
Maximum 0.7 OK

---

9 Summertime temperature
Overheating risk (Thames Valley): Medium OK
Based on:
Overshading: Average
Windows facing South East: 7.90 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

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	39.2800 (1b)	x	2.5000 (2b)	=	98.2000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	39.2800					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	98.2000	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							0 * 10 =		0.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Measured/design AP50		4.0000	
Infiltration rate		0.2000	(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) =	0.1550	(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	0.1976	0.1938	0.1899	0.1705	0.1666	0.1473	0.1473	0.1434	0.1550	0.1666	0.1744	0.1821	(22b)

Mechanical extract ventilation - centralised

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	
Opening Type 2 (Uw = 1.30)			7.9000	1.2357	9.7624			(27)
External Wall 1	14.9300	7.9000	7.0300	0.2200	1.5466			(29a)
Total net area of external elements Aum(A, m2)			14.9300					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	11.3090			(33)
Party Wall 1			47.8300	0.0000	0.0000			(32)
Party Floor 1			39.2800					(32d)
Party Ceilings 1			39.2800					(32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	2.7412	(36)
Total fabric heat loss (33) + (36) =	14.0502	(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	16.2030	16.2030	16.2030	16.2030	16.2030	16.2030	16.2030	16.2030	16.2030	16.2030	16.2030	16.2030	(38)
Heat transfer coeff	30.2532	30.2532	30.2532	30.2532	30.2532	30.2532	30.2532	30.2532	30.2532	30.2532	30.2532	30.2532	(39)
Average = Sum(39)m / 12 =												30.2532	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.7702	0.7702	0.7702	0.7702	0.7702	0.7702	0.7702	0.7702	0.7702	0.7702	0.7702	0.7702	(40)
HLP (average)												0.7702	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.3873	(42)
Average daily hot water use (litres/day)	67.1492	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	73.8641	71.1781	68.4922	65.8062	63.1202	60.4343	60.4343	63.1202	65.8062	68.4922	71.1781	73.8641	(44)
Energy conte	109.5383	95.8029	98.8600	86.1886	82.7000	71.3638	66.1290	75.8840	76.7903	89.4917	97.6872	106.0820	(45)
Energy content (annual)										Total = Sum(45)m =		1056.5179	(45)
Distribution loss (46)m = 0.15 x (45)m	16.4307	14.3704	14.8290	12.9283	12.4050	10.7046	9.9194	11.3826	11.5185	13.4238	14.6531	15.9123	(46)
Water storage loss:													
Total storage loss													

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	26.1263	23.5760	26.0669	25.1864	25.9971	25.1253	25.9421	25.9778	25.1586	26.0381	25.2441	26.1148	(61)
Total heat required for water heating calculated for each month													
	135.6646	119.3789	124.9270	111.3750	108.6971	96.4891	92.0711	101.8618	101.9489	115.5298	122.9313	132.1968	(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													
	135.6646	119.3789	124.9270	111.3750	108.6971	96.4891	92.0711	101.8618	101.9489	115.5298	122.9313	132.1968	(64)
								Total per year (kWh/year) = Sum(64)m =				1363.0714	(64)
Heat gains from water heating, kWh/month													
	42.9531	37.7485	39.3877	34.9543	33.9970	30.0098	28.4734	31.7259	31.8224	36.2655	38.7920	41.8010	(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	69.3667	69.3667	69.3667	69.3667	69.3667	69.3667	69.3667	69.3667	69.3667	69.3667	69.3667	69.3667	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	10.7428	9.5416	7.7598	5.8747	4.3914	3.7074	4.0060	5.2071	6.9890	8.8741	10.3574	11.0414	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	119.7270	120.9693	117.8386	111.1735	102.7600	94.8526	89.5699	88.3275	91.4583	98.1234	106.5368	114.4443	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	29.9367	29.9367	29.9367	29.9367	29.9367	29.9367	29.9367	29.9367	29.9367	29.9367	29.9367	29.9367	(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)													
	-55.4933	-55.4933	-55.4933	-55.4933	-55.4933	-55.4933	-55.4933	-55.4933	-55.4933	-55.4933	-55.4933	-55.4933	(71)
Water heating gains (Table 5)													
	57.7326	56.1733	52.9404	48.5476	45.6949	41.6802	38.2707	42.6423	44.1978	48.7440	53.8778	56.1841	(72)
Total internal gains													
	235.0124	233.4943	225.3488	212.4058	199.6563	187.0502	178.6566	182.9869	189.4551	202.5514	217.5820	228.4797	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	7.9000	36.7938	0.5000	0.7000	0.7700	70.5023	(77)

Solar gains	70.5023	120.0915	164.3145	203.5936	228.0418	226.3927	218.2667	200.0273	177.9178	132.7267	84.4455	60.3353	(83)
Total gains	305.5147	353.5858	389.6633	415.9994	427.6981	413.4429	396.9233	383.0142	367.3729	335.2781	302.0275	288.8150	(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	90.1651	90.1651	90.1651	90.1651	90.1651	90.1651	90.1651	90.1651	90.1651	90.1651	90.1651	90.1651	
alpha	7.0110	7.0110	7.0110	7.0110	7.0110	7.0110	7.0110	7.0110	7.0110	7.0110	7.0110	7.0110	
util living area													
	0.9882	0.9686	0.9206	0.8127	0.6455	0.4671	0.3353	0.3631	0.5635	0.8457	0.9702	0.9917	(86)
MIT	20.4777	20.6286	20.7946	20.9282	20.9864	20.9987	20.9999	20.9998	20.9956	20.9201	20.6725	20.4302	(87)
Th 2	20.2792	20.2792	20.2792	20.2792	20.2792	20.2792	20.2792	20.2792	20.2792	20.2792	20.2792	20.2792	(88)
util rest of house													
	0.9849	0.9606	0.9026	0.7790	0.5995	0.4151	0.2804	0.3064	0.5067	0.8087	0.9612	0.9893	(89)
MIT 2	19.8104	19.9566	20.1119	20.2274	20.2712	20.2787	20.2792	20.2792	20.2772	20.2236	20.0008	19.7637	(90)
Living area fraction									fLA = Living area / (4) =			0.4908	(91)
MIT	20.1379	20.2864	20.4470	20.5714	20.6222	20.6321	20.6329	20.6329	20.6298	20.5654	20.3305	20.0908	(92)
Temperature adjustment												0.0000	
adjusted MIT	20.1379	20.2864	20.4470	20.5714	20.6222	20.6321	20.6329	20.6329	20.6298	20.5654	20.3305	20.0908	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9841	0.9607	0.9071	0.7932	0.6216	0.4406	0.3073	0.3342	0.5345	0.8241	0.9619	0.9886	(94)
Useful gains	300.6623	339.6840	353.4699	329.9579	265.8737	182.1598	121.9878	128.0191	196.3590	276.3083	290.5304	285.5210	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	479.1477	465.4876	421.9410	353.0957	269.9260	182.4900	122.0094	128.0585	197.5463	301.4863	400.2647	480.7476	(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													
	132.7932	84.5400	50.9425	16.6592	3.0149	0.0000	0.0000	0.0000	0.0000	18.7324	79.0087	145.2486	(98)
Space heating												530.9395	(98)
Space heating per m2											(98) / (4) =	13.5168	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	93.2000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	569.6776	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	132.7932	84.5400	50.9425	16.6592	3.0149	0.0000	0.0000	0.0000	0.0000	18.7324	79.0087	145.2486	(98)
Space heating efficiency (main heating system 1)	93.2000	93.2000	93.2000	93.2000	93.2000	0.0000	0.0000	0.0000	0.0000	93.2000	93.2000	93.2000	(210)
Space heating fuel (main heating system)	142.4819	90.7082	54.6593	17.8747	3.2349	0.0000	0.0000	0.0000	0.0000	20.0992	84.7733	155.8461	(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	135.6646	119.3789	124.9270	111.3750	108.6971	96.4891	92.0711	101.8618	101.9489	115.5298	122.9313	132.1968	(64)
Efficiency of water heater												87.3000	(216)
(217)m	88.7108	88.4793	88.1207	87.6667	87.3758	87.3000	87.3000	87.3000	87.3000	87.6934	88.4121	88.7946	(217)
Fuel for water heating, kWh/month	152.9291	134.9229	141.7681	127.0436	124.4018	110.5258	105.4652	116.6802	116.7800	131.7429	139.0435	148.8794	(219)
Water heating fuel used												1550.1826	(219)

Annual totals kWh/year		
Space heating fuel - main system	569.6776	(211)
Space heating fuel - secondary	0.0000	(215)
Electricity for pumps and fans:		
(MEVCentralised, Database: in-use factor = 1.3000, SFP = 0.2210)		
mechanical ventilation fans (SFP = 0.2210)	26.4767	(230a)
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	101.4767	(231)
Electricity for lighting (calculated in Appendix L)	189.7208	(232)
Total delivered energy for all uses	2411.0577	(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	569.6776	0.2160	123.0504	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1550.1826	0.2160	334.8394	(264)
Space and water heating			457.8898	(265)
Pumps and fans	101.4767	0.5190	52.6664	(267)
Energy for lighting	189.7208	0.5190	98.4651	(268)
Total CO2, kg/year			609.0213	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			15.5000	(273)

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

DER		15.5000	ZC1
Total Floor Area	TFA	39.2800	
Assumed number of occupants	N	1.3873	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		18.0620	ZC2
CO2 emissions from cooking, equation (L16)		3.8772	ZC3
Total CO2 emissions		37.4392	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		37.4392	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	39.2800 (1b)	x	2.5000 (2b)	=	98.2000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	39.2800					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	98.2000	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							2 * 10 =		20.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.2037	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4537	(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) =	0.3516	(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	0.4483	0.4395	0.4307	0.3868	0.3780	0.3340	0.3340	0.3252	0.3516	0.3780	0.3955	0.4131	(22b)
Effective ac	0.6005	0.5966	0.5928	0.5748	0.5714	0.5558	0.5558	0.5529	0.5618	0.5714	0.5782	0.5853	(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 Opening Type (Uw = 1.40)			7.9000	1.3258	10.4735			(27)
External Wall 1	14.9300	7.9000	7.0300	0.1800	1.2654			(29a)
Total net area of external elements Aum(A, m2)			14.9300					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	11.7389			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							1.8893	(36)
Total fabric heat loss						(33) + (36) =	13.6282	(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	19.4591	19.3326	19.2087	18.6266	18.5177	18.0107	18.0107	17.9168	18.2060	18.5177	18.7380	18.9683	(38)
Heat transfer coeff	33.0872	32.9608	32.8369	32.2548	32.1459	31.6389	31.6389	31.5450	31.8341	32.1459	32.3662	32.5965	(39)
Average = Sum(39)m / 12 =												32.2542	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.8423	0.8391	0.8360	0.8211	0.8184	0.8055	0.8055	0.8031	0.8104	0.8184	0.8240	0.8299	(40)
HLP (average)												0.8211	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.3873	(42)
Average daily hot water use (litres/day)	67.1492	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	73.8641	71.1781	68.4922	65.8062	63.1202	60.4343	60.4343	63.1202	65.8062	68.4922	71.1781	73.8641	(44)
Energy conte	109.5383	95.8029	98.8600	86.1886	82.7000	71.3638	66.1290	75.8840	76.7903	89.4917	97.6872	106.0820	(45)
Energy content (annual)										Total = Sum(45)m =		1056.5179	(45)
Distribution loss (46)m = 0.15 x (45)m	16.4307	14.3704	14.8290	12.9283	12.4050	10.7046	9.9194	11.3826	11.5185	13.4238	14.6531	15.9123	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	37.6403	32.7614	34.9028	32.4524	32.1654	29.8032	30.7966	32.1654	32.4524	34.9028	35.1015	37.6403	(61)
Total heat required for water heating calculated for each month	147.1786	128.5643	133.7629	118.6409	114.8653	101.1670	96.9257	108.0494	109.2427	124.3946	132.7888	143.7223	(62)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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													
	147.1786	128.5643	133.7629	118.6409	114.8653	101.1670	96.9257	108.0494	109.2427	124.3946	132.7888	143.7223	(64)
									Total per year (kWh/year) = Sum(64)m =			1459.3025	(64)
Heat gains from water heating, kWh/month													
	45.8316	40.0448	41.5967	36.7708	35.5391	31.1793	29.6871	33.2728	33.6459	38.4817	41.2564	44.6823	(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	69.3667	69.3667	69.3667	69.3667	69.3667	69.3667	69.3667	69.3667	69.3667	69.3667	69.3667	69.3667	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	10.7428	9.5416	7.7598	5.8747	4.3914	3.7074	4.0060	5.2071	6.9890	8.8741	10.3574	11.0414	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	119.7270	120.9693	117.8386	111.1735	102.7600	94.8526	89.5699	88.3275	91.4583	98.1234	106.5368	114.4443	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	29.9367	29.9367	29.9367	29.9367	29.9367	29.9367	29.9367	29.9367	29.9367	29.9367	29.9367	29.9367	(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)													
	-55.4933	-55.4933	-55.4933	-55.4933	-55.4933	-55.4933	-55.4933	-55.4933	-55.4933	-55.4933	-55.4933	-55.4933	(71)
Water heating gains (Table 5)													
	61.6016	59.5905	55.9095	51.0705	47.7676	43.3045	39.9020	44.7215	46.7304	51.7227	57.3005	60.0569	(72)
Total internal gains													
	238.8813	236.9115	228.3178	214.9287	201.7290	188.6745	180.2878	185.0661	191.9876	205.5302	221.0047	232.3526	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	7.9000	36.7938	0.6300	0.7000	0.7700	88.8329	(77)

Solar gains	88.8329	151.3153	207.0362	256.5279	287.3327	285.2548	275.0161	252.0344	224.1765	167.2357	106.4014	76.0225	(83)
Total gains	327.7142	388.2268	435.3541	471.4566	489.0617	473.9293	455.3039	437.1005	416.1641	372.7659	327.4061	308.3750	(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	82.4420	82.7582	83.0706	84.5698	84.8563	86.2161	86.2161	86.4727	85.6872	84.8563	84.2787	83.6831	
alpha	6.4961	6.5172	6.5380	6.6380	6.6571	6.7477	6.7477	6.7648	6.7125	6.6571	6.6186	6.5789	
util living area													
	0.9861	0.9613	0.9028	0.7746	0.6021	0.4265	0.3057	0.3318	0.5244	0.8176	0.9635	0.9899	(86)
MIT	20.4189	20.6009	20.7893	20.9362	20.9886	20.9990	20.9999	20.9999	20.9963	20.9248	20.6583	20.3846	(87)
Th 2	20.2168	20.2196	20.2223	20.2350	20.2374	20.2486	20.2486	20.2507	20.2443	20.2374	20.2326	20.2275	(88)
util rest of house													
	0.9822	0.9516	0.8818	0.7379	0.5558	0.3768	0.2535	0.2779	0.4684	0.7770	0.9527	0.9870	(89)
MIT 2	19.4571	19.7166	19.9745	20.1690	20.2277	20.2480	20.2486	20.2506	20.2419	20.1623	19.8114	19.4166	(90)
Living area fraction									fLA = Living area / (4) =			0.4908	(91)
MIT	19.9292	20.1506	20.3744	20.5456	20.6012	20.6166	20.6174	20.6184	20.6122	20.5366	20.2271	19.8917	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.9292	20.1506	20.3744	20.5456	20.6012	20.6166	20.6174	20.6184	20.6122	20.5366	20.2271	19.8917	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9804	0.9506	0.8862	0.7532	0.5781	0.4012	0.2791	0.3044	0.4958	0.7936	0.9526	0.9855	(94)
Useful gains	321.3041	369.0669	385.8102	355.1152	282.7313	190.1178	127.0878	133.0385	206.3377	295.8447	311.8894	303.8908	(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													
	517.1274	502.6730	455.5926	375.6251	286.1359	190.3599	127.1045	133.0682	207.3098	319.4197	424.8739	511.4955	(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													
	145.6925	89.7833	51.9181	14.7671	2.5330	0.0000	0.0000	0.0000	0.0000	17.5398	81.3489	154.4579	(98)
Space heating												558.0405	(98)
Space heating per m2											(98) / (4) =	14.2067	(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 %)	93.4000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Space heating requirement												597.4738	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	145.6925	89.7833	51.9181	14.7671	2.5330	0.0000	0.0000	0.0000	0.0000	17.5398	81.3489	154.4579	(98)
Space heating efficiency (main heating system 1)	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000		(210)
Space heating fuel (main heating system)	155.9877	96.1277	55.5868	15.8106	2.7120	0.0000	0.0000	0.0000	0.0000	18.7792	87.0973	165.3725	(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	147.1786	128.5643	133.7629	118.6409	114.8653	101.1670	96.9257	108.0494	109.2427	124.3946	132.7888	143.7223	(64)
Efficiency of water heater												80.3000	(216)
(217)m	85.0257	84.1667	82.8894	81.3055	80.4940	80.3000	80.3000	80.3000	80.3000	81.4242	83.8593	85.2328	(217)
Fuel for water heating, kWh/month	173.0990	152.7496	161.3751	145.9199	142.7004	125.9863	120.7044	134.5572	136.0432	152.7735	158.3471	168.6233	(219)
Water heating fuel used												1772.8791	(219)
Annual totals kWh/year													
Space heating fuel - main system												597.4738	(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)												189.7208	(232)
Total delivered energy for all uses												2635.0737	(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	597.4738	0.2160	129.0543	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1772.8791	0.2160	382.9419	(264)
Space and water heating			511.9962	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	189.7208	0.5190	98.4651	(268)
Total CO2, kg/m2/year			649.3863	(272)
Emissions per m2 for space and water heating			13.0345	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.5067	(272b)
Emissions per m2 for pumps and fans			0.9910	(272c)
Target Carbon Dioxide Emission Rate (TER) = (13.0345 * 1.00) + 2.5067 + 0.9910, rounded to 2 d.p.			16.5300	(273)

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

Design SAP
elmhurst energy

Property Reference	Plot 107	**Issued on Date**	13/02/2020
Assessment Reference	001	**Prop Type Ref**	TF
Property	Epping College Site B, Plot 107		

SAP Rating	83 B	**DER**	19.60	**TER**	19.39
Environmental	89 B	**% DER<TER**	-1.10		
CO_2 Emissions (t/year)	0.66	**DFEE**	39.79	**TFEE**	38.97
General Requirements Compliance	Fail	**% DFEE<TFEE**	-2.12		

Assessor Details	Miss Georgia Dimitriou, Georgia Dimitriou, Tel: 07599467602, erieta.dimitriou@lowenergyconsultancy.co.uk	**Assessor ID**	P864-0001
Client			

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

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

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DWELLING AS DESIGNED

Top-floor flat, total floor area 39 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) 19.39 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 19.60 kgCO□/m²Fail
Excess emissions =0.21 kgCO□/m² (1.1%)

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)39.0 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)39.8 kWh/m²/yrFail
Excess energy =0.8 kWh/m²/yr (2.1%)

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2 Fabric U-values

Element	Average	Highest	
External wall	0.22 (max. 0.30)	0.22 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	(no floor)		
Roof	0.16 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

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

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3 Air permeability
Air permeability at 50 pascals: 4.00 (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 database
Vaillant ecoFIT sustain 835 VUW 356/6-3 (H-GB)
Combi boiler
Efficiency: 89.3% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

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5 Cylinder insulation
Hot water storage No cylinder

---

6 Controls
Space heating controls: Programmer, room thermostat and TRVs OK

Hot water controls: No cylinder

Boiler interlock Yes OK

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

---

8 Mechanical ventilation
Continuous extract system
Specific fan power: 0.17
Maximum 0.7 OK

---

9 Summertime temperature
Overheating risk (Thames Valley): Medium OK
Based on:
Overshading: Average
Windows facing South East: 7.90 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

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	39.2800 (1b)	x	2.5000 (2b)	=	98.2000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	39.2800					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	98.2000	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							0 * 10 =		0.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Measured/design AP50		4.0000	
Infiltration rate		0.2000	(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) =	0.1550	(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	0.1976	0.1938	0.1899	0.1705	0.1666	0.1473	0.1473	0.1434	0.1550	0.1666	0.1744	0.1821	(22b)

Mechanical extract ventilation - centralised

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	
Opening Type 2 (Uw = 1.30)			7.9000	1.2357	9.7624			(27)
External Wall 1	14.9300	7.9000	7.0300	0.2200	1.5466			(29a)
External Roof 1	39.2800		39.2800	0.1600	6.2848			(30)
Total net area of external elements Aum(A, m2)			54.2100					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		17.5938			(33)
Party Wall 1			47.8300	0.0000	0.0000			(32)
Party Floor 1			39.2800					(32d)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	8.7273	(36)
Total fabric heat loss (33) + (36) =	26.3211	(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	16.2030	16.2030	16.2030	16.2030	16.2030	16.2030	16.2030	16.2030	16.2030	16.2030	16.2030	16.2030	(38)
Heat transfer coeff	42.5241	42.5241	42.5241	42.5241	42.5241	42.5241	42.5241	42.5241	42.5241	42.5241	42.5241	42.5241	(39)
Average = Sum(39)m / 12 =												42.5241	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0826	1.0826	1.0826	1.0826	1.0826	1.0826	1.0826	1.0826	1.0826	1.0826	1.0826	1.0826	(40)
HLP (average)												1.0826	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.3873	(42)
Average daily hot water use (litres/day)	67.1492	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	73.8641	71.1781	68.4922	65.8062	63.1202	60.4343	60.4343	63.1202	65.8062	68.4922	71.1781	73.8641	(44)
Energy conte	109.5383	95.8029	98.8600	86.1886	82.7000	71.3638	66.1290	75.8840	76.7903	89.4917	97.6872	106.0820	(45)
Energy content (annual)										Total = Sum(45)m =		1056.5179	(45)
Distribution loss (46)m = 0.15 x (45)m	16.4307	14.3704	14.8290	12.9283	12.4050	10.7046	9.9194	11.3826	11.5185	13.4238	14.6531	15.9123	(46)
Water storage loss:													
Total storage loss													

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	26.1263	23.5760	26.0669	25.1864	25.9971	25.1253	25.9421	25.9778	25.1586	26.0381	25.2441	26.1148	(61)
Total heat required for water heating calculated for each month													
	135.6646	119.3789	124.9270	111.3750	108.6971	96.4891	92.0711	101.8618	101.9489	115.5298	122.9313	132.1968	(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													
	135.6646	119.3789	124.9270	111.3750	108.6971	96.4891	92.0711	101.8618	101.9489	115.5298	122.9313	132.1968	(64)
								Total per year (kWh/year) = Sum(64)m =				1363.0714	(64)
Heat gains from water heating, kWh/month													
	42.9531	37.7485	39.3877	34.9543	33.9970	30.0098	28.4734	31.7259	31.8224	36.2655	38.7920	41.8010	(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	69.3667	69.3667	69.3667	69.3667	69.3667	69.3667	69.3667	69.3667	69.3667	69.3667	69.3667	69.3667	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	10.7428	9.5416	7.7598	5.8747	4.3914	3.7074	4.0060	5.2071	6.9890	8.8741	10.3574	11.0414	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	119.7270	120.9693	117.8386	111.1735	102.7600	94.8526	89.5699	88.3275	91.4583	98.1234	106.5368	114.4443	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	29.9367	29.9367	29.9367	29.9367	29.9367	29.9367	29.9367	29.9367	29.9367	29.9367	29.9367	29.9367	(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)													
	-55.4933	-55.4933	-55.4933	-55.4933	-55.4933	-55.4933	-55.4933	-55.4933	-55.4933	-55.4933	-55.4933	-55.4933	(71)
Water heating gains (Table 5)													
	57.7326	56.1733	52.9404	48.5476	45.6949	41.6802	38.2707	42.6423	44.1978	48.7440	53.8778	56.1841	(72)
Total internal gains													
	235.0124	233.4943	225.3488	212.4058	199.6563	187.0502	178.6566	182.9869	189.4551	202.5514	217.5820	228.4797	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	7.9000	36.7938	0.5000	0.7000	0.7700	70.5023	(77)

Solar gains	70.5023	120.0915	164.3145	203.5936	228.0418	226.3927	218.2667	200.0273	177.9178	132.7267	84.4455	60.3353	(83)
Total gains	305.5147	353.5858	389.6633	415.9994	427.6981	413.4429	396.9233	383.0142	367.3729	335.2781	302.0275	288.8150	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	64.1467	64.1467	64.1467	64.1467	64.1467	64.1467	64.1467	64.1467	64.1467	64.1467	64.1467	64.1467	
alpha	5.2764	5.2764	5.2764	5.2764	5.2764	5.2764	5.2764	5.2764	5.2764	5.2764	5.2764	5.2764	
util living area													
	0.9933	0.9850	0.9654	0.9153	0.8060	0.6316	0.4666	0.5034	0.7337	0.9319	0.9856	0.9950	(86)
MIT	20.0156	20.1858	20.4180	20.6762	20.8772	20.9733	20.9954	20.9932	20.9422	20.6858	20.2898	19.9663	(87)
Th 2	20.0151	20.0151	20.0151	20.0151	20.0151	20.0151	20.0151	20.0151	20.0151	20.0151	20.0151	20.0151	(88)
util rest of house													
	0.9912	0.9803	0.9546	0.8892	0.7514	0.5454	0.3647	0.3994	0.6524	0.9051	0.9804	0.9934	(89)
MIT 2	19.1305	19.2983	19.5243	19.7663	19.9371	20.0035	20.0140	20.0133	19.9864	19.7805	19.4024	19.0816	(90)
Living area fraction									fLA = Living area / (4) =			0.4908	(91)
MIT	19.5649	19.7339	19.9630	20.2129	20.3985	20.4795	20.4957	20.4943	20.4556	20.2248	19.8380	19.5158	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.5649	19.7339	19.9630	20.2129	20.3985	20.4795	20.4957	20.4943	20.4556	20.2248	19.8380	19.5158	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9900	0.9787	0.9539	0.8950	0.7740	0.5872	0.4149	0.4507	0.6906	0.9116	0.9792	0.9923	(94)
Useful gains	302.4551	346.0596	371.7149	372.3184	331.0401	242.7568	164.6972	172.6119	253.7125	305.6379	295.7389	286.6001	(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													
	649.1258	630.7967	572.5001	481.0709	369.8966	250.0208	165.6612	174.1046	270.2642	409.2874	541.6696	651.2918	(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													
	257.9230	191.3434	149.3842	78.3018	28.9093	0.0000	0.0000	0.0000	0.0000	77.1153	177.0701	271.3306	(98)
Space heating												1231.3776	(98)
Space heating per m2											(98) / (4) =	31.3487	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	93.2000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	1321.2206	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	257.9230	191.3434	149.3842	78.3018	28.9093	0.0000	0.0000	0.0000	0.0000	77.1153	177.0701	271.3306	(98)
Space heating efficiency (main heating system 1)	93.2000	93.2000	93.2000	93.2000	93.2000	0.0000	0.0000	0.0000	0.0000	93.2000	93.2000	93.2000	(210)
Space heating fuel (main heating system)	276.7414	205.3040	160.2835	84.0148	31.0185	0.0000	0.0000	0.0000	0.0000	82.7417	189.9894	291.1273	(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	135.6646	119.3789	124.9270	111.3750	108.6971	96.4891	92.0711	101.8618	101.9489	115.5298	122.9313	132.1968	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.1789	89.0633	88.8557	88.4743	87.8937	87.3000	87.3000	87.3000	87.3000	88.4382	88.9887	89.2290	(217)
Fuel for water heating, kWh/month	152.1264	134.0382	140.5952	125.8840	123.6689	110.5258	105.4652	116.6802	116.7800	130.6334	138.1426	148.1546	(219)
Water heating fuel used												1542.6946	(219)

Annual totals kWh/year

Space heating fuel - main system	1321.2206	(211)
Space heating fuel - secondary	0.0000	(215)

Electricity for pumps and fans:
(MEVCentralised, Database: in-use factor = 1.3000, SFP = 0.2210)

mechanical ventilation fans (SFP = 0.2210)	26.4767	(230a)
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	101.4767	(231)
Electricity for lighting (calculated in Appendix L)	189.7208	(232)
Total delivered energy for all uses	3155.1127	(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	1321.2206	0.2160	285.3836	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1542.6946	0.2160	333.2220	(264)
Space and water heating			618.6057	(265)
Pumps and fans	101.4767	0.5190	52.6664	(267)
Energy for lighting	189.7208	0.5190	98.4651	(268)
Total CO2, kg/year			769.7372	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			19.6000	(273)

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

DER		19.6000	ZC1
Total Floor Area	TFA	39.2800	
Assumed number of occupants	N	1.3873	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		18.0620	ZC2
CO2 emissions from cooking, equation (L16)		3.8772	ZC3
Total CO2 emissions		41.5392	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		41.5392	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	39.2800 (1b)	x	2.5000 (2b)	=	98.2000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	39.2800					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	98.2000	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							2 * 10 =		20.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.2037	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4537	(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) =	0.3516	(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	0.4483	0.4395	0.4307	0.3868	0.3780	0.3340	0.3340	0.3252	0.3516	0.3780	0.3955	0.4131	(22b)
Effective ac	0.6005	0.5966	0.5928	0.5748	0.5714	0.5558	0.5558	0.5529	0.5618	0.5714	0.5782	0.5853	(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 Opening Type (Uw = 1.40)			7.9000	1.3258	10.4735			(27)
External Wall 1	14.9300	7.9000	7.0300	0.1800	1.2654			(29a)
External Roof 1	39.2800		39.2800	0.1300	5.1064			(30)
Total net area of external elements Aum(A, m2)			54.2100					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	16.8453			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							6.3450	(36)
Total fabric heat loss						(33) + (36) =	23.1903	(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	19.4591	19.3326	19.2087	18.6266	18.5177	18.0107	18.0107	17.9168	18.2060	18.5177	18.7380	18.9683	(38)
Heat transfer coeff	42.6493	42.5229	42.3990	41.8169	41.7080	41.2010	41.2010	41.1071	41.3962	41.7080	41.9283	42.1586	(39)
Average = Sum(39)m / 12 =												41.8163	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0858	1.0826	1.0794	1.0646	1.0618	1.0489	1.0489	1.0465	1.0539	1.0618	1.0674	1.0733	(40)
HLP (average)												1.0646	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.3873	(42)
Average daily hot water use (litres/day)	67.1492	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	73.8641	71.1781	68.4922	65.8062	63.1202	60.4343	60.4343	63.1202	65.8062	68.4922	71.1781	73.8641	(44)
Energy conte	109.5383	95.8029	98.8600	86.1886	82.7000	71.3638	66.1290	75.8840	76.7903	89.4917	97.6872	106.0820	(45)
Energy content (annual)										Total = Sum(45)m =		1056.5179	(45)
Distribution loss (46)m = 0.15 x (45)m	16.4307	14.3704	14.8290	12.9283	12.4050	10.7046	9.9194	11.3826	11.5185	13.4238	14.6531	15.9123	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	37.6403	32.7614	34.9028	32.4524	32.1654	29.8032	30.7966	32.1654	32.4524	34.9028	35.1015	37.6403	(61)
Total heat required for water heating calculated for each month													

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	147.1786	128.5643	133.7629	118.6409	114.8653	101.1670	96.9257	108.0494	109.2427	124.3946	132.7888	143.7223	(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													
	147.1786	128.5643	133.7629	118.6409	114.8653	101.1670	96.9257	108.0494	109.2427	124.3946	132.7888	143.7223	(64)
								Total per year (kWh/year) = Sum(64)m =				1459.3025	(64)
Heat gains from water heating, kWh/month													
	45.8316	40.0448	41.5967	36.7708	35.5391	31.1793	29.6871	33.2728	33.6459	38.4817	41.2564	44.6823	(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	69.3667	69.3667	69.3667	69.3667	69.3667	69.3667	69.3667	69.3667	69.3667	69.3667	69.3667	69.3667	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	10.7428	9.5416	7.7598	5.8747	4.3914	3.7074	4.0060	5.2071	6.9890	8.8741	10.3574	11.0414	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	119.7270	120.9693	117.8386	111.1735	102.7600	94.8526	89.5699	88.3275	91.4583	98.1234	106.5368	114.4443	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	29.9367	29.9367	29.9367	29.9367	29.9367	29.9367	29.9367	29.9367	29.9367	29.9367	29.9367	29.9367	(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)													
	-55.4933	-55.4933	-55.4933	-55.4933	-55.4933	-55.4933	-55.4933	-55.4933	-55.4933	-55.4933	-55.4933	-55.4933	(71)
Water heating gains (Table 5)													
	61.6016	59.5905	55.9095	51.0705	47.7676	43.3045	39.9020	44.7215	46.7304	51.7227	57.3005	60.0569	(72)
Total internal gains													
	238.8813	236.9115	228.3178	214.9287	201.7290	188.6745	180.2878	185.0661	191.9876	205.5302	221.0047	232.3526	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	7.9000	36.7938	0.6300	0.7000	0.7700	88.8329	(77)

Solar gains	88.8329	151.3153	207.0362	256.5279	287.3327	285.2548	275.0161	252.0344	224.1765	167.2357	106.4014	76.0225	(83)
Total gains	327.7142	388.2268	435.3541	471.4566	489.0617	473.9293	455.3039	437.1005	416.1641	372.7659	327.4061	308.3750	(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	63.9583	64.1484	64.3359	65.2315	65.4019	66.2067	66.2067	66.3579	65.8943	65.4019	65.0582	64.7027	
alpha	5.2639	5.2766	5.2891	5.3488	5.3601	5.4138	5.4138	5.4239	5.3930	5.3601	5.3372	5.3135	
util living area													
	0.9909	0.9777	0.9469	0.8707	0.7317	0.5458	0.3965	0.4300	0.6553	0.8991	0.9793	0.9932	(86)
MIT	20.0625	20.2615	20.5094	20.7681	20.9270	20.9878	20.9982	20.9972	20.9685	20.7604	20.3636	20.0252	(87)
Th 2	20.0125	20.0151	20.0177	20.0299	20.0321	20.0428	20.0428	20.0448	20.0387	20.0321	20.0275	20.0227	(88)
util rest of house													
	0.9880	0.9711	0.9317	0.8370	0.6734	0.4688	0.3112	0.3421	0.5761	0.8646	0.9720	0.9910	(89)
MIT 2	18.7853	19.0730	19.4235	19.7780	19.9674	20.0354	20.0421	20.0437	20.0170	19.7790	19.2319	18.7390	(90)
Living area fraction									fLA = Living area / (4) =			0.4908	(91)
MIT	19.4122	19.6564	19.9565	20.2640	20.4384	20.5029	20.5114	20.5117	20.4840	20.2607	19.7873	19.3703	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.4122	19.6564	19.9565	20.2640	20.4384	20.5029	20.5114	20.5117	20.4840	20.2607	19.7873	19.3703	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9858	0.9682	0.9307	0.8458	0.6988	0.5063	0.3531	0.3853	0.6138	0.8736	0.9698	0.9892	(94)
Useful gains	323.0675	375.8682	405.1644	398.7607	341.7669	239.9616	160.7766	168.4200	255.4581	325.6580	317.5092	305.0308	(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													
	644.5245	627.4830	570.5417	475.2050	364.4615	243.2035	161.1534	169.0205	264.2742	402.9285	531.9584	639.5596	(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													
	239.1640	169.0851	123.0407	55.0399	16.8848	0.0000	0.0000	0.0000	0.0000	57.4892	154.4034	248.8895	(98)
Space heating												1063.9966	(98)
Space heating per m2											(98) / (4) =	27.0875	(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 %)	93.4000	(206)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Efficiency of secondary/supplementary heating system, %													0.0000	(208)
Space heating requirement													1139.1826	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Space heating requirement	239.1640	169.0851	123.0407	55.0399	16.8848	0.0000	0.0000	0.0000	0.0000	57.4892	154.4034	248.8895		(98)
Space heating efficiency (main heating system 1)	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000		(210)
Space heating fuel (main heating system)	256.0643	181.0333	131.7352	58.9292	18.0780	0.0000	0.0000	0.0000	0.0000	61.5516	165.3141	266.4769		(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	147.1786	128.5643	133.7629	118.6409	114.8653	101.1670	96.9257	108.0494	109.2427	124.3946	132.7888	143.7223		(64)
Efficiency of water heater												80.3000		(216)
(217)m	86.2665	85.7418	84.8416	83.2475	81.4665	80.3000	80.3000	80.3000	80.3000	83.2395	85.4316	86.4209		(217)
Fuel for water heating, kWh/month	170.6093	149.9435	157.6619	142.5159	140.9971	125.9863	120.7044	134.5572	136.0432	149.4417	155.4328	166.3051		(219)
Water heating fuel used												1750.1983		(219)
Annual totals kWh/year														
Space heating fuel - main system												1139.1826		(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)												189.7208		(232)
Total delivered energy for all uses												3154.1018		(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	1139.1826	0.2160	246.0635	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1750.1983	0.2160	378.0428	(264)
Space and water heating			624.1063	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	189.7208	0.5190	98.4651	(268)
Total CO2, kg/m2/year			761.4964	(272)
Emissions per m2 for space and water heating			15.8887	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.5067	(272b)
Emissions per m2 for pumps and fans			0.9910	(272c)
Target Carbon Dioxide Emission Rate (TER) = (15.8887 * 1.00) + 2.5067 + 0.9910, rounded to 2 d.p.			19.3900	(273)

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

Design SAP
elmhurst energy

Property Reference	Plot 120	**Issued on Date**	13/02/2020
Assessment Reference	001	**Prop Type Ref**	TF
Property	Epping College Site B, Plot 120		

SAP Rating	83 B	**DER**	19.06	**TER**	18.86
Environmental	87 B	**% DER<TER**	-1.07		
CO_2 Emissions (t/year)	1.03	**DFEE**	47.80	**TFEE**	49.95
General Requirements Compliance	Fail	**% DFEE<TFEE**	4.29		

Assessor Details	Miss Georgia Dimitriou, Georgia Dimitriou, Tel: 07599467602, erieta.dimitriou@lowenergyconsultancy.co.uk	**Assessor ID**	P864-0001
Client			

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

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DWELLING AS DESIGNED

Top-floor flat, total floor area 65 m²

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

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 18.86 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 19.06 kgCO□/m²Fail
Excess emissions =0.20 kgCO□/m² (1.1%)

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)49.9 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)47.8 kWh/m²/yrOK

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2 Fabric U-values

Element	Average	Highest	
External wall	0.22 (max. 0.30)	0.22 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	(no floor)		
Roof	0.16 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

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

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3 Air permeability
Air permeability at 50 pascals: 4.00 (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 database
Vaillant ecoFIT sustain 835 VUW 356/6-3 (H-GB)
Combi boiler
Efficiency: 89.3% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

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5 Cylinder insulation
Hot water storage No cylinder

---

6 Controls
Space heating controls: Programmer, room thermostat and TRVs OK

Hot water controls: No cylinder

Boiler interlock Yes OK

---

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

---

8 Mechanical ventilation
Continuous extract system
Specific fan power: 0.16
Maximum 0.7 OK

---

9 Summertime temperature
Overheating risk (Thames Valley): Slight OK
Based on:
Overshading: Average
Windows facing East: 10.19 m², No overhang
Windows facing South: 2.30 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

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	64.9300 (1b)	x	2.5000 (2b)	=	162.3250	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	64.9300					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	162.3250	(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		4.0000	
Infiltration rate		0.2000	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1700	(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	0.2168	0.2125	0.2083	0.1870	0.1828	0.1615	0.1615	0.1573	0.1700	0.1828	0.1913	0.1998	(22b)

Mechanical extract ventilation - centralised

If mechanical ventilation:	0.5000	(23a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
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	
Opening Type 2 (Uw = 1.30)			12.4900	1.2357	15.4344			(27)
External Wall 1	44.9000	12.4900	32.4100	0.2200	7.1302			(29a)
External Roof 1	64.9300		64.9300	0.1600	10.3888			(30)
Total net area of external elements Aum(A, m2)			109.8300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		32.9534			(33)
Party Wall 1			36.5500	0.0000	0.0000			(32)
Party Floor 1			64.9300					(32d)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	14.9638	(36)
Total fabric heat loss (33) + (36) =	47.9172	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	26.7836	26.7836	26.7836	26.7836	26.7836	26.7836	26.7836	26.7836	26.7836	26.7836	26.7836	26.7836	(38)
Heat transfer coeff	74.7008	74.7008	74.7008	74.7008	74.7008	74.7008	74.7008	74.7008	74.7008	74.7008	74.7008	74.7008	(39)
Average = Sum(39)m / 12 =												74.7008	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1505	1.1505	1.1505	1.1505	1.1505	1.1505	1.1505	1.1505	1.1505	1.1505	1.1505	1.1505	(40)
HLP (average)												1.1505	(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	2.1171	(42)
Average daily hot water use (litres/day)	84.4801	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	92.9281	89.5489	86.1697	82.7905	79.4113	76.0321	76.0321	79.4113	82.7905	86.1697	89.5489	92.9281	(44)
Energy conte	137.8097	120.5293	124.3754	108.4335	104.0445	89.7825	83.1967	95.4694	96.6096	112.5892	122.8999	133.4614	(45)
Energy content (annual)										Total = Sum(45)m =		1329.2013	(45)
Distribution loss (46)m = 0.15 x (45)m	20.6715	18.0794	18.6563	16.2650	15.6067	13.4674	12.4795	14.3204	14.4914	16.8884	18.4350	20.0192	(46)
Water storage loss:													
Total storage loss													

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	26.3385	23.7548	26.2445	25.3352	26.1340	25.2384	26.0469	26.1034	25.2911	26.1988	25.4265	26.3203	(61)
Total heat required for water heating calculated for each month													
	164.1483	144.2841	150.6199	133.7687	130.1786	115.0209	109.2436	121.5728	121.9008	138.7880	148.3264	159.7817	(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													
	164.1483	144.2841	150.6199	133.7687	130.1786	115.0209	109.2436	121.5728	121.9008	138.7880	148.3264	159.7817	(64)
								Total per year (kWh/year) = Sum(64)m =				1637.6339	(64)
Heat gains from water heating, kWh/month													
	52.4064	46.0147	47.9160	42.3879	41.1283	36.1623	34.1746	38.2694	38.4455	43.9856	47.2208	50.9560	(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	105.8529	105.8529	105.8529	105.8529	105.8529	105.8529	105.8529	105.8529	105.8529	105.8529	105.8529	105.8529	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	16.7013	14.8340	12.0638	9.1331	6.8271	5.7637	6.2279	8.0953	10.8654	13.7962	16.1022	17.1655	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	185.1879	187.1096	182.2670	171.9578	158.9443	146.7134	138.5424	136.6208	141.4633	151.7725	164.7861	177.0169	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	33.5853	33.5853	33.5853	33.5853	33.5853	33.5853	33.5853	33.5853	33.5853	33.5853	33.5853	33.5853	(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)													
	-84.6823	-84.6823	-84.6823	-84.6823	-84.6823	-84.6823	-84.6823	-84.6823	-84.6823	-84.6823	-84.6823	-84.6823	(71)
Water heating gains (Table 5)													
	70.4387	68.4742	64.4032	58.8721	55.2800	50.2254	45.9336	51.4374	53.3965	59.1205	65.5845	68.4892	(72)
Total internal gains													
	330.0838	328.1737	316.4899	297.7189	278.8072	260.4584	248.4598	253.9093	263.4811	282.4450	304.2286	320.4276	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	10.1900	19.6403	0.5000	0.7000	0.7700	48.5426	(76)
South	2.3000	46.7521	0.5000	0.7000	0.7700	26.0813	(78)

Solar gains	74.6239	137.6741	210.7956	289.5739	343.6007	347.8073	332.6698	292.5163	238.7205	158.7491	91.4422	62.4557	(83)
Total gains	404.7077	465.8478	527.2855	587.2929	622.4080	608.2657	581.1296	546.4256	502.2016	441.1942	395.6707	382.8833	(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	60.3611	60.3611	60.3611	60.3611	60.3611	60.3611	60.3611	60.3611	60.3611	60.3611	60.3611	60.3611	
alpha	5.0241	5.0241	5.0241	5.0241	5.0241	5.0241	5.0241	5.0241	5.0241	5.0241	5.0241	5.0241	
util living area													
	0.9976	0.9948	0.9860	0.9566	0.8763	0.7205	0.5511	0.6047	0.8447	0.9740	0.9951	0.9982	(86)
MIT	19.7797	19.9308	20.1854	20.5053	20.7840	20.9424	20.9878	20.9809	20.8680	20.4979	20.0677	19.7377	(87)
Th 2	19.9598	19.9598	19.9598	19.9598	19.9598	19.9598	19.9598	19.9598	19.9598	19.9598	19.9598	19.9598	(88)
util rest of house													
	0.9968	0.9930	0.9810	0.9403	0.8303	0.6283	0.4282	0.4799	0.7720	0.9611	0.9931	0.9976	(89)
MIT 2	18.8514	19.0018	19.2538	19.5636	19.8149	19.9335	19.9568	19.9545	19.8874	19.5618	19.1388	18.8096	(90)
Living area fraction									fLA = Living area / (4) =			0.3755	(91)
MIT	19.2000	19.3506	19.6036	19.9172	20.1788	20.3123	20.3439	20.3399	20.2556	19.9133	19.4876	19.1581	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.2000	19.3506	19.6036	19.9172	20.1788	20.3123	20.3439	20.3399	20.2556	19.9133	19.4876	19.1581	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9960	0.9916	0.9789	0.9395	0.8412	0.6615	0.4748	0.5272	0.7952	0.9603	0.9919	0.9970	(94)
Useful gains	403.1066	461.9388	516.1473	551.7662	523.5667	402.3817	275.9473	288.0972	399.3525	423.6942	392.4801	381.7227	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1113.0398	1079.4728	978.8483	822.9937	633.3727	426.7135	279.6728	294.3109	459.8301	695.7115	925.3628	1117.3806	(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													
	528.1903	414.9829	344.2496	195.2838	81.6956	0.0000	0.0000	0.0000	0.0000	202.3809	383.6756	547.3295	(98)
Space heating												2697.7881	(98)
Space heating per m2											(98) / (4) =	41.5492	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	93.2000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2894.6224	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	528.1903	414.9829	344.2496	195.2838	81.6956	0.0000	0.0000	0.0000	0.0000	202.3809	383.6756	547.3295	(98)
Space heating efficiency (main heating system 1)	93.2000	93.2000	93.2000	93.2000	93.2000	0.0000	0.0000	0.0000	0.0000	93.2000	93.2000	93.2000	(210)
Space heating fuel (main heating system)	566.7278	445.2606	369.3665	209.5320	87.6563	0.0000	0.0000	0.0000	0.0000	217.1469	411.6690	587.2634	(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	164.1483	144.2841	150.6199	133.7687	130.1786	115.0209	109.2436	121.5728	121.9008	138.7880	148.3264	159.7817	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.4951	89.4336	89.2972	88.9981	88.3958	87.3000	87.3000	87.3000	87.3000	88.9973	89.3723	89.5280	(217)
Fuel for water heating, kWh/month	183.4158	161.3311	168.6727	150.3050	147.2678	131.7536	125.1359	139.2587	139.6343	155.9463	165.9647	178.4713	(219)
Water heating fuel used												1847.1572	(219)

Annual totals kWh/year		
Space heating fuel - main system	2894.6224	(211)
Space heating fuel - secondary	0.0000	(215)

Electricity for pumps and fans:
(MEVCentralised, Database: in-use factor = 1.3000, SFP = 0.2080)

mechanical ventilation fans (SFP = 0.2080)	41.1916	(230a)
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	116.1916	(231)
Electricity for lighting (calculated in Appendix L)	294.9510	(232)
Total delivered energy for all uses	5152.9222	(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	2894.6224	0.2160	625.2384	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1847.1572	0.2160	398.9860	(264)
Space and water heating			1024.2244	(265)
Pumps and fans	116.1916	0.5190	60.3034	(267)
Energy for lighting	294.9510	0.5190	153.0796	(268)
Total CO2, kg/year			1237.6074	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			19.0600	(273)

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

DER		19.0600	ZC1
Total Floor Area	TFA	64.9300	
Assumed number of occupants	N	2.1171	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		16.9010	ZC2
CO2 emissions from cooking, equation (L16)		2.6153	ZC3
Total CO2 emissions		38.5763	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		38.5763	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	64.9300 (1b)	x	2.5000 (2b)	=	162.3250	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	64.9300					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	162.3250	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							2 * 10 =	20.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1232	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3732	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3172	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4045	0.3965	0.3886	0.3490	0.3410	0.3014	0.3014	0.2934	0.3172	0.3410	0.3569	0.3727	(22b)
Effective ac	0.5818	0.5786	0.5755	0.5609	0.5581	0.5454	0.5454	0.5431	0.5503	0.5581	0.5637	0.5695	(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 Opening Type (Uw = 1.40)			12.4900	1.3258	16.5587			(27)
External Wall 1	44.9000	12.4900	32.4100	0.1800	5.8338			(29a)
External Roof 1	64.9300		64.9300	0.1300	8.4409			(30)
Total net area of external elements Aum(A, m2)			109.8300					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	30.8334			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							13.4723	(36)
Total fabric heat loss						(33) + (36) =	44.3057	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	31.1652	30.9951	30.8283	30.0450	29.8984	29.2162	29.2162	29.0898	29.4790	29.8984	30.1949	30.5049	(38)
Heat transfer coeff	75.4709	75.3008	75.1340	74.3507	74.2041	73.5219	73.5219	73.3955	73.7847	74.2041	74.5006	74.8106	(39)
Average = Sum(39)m / 12 =												74.3500	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1623	1.1597	1.1572	1.1451	1.1428	1.1323	1.1323	1.1304	1.1364	1.1428	1.1474	1.1522	(40)
HLP (average)												1.1451	(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	2.1171	(42)
Average daily hot water use (litres/day)	84.4801	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	92.9281	89.5489	86.1697	82.7905	79.4113	76.0321	76.0321	79.4113	82.7905	86.1697	89.5489	92.9281	(44)
Energy conte	137.8097	120.5293	124.3754	108.4335	104.0445	89.7825	83.1967	95.4694	96.6096	112.5892	122.8999	133.4614	(45)
Energy content (annual)										Total = Sum(45)m =		1329.2013	(45)
Distribution loss (46)m = 0.15 x (45)m	20.6715	18.0794	18.6563	16.2650	15.6067	13.4674	12.4795	14.3204	14.4914	16.8884	18.4350	20.0192	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	47.3552	41.2170	43.9111	40.8282	40.4671	37.4953	38.7451	40.4671	40.8282	43.9111	44.1611	47.3552	(61)
Total heat required for water heating calculated for each month													

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	185.1649	161.7463	168.2866	149.2617	144.5117	127.2778	121.9418	135.9366	137.4378	156.5004	167.0611	180.8165	(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													
	185.1649	161.7463	168.2866	149.2617	144.5117	127.2778	121.9418	135.9366	137.4378	156.5004	167.0611	180.8165	(64)
								Total per year (kWh/year) = Sum(64)m =				1835.9432	(64)
Heat gains from water heating, kWh/month													
	57.6605	50.3802	52.3326	46.2612	44.7116	39.2265	37.3492	41.8604	42.3298	48.4137	51.9045	56.2147	(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	105.8529	105.8529	105.8529	105.8529	105.8529	105.8529	105.8529	105.8529	105.8529	105.8529	105.8529	105.8529	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	16.7013	14.8340	12.0638	9.1331	6.8271	5.7637	6.2279	8.0953	10.8654	13.7962	16.1022	17.1655	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	185.1879	187.1096	182.2670	171.9578	158.9443	146.7134	138.5424	136.6208	141.4633	151.7725	164.7861	177.0169	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	33.5853	33.5853	33.5853	33.5853	33.5853	33.5853	33.5853	33.5853	33.5853	33.5853	33.5853	33.5853	(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)													
	-84.6823	-84.6823	-84.6823	-84.6823	-84.6823	-84.6823	-84.6823	-84.6823	-84.6823	-84.6823	-84.6823	-84.6823	(71)
Water heating gains (Table 5)													
	77.5007	74.9706	70.3395	64.2517	60.0962	54.4813	50.2005	56.2639	58.7913	65.0722	72.0896	75.5574	(72)
Total internal gains													
	337.1459	334.6701	322.4263	303.0984	283.6235	264.7143	252.7267	258.7358	268.8759	288.3967	310.7337	327.4957	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	10.1900	19.6403	0.6300	0.7000	0.7700	61.1636	(76)
South	2.3000	46.7521	0.6300	0.7000	0.7700	32.8625	(78)

Solar gains	94.0261	173.4693	265.6025	364.8632	432.9369	438.2372	419.1639	368.5706	300.7878	200.0239	115.2171	78.6942	(83)
Total gains	431.1720	508.1394	588.0287	667.9616	716.5604	702.9515	671.8906	627.3064	569.6638	488.4207	425.9508	406.1899	(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	59.7452	59.8802	60.0131	60.6454	60.7652	61.3291	61.3291	61.4346	61.1106	60.7652	60.5234	60.2726	
alpha	4.9830	4.9920	5.0009	5.0430	5.0510	5.0886	5.0886	5.0956	5.0740	5.0510	5.0349	5.0182	
util living area													
	0.9969	0.9924	0.9784	0.9313	0.8186	0.6379	0.4753	0.5274	0.7851	0.9611	0.9932	0.9977	(86)
MIT	19.8014	19.9776	20.2573	20.5981	20.8501	20.9679	20.9940	20.9901	20.9103	20.5622	20.1137	19.7687	(87)
Th 2	19.9502	19.9524	19.9544	19.9642	19.9660	19.9745	19.9745	19.9761	19.9712	19.9660	19.9623	19.9585	(88)
util rest of house													
	0.9958	0.9899	0.9710	0.9081	0.7638	0.5486	0.3678	0.4155	0.7044	0.9432	0.9906	0.9969	(89)
MIT 2	18.3612	18.6191	19.0237	19.5061	19.8259	19.9543	19.9724	19.9723	19.9035	19.4690	18.8256	18.3194	(90)
Living area fraction									fLA = Living area / (4) =			0.3755	(91)
MIT	18.9019	19.1292	19.4869	19.9161	20.2105	20.3349	20.3560	20.3545	20.2815	19.8795	19.3092	18.8636	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9019	19.1292	19.4869	19.9161	20.2105	20.3349	20.3560	20.3545	20.2815	19.8795	19.3092	18.8636	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9943	0.9872	0.9668	0.9069	0.7779	0.5812	0.4084	0.4577	0.7309	0.9414	0.9882	0.9957	(94)
Useful gains	428.7179	501.6176	568.5312	605.7608	557.4254	408.5372	274.3786	287.1392	416.3827	459.7868	420.9322	404.4370	(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													
	1102.0227	1071.4698	975.7603	819.0576	631.5119	421.6410	276.1495	290.2390	456.1016	688.5756	909.5956	1096.9942	(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													
	500.9388	382.9407	302.9784	153.5737	55.1204	0.0000	0.0000	0.0000	0.0000	170.2189	351.8376	515.2625	(98)
Space heating												2432.8710	(98)
Space heating per m2											(98) / (4) =	37.4691	(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)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Efficiency of main space heating system 1 (in %)	93.4000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2604.7869	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	500.9388	382.9407	302.9784	153.5737	55.1204	0.0000	0.0000	0.0000	0.0000	170.2189	351.8376	515.2625	(98)
Space heating efficiency (main heating system 1)	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)	536.3371	410.0007	324.3880	164.4258	59.0154	0.0000	0.0000	0.0000	0.0000	182.2472	376.6998	551.6729	(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	185.1649	161.7463	168.2866	149.2617	144.5117	127.2778	121.9418	135.9366	137.4378	156.5004	167.0611	180.8165	(64)
Efficiency of water heater												80.3000	(216)
(217)m	87.4321	87.1451	86.5142	85.1229	82.8560	80.3000	80.3000	80.3000	80.3000	85.2630	86.8817	87.5398	(217)
Fuel for water heating, kWh/month	211.7813	185.6057	194.5190	175.3484	174.4131	158.5029	151.8578	169.2859	171.1555	183.5501	192.2856	206.5534	(219)
Water heating fuel used												2174.8587	(219)

Annual totals kWh/year		
Space heating fuel - main system	2604.7869	(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)	294.9510	(232)
Total delivered energy for all uses	5149.5967	(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	2604.7869	0.2160	562.6340	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2174.8587	0.2160	469.7695	(264)
Space and water heating			1032.4035	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	294.9510	0.5190	153.0796	(268)
Total CO2, kg/m2/year			1224.4080	(272)
Emissions per m2 for space and water heating			15.9003	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.3576	(272b)
Emissions per m2 for pumps and fans			0.5995	(272c)
Target Carbon Dioxide Emission Rate (TER) = (15.9003 * 1.00) + 2.3576 + 0.5995, rounded to 2 d.p.			18.8600	(273)

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

Design SAP
elmhurst energy

Property Reference	Plot 141	**Issued on Date**	13/02/2020
Assessment Reference	001	**Prop Type Ref**	GF
Property	Epping College Site B, Plot 141		

SAP Rating	84 B	**DER**	17.74	**TER**	17.23
Environmental	86 B	**% DER<TER**	-2.95		
CO_2 Emissions (t/year)	1.24	**DFEE**	46.89	**TFEE**	47.63
General Requirements Compliance	Fail	**% DFEE<TFEE**	1.55		

Assessor Details	Miss Georgia Dimitriou, Georgia Dimitriou, Tel: 07599467602, erieta.dimitriou@lowenergyconsultancy.co.uk	**Assessor ID**	P864-0001
Client			

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

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

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DWELLING AS DESIGNED

Ground-floor flat, total floor area 85 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) 17.23 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 17.74 kgCO□/m²Fail
Excess emissions =0.51 kgCO□/m² (3.0%)

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)47.6 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)46.9 kWh/m²/yrOK

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2 Fabric U-values

Element	Average	Highest	
External wall	0.22 (max. 0.30)	0.22 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.20 (max. 0.25)	0.20 (max. 0.70)	OK
Roof	(no roof)		
Openings	1.32 (max. 2.00)	1.50 (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: 4.00 (design value)
Maximum 10.0 OK

---

4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Vaillant ecoFIT sustain 835 VUW 356/6-3 (H-GB)
Combi boiler
Efficiency: 89.3% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

---

5 Cylinder insulation
Hot water storage No cylinder

---

6 Controls
Space heating controls: Programmer, room thermostat and TRVs OK

Hot water controls: No cylinder

Boiler interlock Yes OK

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

---

8 Mechanical ventilation
Continuous extract system
Specific fan power: 0.16
Maximum 0.7 OK

---

9 Summertime temperature
Overheating risk (Thames Valley): Slight OK
Based on:
Overshading: Average
Windows facing North: 11.48 m², No overhang
Windows facing South: 5.60 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

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	31.6500 (1b)	x	2.5000 (2b)	=	79.1250	(1b) - (3b)
First floor	52.9700 (1c)	x	2.8000 (2c)	=	148.3160	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 84.6200						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	227.4410	(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		4.0000	
Infiltration rate		0.2000	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1700	(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	0.2168	0.2125	0.2083	0.1870	0.1828	0.1615	0.1615	0.1573	0.1700	0.1828	0.1913	0.1998	(22b)
Mechanical extract ventilation - centralised													
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	
Opening Type 1			2.3000	1.5000	3.4500			(26)
Opening Type 2 (Uw = 1.30)			17.0800	1.2357	21.1065			(27)
Heat Loss Floor 1			21.3200	0.2000	4.2640			(28b)
External Wall 1	77.7200	19.3800	58.3400	0.2200	12.8348			(29a)
Total net area of external elements Aum(A, m2)			99.0400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		41.6553			(33)
Party Wall 1			61.5000	0.0000	0.0000			(32)
Party Floor 1			31.6500					(32d)
Party Ceilings 1			52.9700					(32b)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							13.7565	(36)
Total fabric heat loss					(33) + (36) =		55.4118	(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	37.5278	37.5278	37.5278	37.5278	37.5278	37.5278	37.5278	37.5278	37.5278	37.5278	37.5278	37.5278	(38)
Heat transfer coeff	92.9395	92.9395	92.9395	92.9395	92.9395	92.9395	92.9395	92.9395	92.9395	92.9395	92.9395	92.9395	(39)
Average = Sum(39)m / 12 =												92.9395	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0983	1.0983	1.0983	1.0983	1.0983	1.0983	1.0983	1.0983	1.0983	1.0983	1.0983	1.0983	(40)
HLP (average)												1.0983	(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	2.5447	(42)
Average daily hot water use (litres/day)	94.6367	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	104.1003	100.3149	96.5294	92.7439	88.9585	85.1730	85.1730	88.9585	92.7439	96.5294	100.3149	104.1003	(44)
Energy conte	154.3778	135.0198	139.3284	121.4698	116.5532	100.5765	93.1990	106.9472	108.2245	126.1252	137.6755	149.5067	(45)
Energy content (annual)										Total = Sum(45)m =		1489.0034	(45)

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

	23.1567	20.2530	20.8993	18.2205	17.4830	15.0865	13.9798	16.0421	16.2337	18.9188	20.6513	22.4260	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	26.4569	23.8767	26.3675	25.4382	26.2288	25.3167	26.1195	26.1904	25.3829	26.3101	25.5507	26.4350	(61)
Total heat required for water heating calculated for each month	180.8347	158.8965	165.6958	146.9080	142.7820	125.8932	119.3184	133.1375	133.6073	152.4353	163.2262	175.9417	(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	180.8347	158.8965	165.6958	146.9080	142.7820	125.8932	119.3184	133.1375	133.6073	152.4353	163.2262	175.9417	(64)
								Total per year (kWh/year) = Sum(64)m =				1798.6768	(64)
Heat gains from water heating, kWh/month	57.9449	50.8633	52.9185	46.7483	45.3111	39.7709	37.5185	42.1075	42.3303	48.5141	52.1648	56.3197	(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	127.2351	127.2351	127.2351	127.2351	127.2351	127.2351	127.2351	127.2351	127.2351	127.2351	127.2351	127.2351	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	20.5245	18.2297	14.8254	11.2238	8.3899	7.0831	7.6535	9.9484	13.3527	16.9543	19.7882	21.0950	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	228.8250	231.1995	225.2159	212.4774	196.3974	181.2845	171.1881	168.8137	174.7973	187.5357	203.6157	218.7287	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.7235	35.7235	35.7235	35.7235	35.7235	35.7235	35.7235	35.7235	35.7235	35.7235	35.7235	35.7235	(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)	-101.7881	-101.7881	-101.7881	-101.7881	-101.7881	-101.7881	-101.7881	-101.7881	-101.7881	-101.7881	-101.7881	-101.7881	(71)
Water heating gains (Table 5)	77.8829	75.6894	71.1271	64.9281	60.9021	55.2373	50.4281	56.5961	58.7922	65.2072	72.4511	75.6985	(72)
Total internal gains	391.4030	389.2891	375.3389	352.7999	329.8599	307.7755	293.4403	299.5287	311.1127	333.8677	360.0255	379.6927	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	11.4800	10.6334	0.5000	0.7000	0.7700	29.6084	(74)
South	5.6000	46.7521	0.5000	0.7000	0.7700	63.5024	(78)

Solar gains	93.1108	160.5837	228.6269	304.1686	364.0711	372.8721	354.6454	307.4460	253.9910	179.5292	111.7978	79.5549	(83)
Total gains	484.5137	549.8729	603.9658	656.9685	693.9310	680.6476	648.0858	606.9747	565.1037	513.3970	471.8233	459.2476	(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, ni1,m (see Table 9a)													
tau	63.2281	63.2281	63.2281	63.2281	63.2281	63.2281	63.2281	63.2281	63.2281	63.2281	63.2281	63.2281	
alpha	5.2152	5.2152	5.2152	5.2152	5.2152	5.2152	5.2152	5.2152	5.2152	5.2152	5.2152	5.2152	
util living area	0.9984	0.9966	0.9915	0.9739	0.9158	0.7777	0.6086	0.6666	0.8872	0.9824	0.9967	0.9988	(86)
MIT	19.8030	19.9375	20.1611	20.4569	20.7436	20.9267	20.9838	20.9743	20.8432	20.4821	20.0795	19.7645	(87)
Th 2	20.0022	20.0022	20.0022	20.0022	20.0022	20.0022	20.0022	20.0022	20.0022	20.0022	20.0022	20.0022	(88)
util rest of house	0.9979	0.9954	0.9884	0.9633	0.8801	0.6910	0.4819	0.5402	0.8264	0.9733	0.9953	0.9984	(89)
MIT 2	18.9088	19.0429	19.2651	19.5552	19.8220	19.9667	19.9979	19.9945	19.9108	19.5830	19.1849	18.8704	(90)
Living area fraction									fLA = Living area / (4) =			0.2290	(91)
MIT	19.1136	19.2478	19.4703	19.7617	20.0330	20.1865	20.2237	20.2189	20.1244	19.7889	19.3897	19.0752	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.1136	19.2478	19.4703	19.7617	20.0330	20.1865	20.2237	20.2189	20.1244	19.7889	19.3897	19.0752	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9972	0.9942	0.9862	0.9601	0.8814	0.7087	0.5113	0.5694	0.8352	0.9707	0.9941	0.9979	(94)
Useful gains	483.1579	546.6759	595.6526	630.7334	611.6439	482.3508	331.3633	345.6159	471.9740	498.3515	469.0583	458.2680	(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	1376.7715	1333.4734	1205.4526	1009.4805	774.4694	519.2085	336.7807	354.9244	559.9014	854.0133	1142.2030	1382.4957	(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	664.8485	528.7279	453.6913	272.6979	121.1422	0.0000	0.0000	0.0000	0.0000	264.6124	484.6642	687.6254	(98)
Space heating												3478.0097	(98)
Space heating per m2											(98) / (4) =	41.1015	(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 %)	93.2000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3731.7701	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	664.8485	528.7279	453.6913	272.6979	121.1422	0.0000	0.0000	0.0000	0.0000	264.6124	484.6642	687.6254	(98)
Space heating efficiency (main heating system 1)	93.2000	93.2000	93.2000	93.2000	93.2000	0.0000	0.0000	0.0000	0.0000	93.2000	93.2000	93.2000	(210)
Space heating fuel (main heating system)	713.3568	567.3046	486.7932	292.5943	129.9809	0.0000	0.0000	0.0000	0.0000	283.9189	520.0259	737.7955	(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	180.8347	158.8965	165.6958	146.9080	142.7820	125.8932	119.3184	133.1375	133.6073	152.4353	163.2262	175.9417	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.5638	89.5129	89.4055	89.1630	88.6076	87.3000	87.3000	87.3000	87.3000	89.1179	89.4514	89.5936	(217)
Fuel for water heating, kWh/month	201.9061	177.5125	185.3307	164.7634	161.1397	144.2076	136.6763	152.5058	153.0439	171.0489	182.4748	196.3774	(219)

Water heating fuel used	2026.9869	(219)
Annual totals kWh/year		
Space heating fuel - main system	3731.7701	(211)
Space heating fuel - secondary	0.0000	(215)

Electricity for pumps and fans:
(MEVCentralised, Database: in-use factor = 1.3000, SFP = 0.2080)

mechanical ventilation fans (SFP = 0.2080)	57.7154	(230a)
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	132.7154	(231)
Electricity for lighting (calculated in Appendix L)	362.4695	(232)
Total delivered energy for all uses	6253.9419	(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	3731.7701	0.2160	806.0623	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2026.9869	0.2160	437.8292	(264)
Space and water heating			1243.8915	(265)
Pumps and fans	132.7154	0.5190	68.8793	(267)
Energy for lighting	362.4695	0.5190	188.1217	(268)
Total CO2, kg/year			1500.8925	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			17.7400	(273)

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

DER		17.7400	ZC1
Total Floor Area	TFA	84.6200	
Assumed number of occupants	N	2.5447	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		16.0242	ZC2
CO2 emissions from cooking, equation (L16)		2.1280	ZC3
Total CO2 emissions		35.8922	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		35.8922	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	31.6500 (1b)	x	2.5000 (2b)	=	79.1250	(1b) - (3b)
First floor	52.9700 (1c)	x	2.8000 (2c)	=	148.3160	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	84.6200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		227.4410	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							3 * 10 =		30.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1319	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3819	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3246	(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	0.4139	0.4058	0.3977	0.3571	0.3490	0.3084	0.3084	0.3003	0.3246	0.3490	0.3652	0.3814	(22b)
Effective ac	0.5857	0.5823	0.5791	0.5638	0.5609	0.5476	0.5476	0.5451	0.5527	0.5609	0.5667	0.5727	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.3000	1.0000	2.3000			(26)
TER Opening Type (Uw = 1.40)			17.0800	1.3258	22.6439			(27)
Heat Loss Floor 1			21.3200	0.1300	2.7716			(28b)
External Wall 1	77.7200	19.3800	58.3400	0.1800	10.5012			(29a)
Total net area of external elements Aum(A, m2)			99.0400					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	38.2167			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.6603	(36)
Total fabric heat loss					(33) + (36) =		48.8770	(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	43.9564	43.7067	43.4620	42.3127	42.0977	41.0967	41.0967	40.9114	41.4823	42.0977	42.5327	42.9875	(38)
Heat transfer coeff	92.8334	92.5838	92.3391	91.1898	90.9748	89.9738	89.9738	89.7884	90.3593	90.9748	91.4098	91.8645	(39)
Average = Sum(39)m / 12 =												91.1888	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0971	1.0941	1.0912	1.0776	1.0751	1.0633	1.0633	1.0611	1.0678	1.0751	1.0802	1.0856	(40)
HLP (average)												1.0776	(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	2.5447	(42)
Average daily hot water use (litres/day)	94.6367	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	104.1003	100.3149	96.5294	92.7439	88.9585	85.1730	85.1730	88.9585	92.7439	96.5294	100.3149	104.1003	(44)
Energy conte	154.3778	135.0198	139.3284	121.4698	116.5532	100.5765	93.1990	106.9472	108.2245	126.1252	137.6755	149.5067	(45)
Energy content (annual)										Total = Sum(45)m =		1489.0034	(45)
Distribution loss (46)m = 0.15 x (45)m	23.1567	20.2530	20.8993	18.2205	17.4830	15.0865	13.9798	16.0421	16.2337	18.9188	20.6513	22.4260	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Combi loss	50.9589	46.0274	49.1903	45.7367	45.3323	42.0031	43.4032	45.3323	45.7367	49.1903	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month													
	205.3367	181.0472	188.5187	167.2066	161.8855	142.5797	136.6022	152.2794	153.9612	175.3155	186.9906	200.4656	(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													
	205.3367	181.0472	188.5187	167.2066	161.8855	142.5797	136.6022	152.2794	153.9612	175.3155	186.9906	200.4656	(64)
Total per year (kWh/year) = Sum(64)m =												2052.1887	(64)
Heat gains from water heating, kWh/month													
	64.0703	56.4009	58.6243	51.8229	50.0870	43.9425	41.8395	46.8930	47.4188	54.2342	58.1059	62.4507	(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	127.2351	127.2351	127.2351	127.2351	127.2351	127.2351	127.2351	127.2351	127.2351	127.2351	127.2351	127.2351	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.5245	18.2297	14.8254	11.2238	8.3899	7.0831	7.6535	9.9484	13.3527	16.9543	19.7882	21.0950	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	228.8250	231.1995	225.2159	212.4774	196.3974	181.2845	171.1881	168.8137	174.7973	187.5357	203.6157	218.7287	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.7235	35.7235	35.7235	35.7235	35.7235	35.7235	35.7235	35.7235	35.7235	35.7235	35.7235	35.7235	(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)													
	-101.7881	-101.7881	-101.7881	-101.7881	-101.7881	-101.7881	-101.7881	-101.7881	-101.7881	-101.7881	-101.7881	-101.7881	(71)
Water heating gains (Table 5)													
	86.1161	83.9300	78.7960	71.9763	67.3212	61.0312	56.2358	63.0282	65.8595	72.8954	80.7026	83.9391	(72)
Total internal gains													
	399.6361	397.5297	383.0078	359.8480	336.2791	313.5694	299.2481	305.9608	318.1800	341.5560	368.2770	387.9333	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	11.4800	10.6334	0.6300	0.7000	0.7700	37.3066	(74)
South	5.6000	46.7521	0.6300	0.7000	0.7700	80.0130	(78)

Solar gains	117.3196	202.3355	288.0699	383.2524	458.7295	469.8188	446.8532	387.3820	320.0287	226.2068	140.8652	100.2392	(83)
Total gains	516.9557	599.8652	671.0778	743.1004	795.0087	783.3882	746.1013	693.3428	638.2086	567.7628	509.1422	488.1725	(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	63.3004	63.4711	63.6392	64.4413	64.5936	65.3122	65.3122	65.4471	65.0336	64.5936	64.2862	63.9680	
alpha	5.2200	5.2314	5.2426	5.2961	5.3062	5.3541	5.3541	5.3631	5.3356	5.3062	5.2857	5.2645	
util living area													
	0.9978	0.9949	0.9865	0.9561	0.8664	0.6914	0.5221	0.5802	0.8322	0.9723	0.9952	0.9984	(86)
MIT	19.8407	19.9978	20.2406	20.5581	20.8230	20.9614	20.9928	20.9878	20.8959	20.5565	20.1413	19.8142	(87)
Th 2	20.0032	20.0056	20.0080	20.0191	20.0212	20.0309	20.0309	20.0327	20.0272	20.0212	20.0170	20.0126	(88)
util rest of house													
	0.9971	0.9931	0.9817	0.9400	0.8201	0.6040	0.4116	0.4660	0.7602	0.9590	0.9933	0.9979	(89)
MIT 2	18.4565	18.6873	19.0410	19.4995	19.8482	20.0054	20.0283	20.0277	19.9440	19.5060	18.9056	18.4245	(90)
Living area fraction									fLA = Living area / (4) =			0.2290	(91)
MIT	18.7735	18.9874	19.3157	19.7420	20.0714	20.2244	20.2492	20.2476	20.1620	19.7466	19.1886	18.7428	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7735	18.9874	19.3157	19.7420	20.0714	20.2244	20.2492	20.2476	20.1620	19.7466	19.1886	18.7428	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9958	0.9906	0.9772	0.9344	0.8228	0.6225	0.4370	0.4922	0.7715	0.9541	0.9910	0.9968	(94)
Useful gains	514.7768	594.2504	655.7879	694.3376	654.1471	487.6383	326.0500	341.2864	492.3845	541.6957	504.5380	486.6233	(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													
	1343.6279	1304.2653	1183.3924	988.6778	761.5888	506.0455	328.3311	345.4697	547.7617	832.1112	1105.0177	1335.9666	(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													
	616.6652	477.1300	392.5378	211.9250	79.9366	0.0000	0.0000	0.0000	0.0000	216.0691	432.3454	631.9114	(98)
Space heating												3058.5205	(98)
Space heating per m2											(98) / (4) =	36.1442	(99)

8c. Space cooling requirement

Not applicable

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

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	93.4000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3274.6472	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	616.6652	477.1300	392.5378	211.9250	79.9366	0.0000	0.0000	0.0000	0.0000	216.0691	432.3454	631.9114	(98)
Space heating efficiency (main heating system 1)	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)	660.2412	510.8459	420.2760	226.9004	85.5852	0.0000	0.0000	0.0000	0.0000	231.3374	462.8965	676.5647	(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	205.3367	181.0472	188.5187	167.2066	161.8855	142.5797	136.6022	152.2794	153.9612	175.3155	186.9906	200.4656	(64)
Efficiency of water heater												80.3000	(216)
(217)m	87.6462	87.3769	86.8556	85.6489	83.3794	80.3000	80.3000	80.3000	80.3000	85.5784	87.0926	87.7421	(217)
Fuel for water heating, kWh/month	234.2791	207.2026	217.0483	195.2232	194.1553	177.5588	170.1148	189.6381	191.7325	204.8594	214.7030	228.4713	(219)
Water heating fuel used												2424.9864	(219)

Annual totals kWh/year		
Space heating fuel - main system	3274.6472	(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)	362.4695	(232)
Total delivered energy for all uses	6137.1031	(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	3274.6472	0.2160	707.3238	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2424.9864	0.2160	523.7971	(264)
Space and water heating			1231.1209	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	362.4695	0.5190	188.1217	(268)
Total CO2, kg/m2/year			1458.1675	(272)
Emissions per m2 for space and water heating			14.5488	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.2231	(272b)
Emissions per m2 for pumps and fans			0.4600	(272c)
Target Carbon Dioxide Emission Rate (TER) = (14.5488 * 1.00) + 2.2231 + 0.4600, rounded to 2 d.p.			17.2300	(273)

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

Design SAP
elmhurst energy

Property Reference	Plot 157	**Issued on Date**	13/02/2020
Assessment Reference	001	**Prop Type Ref**	TF
Property	Epping College Site B, Plot 157		

SAP Rating	83 B	**DER**	19.75	**TER**	19.53
Environmental	88 B	**% DER<TER**	-1.14		
CO_2 Emissions (t/year)	0.84	**DFEE**	45.73	**TFEE**	46.86
General Requirements Compliance	Fail	**% DFEE<TFEE**	2.42		

Assessor Details	Miss Georgia Dimitriou, Georgia Dimitriou, Tel: 07599467602, erieta.dimitriou@lowenergyconsultancy.co.uk	**Assessor ID**	P864-0001
Client			

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

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

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DWELLING AS DESIGNED

Top-floor flat, total floor area 51 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) 19.53 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 19.75 kgCO□/m²Fail
Excess emissions =0.22 kgCO□/m² (1.1%)

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)46.9 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)45.7 kWh/m²/yrOK

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2 Fabric U-values

Element	Average	Highest	
External wall	0.22 (max. 0.30)	0.22 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	(no floor)		
Roof	0.16 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.34 (max. 2.00)	1.50 (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: 4.00 (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 database
Vaillant ecoFIT sustain 835 VUW 356/6-3 (H-GB)
Combi boiler
Efficiency: 89.3% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

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5 Cylinder insulation
Hot water storage No cylinder

---

6 Controls
Space heating controls: Programmer, room thermostat and TRVs OK

Hot water controls: No cylinder

Boiler interlock Yes OK

---

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

---

8 Mechanical ventilation
Continuous extract system
Specific fan power: 0.17
Maximum 0.7 OK

---

9 Summertime temperature
Overheating risk (Thames Valley): Slight OK
Based on:
Overshading: Average
Windows facing North East: 7.90 m², No overhang
Windows facing South West: 1.15 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

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.8500 (1b)	x	2.5000 (2b)	=	127.1250	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	50.8500					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	127.1250	(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		4.0000	
Infiltration rate		0.2000	(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) =	0.1550	(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	0.1976	0.1938	0.1899	0.1705	0.1666	0.1473	0.1473	0.1434	0.1550	0.1666	0.1744	0.1821	(22b)

Mechanical extract ventilation - centralised

If mechanical ventilation:	0.5000	(23a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
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	
Opening Type 1			2.3000	1.5000	3.4500			(26)
Opening Type 2 (Uw = 1.30)			9.0500	1.2357	11.1835			(27)
External Wall 1	19.2300	11.3500	7.8800	0.2200	1.7336			(29a)
External Roof 1	50.8500		50.8500	0.1600	8.1360			(30)
Total net area of external elements Aum(A, m2)			70.0800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		24.5031			(33)
Party Wall 1			54.7300	0.0000	0.0000			(32)
Party Floor 1			50.8500					(32d)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	8.5659	(36)
Total fabric heat loss (33) + (36) =	33.0690	(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	20.9756	20.9756	20.9756	20.9756	20.9756	20.9756	20.9756	20.9756	20.9756	20.9756	20.9756	20.9756	(38)
Heat transfer coeff	54.0446	54.0446	54.0446	54.0446	54.0446	54.0446	54.0446	54.0446	54.0446	54.0446	54.0446	54.0446	(39)
Average = Sum(39)m / 12 =												54.0446	(39)
HLP	1.0628	1.0628	1.0628	1.0628	1.0628	1.0628	1.0628	1.0628	1.0628	1.0628	1.0628	1.0628	(40)
HLP (average)												1.0628	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.7151	(42)
Average daily hot water use (litres/day)	74.9348	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	82.4282	79.4308	76.4334	73.4361	70.4387	67.4413	67.4413	70.4387	73.4361	76.4334	79.4308	82.4282	(44)
Energy conte	122.2387	106.9107	110.3223	96.1817	92.2886	79.6380	73.7963	84.6824	85.6938	99.8678	109.0135	118.3816	(45)
Energy content (annual)										Total = Sum(45)m =		1179.0155	(45)
Distribution loss (46)m = 0.15 x (45)m	18.3358	16.0366	16.5483	14.4272	13.8433	11.9457	11.0695	12.7024	12.8541	14.9802	16.3520	17.7572	(46)
Water storage loss:													

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	26.2157	23.6513	26.1417	25.2490	26.0548	25.1729	25.9862	26.0307	25.2144	26.1057	25.3209	26.2013	(61)
Total heat required for water heating calculated for each month													
	148.4543	130.5620	136.4640	121.4307	118.3434	104.8109	99.7825	110.7130	110.9081	125.9736	134.3344	144.5830	(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													
	148.4543	130.5620	136.4640	121.4307	118.3434	104.8109	99.7825	110.7130	110.9081	125.9736	134.3344	144.5830	(64)
								Total per year (kWh/year) = Sum(64)m =				1486.3600	(64)
Heat gains from water heating, kWh/month													
	47.1983	41.4606	43.2176	38.2927	37.1996	32.7729	31.0338	34.6646	34.7968	39.7325	42.5772	45.9122	(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	85.7574	85.7574	85.7574	85.7574	85.7574	85.7574	85.7574	85.7574	85.7574	85.7574	85.7574	85.7574	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	13.6323	12.1081	9.8470	7.4548	5.5725	4.7046	5.0835	6.6077	8.8688	11.2610	13.1432	14.0112	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	149.4413	150.9921	147.0843	138.7650	128.2635	118.3935	111.7998	110.2490	114.1568	122.4761	132.9776	142.8476	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	31.5757	31.5757	31.5757	31.5757	31.5757	31.5757	31.5757	31.5757	31.5757	31.5757	31.5757	31.5757	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-68.6059	-68.6059	-68.6059	-68.6059	-68.6059	-68.6059	-68.6059	-68.6059	-68.6059	-68.6059	-68.6059	-68.6059	(71)
Water heating gains (Table 5)													
	63.4385	61.6974	58.0882	53.1843	49.9995	45.5179	41.7121	46.5921	48.3289	53.4039	59.1350	61.7100	(72)
Total internal gains													
	278.2394	276.5247	266.7466	251.1313	235.5628	220.3432	210.3226	215.1761	223.0817	238.8681	256.9831	270.2960	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	7.9000	11.2829	0.5000	0.7000	0.7700	21.6198	(75)
Southwest	1.1500	36.7938	0.5000	0.7000	0.7700	10.2630	(79)

Solar gains	31.8827	61.4893	103.2069	159.8503	208.2281	219.5587	206.3361	168.2816	122.5128	73.1018	39.4959	26.4388	(83)
Total gains	310.1221	338.0140	369.9535	410.9816	443.7909	439.9019	416.6587	383.4577	345.5945	311.9699	296.4790	296.7347	(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	65.3396	65.3396	65.3396	65.3396	65.3396	65.3396	65.3396	65.3396	65.3396	65.3396	65.3396	65.3396	
alpha	5.3560	5.3560	5.3560	5.3560	5.3560	5.3560	5.3560	5.3560	5.3560	5.3560	5.3560	5.3560	
util living area													
	0.9978	0.9961	0.9904	0.9674	0.8901	0.7271	0.5582	0.6244	0.8729	0.9805	0.9958	0.9983	(86)
MIT	19.8869	19.9989	20.2170	20.5189	20.7981	20.9511	20.9902	20.9828	20.8663	20.5192	20.1443	19.8520	(87)
Th 2	20.0313	20.0313	20.0313	20.0313	20.0313	20.0313	20.0313	20.0313	20.0313	20.0313	20.0313	20.0313	(88)
util rest of house													
	0.9971	0.9948	0.9870	0.9548	0.8487	0.6397	0.4418	0.5048	0.8093	0.9707	0.9941	0.9977	(89)
MIT 2	19.0161	19.1277	19.3441	19.6388	19.8932	20.0086	20.0288	20.0263	19.9546	19.6431	19.2729	18.9812	(90)
Living area fraction									fLA = Living area / (4) =			0.4832	(91)
MIT	19.4369	19.5486	19.7659	20.0640	20.3304	20.4640	20.4933	20.4884	20.3951	20.0664	19.6939	19.4020	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.4369	19.5486	19.7659	20.0640	20.3304	20.4640	20.4933	20.4884	20.3951	20.0664	19.6939	19.4020	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9966	0.9940	0.9858	0.9553	0.8628	0.6807	0.4985	0.5631	0.8360	0.9712	0.9934	0.9973	(94)
Useful gains	309.0525	335.9750	364.6992	392.6217	382.9244	299.4434	207.6956	215.9182	288.9124	302.9758	294.5169	295.9227	(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													
	818.0655	791.6800	716.9490	603.3554	466.4258	316.9176	210.4133	220.9584	340.2180	511.6089	680.6330	821.5838	(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													
	378.7057	306.2337	262.0739	151.7283	62.1250	0.0000	0.0000	0.0000	0.0000	155.2231	278.0036	391.0919	(98)
Space heating												1985.1851	(98)
Space heating per m2											(98) / (4) =	39.0400	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	93.2000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2130.0270	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	378.7057	306.2337	262.0739	151.7283	62.1250	0.0000	0.0000	0.0000	0.0000	155.2231	278.0036	391.0919	(98)
Space heating efficiency (main heating system 1)	93.2000	93.2000	93.2000	93.2000	93.2000	0.0000	0.0000	0.0000	0.0000	93.2000	93.2000	93.2000	(210)
Space heating fuel (main heating system)	406.3366	328.5770	281.1951	162.7986	66.6578	0.0000	0.0000	0.0000	0.0000	166.5483	298.2871	419.6265	(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 requirement	148.4543	130.5620	136.4640	121.4307	118.3434	104.8109	99.7825	110.7130	110.9081	125.9736	134.3344	144.5830	(64)
Efficiency of water heater (217)m	89.3640	89.3132	89.1856	88.8874	88.2770	87.3000	87.3000	87.3000	87.3000	88.8774	89.2343	89.3985	(217)
Fuel for water heating, kWh/month	166.1232	146.1845	153.0113	136.6118	134.0591	120.0583	114.2984	126.8191	127.0426	141.7386	150.5412	161.7287	(219)

Water heating fuel used	1678.2169	(219)
Annual totals kWh/year		
Space heating fuel - main system	2130.0270	(211)
Space heating fuel - secondary	0.0000	(215)

Electricity for pumps and fans:
(MEVCentralised, Database: in-use factor = 1.3000, SFP = 0.2210)

mechanical ventilation fans (SFP = 0.2210)	34.2754	(230a)
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	109.2754	(231)
Electricity for lighting (calculated in Appendix L)	240.7505	(232)
Total delivered energy for all uses	4158.2698	(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	2130.0270	0.2160	460.0858	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1678.2169	0.2160	362.4948	(264)
Space and water heating			822.5807	(265)
Pumps and fans	109.2754	0.5190	56.7140	(267)
Energy for lighting	240.7505	0.5190	124.9495	(268)
Total CO2, kg/year			1004.2442	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			19.7500	(273)

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

DER		19.7500	ZC1
Total Floor Area	TFA	50.8500	
Assumed number of occupants	N	1.7151	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		17.4151	ZC2
CO2 emissions from cooking, equation (L16)		3.1497	ZC3
Total CO2 emissions		40.3148	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		40.3148	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.8500 (1b)	x	2.5000 (2b)	=	127.1250	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	50.8500					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	127.1250	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							2 * 10 =	20.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1573	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4073	(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) =	0.3157	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4025	0.3946	0.3867	0.3472	0.3394	0.2999	0.2999	0.2920	0.3157	0.3394	0.3551	0.3709	(22b)
Effective ac	0.5810	0.5779	0.5748	0.5603	0.5576	0.5450	0.5450	0.5426	0.5498	0.5576	0.5631	0.5688	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.3000	1.0000	2.3000			(26)
TER Opening Type (Uw = 1.40)			9.0500	1.3258	11.9981			(27)
External Wall 1	19.2300	11.3500	7.8800	0.1800	1.4184			(29a)
External Roof 1	50.8500		50.8500	0.1300	6.6105			(30)
Total net area of external elements Aum(A, m2)			70.0800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	22.3270			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							6.9142	(36)
Total fabric heat loss						(33) + (36) =	29.2412	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	24.3736	24.2417	24.1123	23.5048	23.3912	22.8621	22.8621	22.7641	23.0659	23.3912	23.6211	23.8615	(38)
Heat transfer coeff	53.6148	53.4829	53.3535	52.7461	52.6324	52.1033	52.1033	52.0053	52.3071	52.6324	52.8623	53.1027	(39)
Average = Sum(39)m / 12 =												52.7455	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0544	1.0518	1.0492	1.0373	1.0351	1.0246	1.0246	1.0227	1.0287	1.0351	1.0396	1.0443	(40)
HLP (average)												1.0373	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.7151	(42)
Average daily hot water use (litres/day)	74.9348	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	82.4282	79.4308	76.4334	73.4361	70.4387	67.4413	67.4413	70.4387	73.4361	76.4334	79.4308	82.4282	(44)
Energy conte	122.2387	106.9107	110.3223	96.1817	92.2886	79.6380	73.7963	84.6824	85.6938	99.8678	109.0135	118.3816	(45)
Energy content (annual)										Total = Sum(45)m =		1179.0155	(45)
Distribution loss (46)m = 0.15 x (45)m	18.3358	16.0366	16.5483	14.4272	13.8433	11.9457	11.0695	12.7024	12.8541	14.9802	16.3520	17.7572	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	42.0045	36.5599	38.9496	36.2150	35.8948	33.2587	34.3673	35.8948	36.2150	38.9496	39.1714	42.0045	(61)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Total heat required for water heating calculated for each month

	164.2432	143.4707	149.2719	132.3967	128.1834	112.8967	108.1637	120.5772	121.9088	138.8175	148.1849	160.3862	(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													
	164.2432	143.4707	149.2719	132.3967	128.1834	112.8967	108.1637	120.5772	121.9088	138.8175	148.1849	160.3862	(64)
								Total per year (kWh/year) = Sum(64)m =				1628.5008	(64)
Heat gains from water heating, kWh/month													
	51.1455	44.6878	46.4196	41.0342	39.6596	34.7943	33.1291	37.1306	37.5469	42.9435	46.0398	49.8630	(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	85.7574	85.7574	85.7574	85.7574	85.7574	85.7574	85.7574	85.7574	85.7574	85.7574	85.7574	85.7574	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	13.6323	12.1081	9.8470	7.4548	5.5725	4.7046	5.0835	6.6077	8.8688	11.2610	13.1432	14.0112	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	149.4413	150.9921	147.0843	138.7650	128.2635	118.3935	111.7998	110.2490	114.1568	122.4761	132.9776	142.8476	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	31.5757	31.5757	31.5757	31.5757	31.5757	31.5757	31.5757	31.5757	31.5757	31.5757	31.5757	31.5757	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-68.6059	-68.6059	-68.6059	-68.6059	-68.6059	-68.6059	-68.6059	-68.6059	-68.6059	-68.6059	-68.6059	-68.6059	(71)
Water heating gains (Table 5)													
	68.7439	66.4997	62.3919	56.9919	53.3060	48.3255	44.5284	49.9067	52.1485	57.7197	63.9442	67.0202	(72)
Total internal gains													
	283.5448	281.3271	271.0503	254.9389	238.8692	223.1507	213.1388	218.4906	226.9014	243.1840	261.7923	275.6062	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	7.9000	11.2829	0.6300	0.7000	0.7700	27.2409	(75)
Southwest	1.1500	36.7938	0.6300	0.7000	0.7700	12.9314	(79)

Solar gains	40.1723	77.4765	130.0408	201.4114	262.3674	276.6440	259.9835	212.0349	154.3661	92.1083	49.7649	33.3128	(83)
Total gains	323.7170	358.8036	401.0911	456.3503	501.2367	499.7947	473.1223	430.5255	381.2675	335.2922	311.5572	308.9190	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	65.8633	66.0258	66.1859	66.9481	67.0927	67.7740	67.7740	67.9017	67.5100	67.0927	66.8009	66.4985	
alpha	5.3909	5.4017	5.4124	5.4632	5.4728	5.5183	5.5183	5.5268	5.5007	5.4728	5.4534	5.4332	
util living area													
	0.9973	0.9948	0.9860	0.9485	0.8353	0.6416	0.4799	0.5458	0.8220	0.9723	0.9946	0.9979	(86)
MIT	19.9239	20.0520	20.2886	20.6127	20.8664	20.9758	20.9959	20.9920	20.9103	20.5824	20.1991	19.9005	(87)
Th 2	20.0383	20.0404	20.0425	20.0524	20.0542	20.0628	20.0628	20.0644	20.0595	20.0542	20.0505	20.0466	(88)
util rest of house													
	0.9965	0.9931	0.9812	0.9305	0.7852	0.5582	0.3802	0.4399	0.7501	0.9592	0.9925	0.9973	(89)
MIT 2	18.6033	18.7915	19.1359	19.6005	19.9268	20.0473	20.0613	20.0612	19.9883	19.5680	19.0142	18.5753	(90)
Living area fraction									fLA = Living area / (4) =			0.4832	(91)
MIT	19.2414	19.4005	19.6928	20.0896	20.3808	20.4959	20.5129	20.5109	20.4338	20.0582	19.5868	19.2156	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.2414	19.4005	19.6928	20.0896	20.3808	20.4959	20.5129	20.5109	20.4338	20.0582	19.5868	19.2156	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9955	0.9916	0.9789	0.9313	0.8038	0.5978	0.4285	0.4913	0.7811	0.9593	0.9911	0.9964	(94)
Useful gains	322.2539	355.7832	392.6418	425.0174	402.9040	298.7741	202.7552	211.5197	297.8178	321.6488	308.7935	307.8213	(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													
	801.0796	775.5306	703.8847	590.2085	456.8933	307.1966	203.8741	213.7909	331.3036	497.8061	660.0791	797.3704	(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													
	356.2464	282.0702	231.5647	118.9376	40.1681	0.0000	0.0000	0.0000	0.0000	131.0610	252.9256	364.2245	(98)
Space heating												1777.1981	(98)
Space heating per m2											(98) / (4) =	34.9498	(99)

8c. Space cooling requirement

Not applicable

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

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

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	93.4000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	1902.7817	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	356.2464	282.0702	231.5647	118.9376	40.1681	0.0000	0.0000	0.0000	0.0000	131.0610	252.9256	364.2245	(98)
Space heating efficiency (main heating system 1)	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)	381.4201	302.0024	247.9279	127.3422	43.0065	0.0000	0.0000	0.0000	0.0000	140.3223	270.7983	389.9620	(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	164.2432	143.4707	149.2719	132.3967	128.1834	112.8967	108.1637	120.5772	121.9088	138.8175	148.1849	160.3862	(64)
Efficiency of water heater												80.3000	(216)
(217)m	86.9490	86.7224	86.1527	84.7826	82.4992	80.3000	80.3000	80.3000	80.3000	84.9068	86.3859	87.0525	(217)
Fuel for water heating, kWh/month	188.8960	165.4366	173.2644	156.1603	155.3753	140.5937	134.6995	150.1584	151.8167	163.4939	171.5383	184.2407	(219)

Water heating fuel used	1935.6737	(219)
Annual totals kWh/year		
Space heating fuel - main system	1902.7817	(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)	240.7505	(232)
Total delivered energy for all uses	4154.2059	(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	1902.7817	0.2160	411.0008	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1935.6737	0.2160	418.1055	(264)
Space and water heating			829.1064	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	240.7505	0.5190	124.9495	(268)
Total CO2, kg/m2/year			992.9809	(272)
Emissions per m2 for space and water heating			16.3049	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.4572	(272b)
Emissions per m2 for pumps and fans			0.7655	(272c)
Target Carbon Dioxide Emission Rate (TER) = (16.3049 * 1.00) + 2.4572 + 0.7655, rounded to 2 d.p.			19.5300	(273)

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

Design SAP
elmhurst energy

Property Reference	Plot 163	**Issued on Date**	13/02/2020
Assessment Reference	001	**Prop Type Ref**	LGF
Property	Epping College Site B, Plot 163		

SAP Rating	83 B	**DER**	20.49	**TER**	19.72
Environmental	89 B	**% DER<TER**	-3.91		
CO_2 Emissions (t/year)	0.67	**DFEE**	43.08	**TFEE**	40.07
General Requirements Compliance	Fail	**% DFEE<TFEE**	-7.50		

Assessor Details	Miss Georgia Dimitriou, Georgia Dimitriou, Tel: 07599467602, erieta.dimitriou@lowenergyconsultancy.co.uk	**Assessor ID**	P864-0001
Client			

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

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

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DWELLING AS DESIGNED

Ground-floor flat, total floor area 39 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) 19.72 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 20.49 kgCO□/m²Fail
Excess emissions =0.77 kgCO□/m² (3.9%)

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)40.1 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)43.1 kWh/m²/yrFail
Excess energy =3.0 kWh/m²/yr (7.5%)

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2 Fabric U-values

Element	Average	Highest	
External wall	0.22 (max. 0.30)	0.22 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.20 (max. 0.25)	0.20 (max. 0.70)	OK
Roof	(no roof)		
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

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

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3 Air permeability
Air permeability at 50 pascals: 4.00 (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 database
Vaillant ecoFIT sustain 835 VUW 356/6-3 (H-GB)
Combi boiler
Efficiency: 89.3% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

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5 Cylinder insulation
Hot water storage No cylinder

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6 Controls
Space heating controls: Programmer, room thermostat and TRVs OK

Hot water controls: No cylinder

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
Specific fan power: 0.17
Maximum 0.7 OK

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9 Summertime temperature
Overheating risk (Thames Valley): High Fail
Based on:
Overshading: Average
Windows facing South East: 7.90 m², No overhang
Air change rate: 2.00 ach
Blinds/curtains: None

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10 Key features
Party wall U-value 0.00 W/m²K

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	38.5600 (1b)	x	2.5000 (2b)	=	96.4000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	38.5600					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	96.4000	(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		4.0000	
Infiltration rate		0.2000	(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) =	0.1550	(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	0.1976	0.1938	0.1899	0.1705	0.1666	0.1473	0.1473	0.1434	0.1550	0.1666	0.1744	0.1821	(22b)

Mechanical extract ventilation - centralised

If mechanical ventilation:	0.5000	(23a)
Effective ac	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	
Opening Type 2 (Uw = 1.30)			7.9000	1.2357	9.7624			(27)
Heat Loss Floor 1			38.5600	0.2000	7.7120			(28a)
External Wall 1	14.6500	7.9000	6.7500	0.2200	1.4850			(29a)
Total net area of external elements Aum(A, m2)			53.2100					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		18.9594			(33)
Party Wall 1			47.5500	0.0000	0.0000			(32)
Party Ceilings 1			38.5600					(32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.3232	(36)
Total fabric heat loss (33) + (36) =	28.2826	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	15.9060	15.9060	15.9060	15.9060	15.9060	15.9060	15.9060	15.9060	15.9060	15.9060	15.9060	15.9060	(38)
Heat transfer coeff	44.1886	44.1886	44.1886	44.1886	44.1886	44.1886	44.1886	44.1886	44.1886	44.1886	44.1886	44.1886	(39)
Average = Sum(39)m / 12 =												44.1886	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1460	1.1460	1.1460	1.1460	1.1460	1.1460	1.1460	1.1460	1.1460	1.1460	1.1460	1.1460	(40)
HLP (average)												1.1460	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.3686	(42)
Average daily hot water use (litres/day)	66.7045	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	73.3750	70.7068	68.0386	65.3704	62.7022	60.0341	60.0341	62.7022	65.3704	68.0386	70.7068	73.3750	(44)
Energy conte	108.8129	95.1685	98.2054	85.6178	82.1523	70.8912	65.6911	75.3815	76.2818	88.8991	97.0403	105.3795	(45)
Energy content (annual)										Total = Sum(45)m =		1049.5217	(45)
Distribution loss (46)m = 0.15 x (45)m	16.3219	14.2753	14.7308	12.8427	12.3229	10.6337	9.8537	11.3072	11.4423	13.3349	14.5561	15.8069	(46)
Water storage loss:													
Total storage loss													

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	26.1215	23.5719	26.0629	25.1831	25.9940	25.1227	25.9397	25.9749	25.1556	26.0344	25.2400	26.1102	(61)
Total heat required for water heating calculated for each month													
	134.9345	118.7404	124.2683	110.8009	108.1464	96.0139	91.6308	101.3565	101.4374	114.9335	122.2803	131.4897	(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													
	134.9345	118.7404	124.2683	110.8009	108.1464	96.0139	91.6308	101.3565	101.4374	114.9335	122.2803	131.4897	(64)
								Total per year (kWh/year) = Sum(64)m =				1356.0327	(64)
Heat gains from water heating, kWh/month													
	42.7107	37.5365	39.1690	34.7637	33.8142	29.8520	28.3272	31.5581	31.6526	36.0676	38.5759	41.5662	(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	68.4305	68.4305	68.4305	68.4305	68.4305	68.4305	68.4305	68.4305	68.4305	68.4305	68.4305	68.4305	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	10.5630	9.3820	7.6299	5.7764	4.3179	3.6453	3.9389	5.1200	6.8720	8.7256	10.1841	10.8566	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	117.9296	119.1533	116.0696	109.5045	101.2174	93.4286	88.2253	87.0015	90.0853	96.6503	104.9375	112.7262	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	29.8431	29.8431	29.8431	29.8431	29.8431	29.8431	29.8431	29.8431	29.8431	29.8431	29.8431	29.8431	(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)													
	-54.7444	-54.7444	-54.7444	-54.7444	-54.7444	-54.7444	-54.7444	-54.7444	-54.7444	-54.7444	-54.7444	-54.7444	(71)
Water heating gains (Table 5)													
	57.4068	55.8579	52.6465	48.2829	45.4491	41.4611	38.0742	42.4168	43.9620	48.4779	53.5776	55.8686	(72)
Total internal gains													
	232.4286	230.9224	222.8752	210.0930	197.5136	185.0643	176.7676	181.0675	187.4484	200.3830	215.2283	225.9806	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	7.9000	36.7938	0.5000	0.7000	0.7700	70.5023	(77)

Solar gains	70.5023	120.0915	164.3145	203.5936	228.0418	226.3927	218.2667	200.0273	177.9178	132.7267	84.4455	60.3353	(83)
Total gains	302.9309	351.0139	387.1897	413.6866	425.5554	411.4570	395.0343	381.0947	365.3663	333.1097	299.6739	286.3159	(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	60.5989	60.5989	60.5989	60.5989	60.5989	60.5989	60.5989	60.5989	60.5989	60.5989	60.5989	60.5989	
alpha	5.0399	5.0399	5.0399	5.0399	5.0399	5.0399	5.0399	5.0399	5.0399	5.0399	5.0399	5.0399	
util living area													
	0.9933	0.9854	0.9672	0.9212	0.8195	0.6511	0.4851	0.5227	0.7510	0.9366	0.9861	0.9949	(86)
MIT	19.9348	20.1090	20.3510	20.6256	20.8484	20.9637	20.9931	20.9900	20.9257	20.6403	20.2232	19.8849	(87)
Th 2	19.9635	19.9635	19.9635	19.9635	19.9635	19.9635	19.9635	19.9635	19.9635	19.9635	19.9635	19.9635	(88)
util rest of house													
	0.9912	0.9808	0.9567	0.8957	0.7647	0.5603	0.3745	0.4104	0.6674	0.9105	0.9808	0.9933	(89)
MIT 2	19.0083	19.1802	19.4163	19.6750	19.8667	19.9477	19.9618	19.9608	19.9263	19.6942	19.2944	18.9589	(90)
Living area fraction										fLA = Living area / (4) =		0.4756	(91)
MIT	19.4490	19.6220	19.8609	20.1271	20.3336	20.4309	20.4523	20.4504	20.4016	20.1442	19.7362	19.3993	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.4490	19.6220	19.8609	20.1271	20.3336	20.4309	20.4523	20.4504	20.4016	20.1442	19.7362	19.3993	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9898	0.9789	0.9555	0.9002	0.7858	0.6027	0.4274	0.4641	0.7049	0.9157	0.9794	0.9921	(94)
Useful gains	299.8560	343.6244	369.9441	372.3992	334.3816	247.9846	168.8290	176.8527	257.5601	305.0411	293.4995	284.0677	(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													
	669.4107	650.5427	590.3972	496.1102	381.5064	257.6598	170.2296	178.9792	278.4597	421.7438	558.3734	671.6354	(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													
	274.9487	206.2491	164.0171	89.0720	35.0609	0.0000	0.0000	0.0000	0.0000	86.8269	190.7092	288.3504	(98)
Space heating												1335.2342	(98)
Space heating per m2											(98) / (4) =	34.6274	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	93.2000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	1432.6547	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	274.9487	206.2491	164.0171	89.0720	35.0609	0.0000	0.0000	0.0000	0.0000	86.8269	190.7092	288.3504	(98)
Space heating efficiency (main heating system 1)	93.2000	93.2000	93.2000	93.2000	93.2000	0.0000	0.0000	0.0000	0.0000	93.2000	93.2000	93.2000	(210)
Space heating fuel (main heating system)	295.0093	221.2973	175.9840	95.5708	37.6190	0.0000	0.0000	0.0000	0.0000	93.1619	204.6236	309.3888	(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	134.9345	118.7404	124.2683	110.8009	108.1464	96.0139	91.6308	101.3565	101.4374	114.9335	122.2803	131.4897	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.2243	89.1184	88.9266	88.5690	87.9926	87.3000	87.3000	87.3000	87.3000	88.5248	89.0444	89.2712	(217)
Fuel for water heating, kWh/month	151.2307	133.2390	139.7425	125.1012	122.9039	109.9816	104.9609	116.1013	116.1941	129.8320	137.3251	147.2924	(219)
Water heating fuel used												1533.9046	(219)

Annual totals kWh/year		
Space heating fuel - main system	1432.6547	(211)
Space heating fuel - secondary	0.0000	(215)

Electricity for pumps and fans:
(MEVCentralised, Database: in-use factor = 1.3000, SFP = 0.2210)

mechanical ventilation fans (SFP = 0.2210)	25.9914	(230a)
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	100.9914	(231)
Electricity for lighting (calculated in Appendix L)	186.5463	(232)
Total delivered energy for all uses	3254.0970	(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	1432.6547	0.2160	309.4534	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1533.9046	0.2160	331.3234	(264)
Space and water heating			640.7768	(265)
Pumps and fans	100.9914	0.5190	52.4145	(267)
Energy for lighting	186.5463	0.5190	96.8175	(268)
Total CO2, kg/year			790.0088	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			20.4900	(273)

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

DER		20.4900	ZC1
Total Floor Area	TFA	38.5600	
Assumed number of occupants	N	1.3686	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		18.1231	ZC2
CO2 emissions from cooking, equation (L16)		3.9379	ZC3
Total CO2 emissions		42.5510	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		42.5510	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	38.5600 (1b)	x	2.5000 (2b)	=	96.4000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	38.5600					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	96.4000	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							2 * 10 =		20.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.2075	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4575	(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) =	0.3545	(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	0.4520	0.4432	0.4343	0.3900	0.3811	0.3368	0.3368	0.3279	0.3545	0.3811	0.3989	0.4166	(22b)
Effective ac	0.6022	0.5982	0.5943	0.5760	0.5726	0.5567	0.5567	0.5538	0.5628	0.5726	0.5795	0.5868	(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 Opening Type (Uw = 1.40)			7.9000	1.3258	10.4735			(27)
Heat Loss Floor 1			38.5600	0.1300	5.0128			(28a)
External Wall 1	14.6500	7.9000	6.7500	0.1800	1.2150			(29a)
Total net area of external elements Aum(A, m2)			53.2100					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	16.7013			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							6.9497	(36)
Total fabric heat loss						(33) + (36) =	23.6510	(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	19.1562	19.0300	18.9063	18.3252	18.2165	17.7104	17.7104	17.6167	17.9053	18.2165	18.4364	18.6663	(38)
Heat transfer coeff	42.8072	42.6810	42.5573	41.9762	41.8675	41.3614	41.3614	41.2677	41.5563	41.8675	42.0874	42.3173	(39)
Average = Sum(39)m / 12 =												41.9757	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1101	1.1069	1.1037	1.0886	1.0858	1.0727	1.0727	1.0702	1.0777	1.0858	1.0915	1.0974	(40)
HLP (average)												1.0886	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.3686	(42)
Average daily hot water use (litres/day)	66.7045	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	73.3750	70.7068	68.0386	65.3704	62.7022	60.0341	60.0341	62.7022	65.3704	68.0386	70.7068	73.3750	(44)
Energy conte	108.8129	95.1685	98.2054	85.6178	82.1523	70.8912	65.6911	75.3815	76.2818	88.8991	97.0403	105.3795	(45)
Energy content (annual)										Total = Sum(45)m =		1049.5217	(45)
Distribution loss (46)m = 0.15 x (45)m	16.3219	14.2753	14.7308	12.8427	12.3229	10.6337	9.8537	11.3072	11.4423	13.3349	14.5561	15.8069	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	37.3911	32.5445	34.6717	32.2375	31.9524	29.6058	30.5927	31.9524	32.2375	34.6717	34.8691	37.3911	(61)
Total heat required for water heating calculated for each month													

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	146.2040	127.7130	132.8771	117.8553	114.1047	100.4971	96.2838	107.3339	108.5193	123.5708	131.9094	142.7706	(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													
	146.2040	127.7130	132.8771	117.8553	114.1047	100.4971	96.2838	107.3339	108.5193	123.5708	131.9094	142.7706	(64)
								Total per year (kWh/year) = Sum(64)m =				1449.6391	(64)
Heat gains from water heating, kWh/month													
	45.5281	39.7796	41.3212	36.5273	35.3037	30.9728	29.4905	33.0525	33.4231	38.2269	40.9832	44.3865	(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	68.4305	68.4305	68.4305	68.4305	68.4305	68.4305	68.4305	68.4305	68.4305	68.4305	68.4305	68.4305	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	10.5630	9.3820	7.6299	5.7764	4.3179	3.6453	3.9389	5.1200	6.8720	8.7256	10.1841	10.8566	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	117.9296	119.1533	116.0696	109.5045	101.2174	93.4286	88.2253	87.0015	90.0853	96.6503	104.9375	112.7262	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	29.8431	29.8431	29.8431	29.8431	29.8431	29.8431	29.8431	29.8431	29.8431	29.8431	29.8431	29.8431	(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)													
	-54.7444	-54.7444	-54.7444	-54.7444	-54.7444	-54.7444	-54.7444	-54.7444	-54.7444	-54.7444	-54.7444	-54.7444	(71)
Water heating gains (Table 5)													
	61.1936	59.1959	55.5393	50.7323	47.4513	43.0178	39.6377	44.4253	46.4209	51.3802	56.9211	59.6592	(72)
Total internal gains													
	236.2154	234.2604	225.7679	212.5424	199.5157	186.6209	178.3311	183.0760	189.9074	203.2853	218.5718	229.7712	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	7.9000	36.7938	0.6300	0.7000	0.7700	88.8329	(77)

Solar gains	88.8329	151.3153	207.0362	256.5279	287.3327	285.2548	275.0161	252.0344	224.1765	167.2357	106.4014	76.0225	(83)
Total gains	325.0484	385.5757	432.8042	469.0703	486.8484	471.8757	453.3472	435.1104	414.0839	370.5210	324.9732	305.7937	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	62.5544	62.7394	62.9218	63.7928	63.9584	64.7410	64.7410	64.8880	64.4373	63.9584	63.6242	63.2785	
alpha	5.1703	5.1826	5.1948	5.2529	5.2639	5.3161	5.3161	5.3259	5.2958	5.2639	5.2416	5.2186	
util living area													
	0.9907	0.9774	0.9468	0.8715	0.7342	0.5493	0.3996	0.4333	0.6587	0.8998	0.9791	0.9930	(86)
MIT	20.0361	20.2382	20.4908	20.7559	20.9213	20.9864	20.9979	20.9968	20.9655	20.7486	20.3431	19.9984	(87)
Th 2	19.9926	19.9952	19.9978	20.0102	20.0125	20.0232	20.0232	20.0252	20.0191	20.0125	20.0078	20.0029	(88)
util rest of house													
	0.9878	0.9707	0.9315	0.8376	0.6752	0.4705	0.3119	0.3431	0.5781	0.8651	0.9717	0.9908	(89)
MIT 2	18.7324	19.0244	19.3816	19.7452	19.9428	20.0150	20.0225	20.0240	19.9953	19.7470	19.1875	18.6855	(90)
Living area fraction									fLA = Living area / (4) =			0.4756	(91)
MIT	19.3525	19.6018	19.9092	20.2259	20.4082	20.4770	20.4864	20.4867	20.4568	20.2234	19.7371	19.3100	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.3525	19.6018	19.9092	20.2259	20.4082	20.4770	20.4864	20.4867	20.4568	20.2234	19.7371	19.3100	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9854	0.9675	0.9299	0.8457	0.6998	0.5077	0.3537	0.3861	0.6152	0.8734	0.9692	0.9888	(94)
Useful gains	320.2955	373.0443	402.4729	396.6761	340.7063	239.5604	160.3282	167.9832	254.7610	323.6028	314.9532	302.3616	(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													
	644.3551	627.4852	570.6576	475.4176	364.5897	243.0806	160.7478	168.6483	264.1633	402.9064	531.8644	639.4143	(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													
	241.1003	170.9843	125.1295	56.6939	17.7693	0.0000	0.0000	0.0000	0.0000	59.0019	156.1761	250.7672	(98)
Space heating												1077.6224	(98)
Space heating per m2											(98) / (4) =	27.9466	(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 %)	93.4000	(206)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												1153.7713	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	241.1003	170.9843	125.1295	56.6939	17.7693	0.0000	0.0000	0.0000	0.0000	59.0019	156.1761	250.7672	(98)
Space heating efficiency (main heating system 1)	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)	258.1374	183.0667	133.9716	60.7001	19.0249	0.0000	0.0000	0.0000	0.0000	63.1712	167.2121	268.4873	(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	146.2040	127.7130	132.8771	117.8553	114.1047	100.4971	96.2838	107.3339	108.5193	123.5708	131.9094	142.7706	(64)
Efficiency of water heater												80.3000	(216)
(217)m	86.3023	85.7865	84.9004	83.3237	81.5273	80.3000	80.3000	80.3000	80.3000	83.3079	85.4772	86.4550	(217)
Fuel for water heating, kWh/month	169.4091	148.8730	156.5095	141.4427	139.9588	125.1520	119.9051	133.6661	135.1423	148.3302	154.3212	165.1387	(219)
Water heating fuel used												1737.8487	(219)
Annual totals kWh/year													
Space heating fuel - main system												1153.7713	(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)												186.5463	(232)
Total delivered energy for all uses												3153.1663	(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	1153.7713	0.2160	249.2146	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1737.8487	0.2160	375.3753	(264)
Space and water heating			624.5899	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	186.5463	0.5190	96.8175	(268)
Total CO2, kg/m2/year			760.3324	(272)
Emissions per m2 for space and water heating			16.1979	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.5108	(272b)
Emissions per m2 for pumps and fans			1.0095	(272c)
Target Carbon Dioxide Emission Rate (TER) = (16.1979 * 1.00) + 2.5108 + 1.0095, rounded to 2 d.p.			19.7200	(273)

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

Design SAP
elmhurst energy

Property Reference	Plot 165	**Issued on Date**	13/02/2020
Assessment Reference	001	**Prop Type Ref**	LGF
Property	Epping College Site B, Plot 165		

SAP Rating	83 B	**DER**	20.49	**TER**	19.72
Environmental	89 B	**% DER<TER**	-3.91		
CO_2 Emissions (t/year)	0.67	**DFEE**	43.08	**TFEE**	40.07
General Requirements Compliance	Fail	**% DFEE<TFEE**	-7.50		

Assessor Details	Miss Georgia Dimitriou, Georgia Dimitriou, Tel: 07599467602, erieta.dimitriou@lowenergyconsultancy.co.uk	**Assessor ID**	P864-0001
Client			

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

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

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DWELLING AS DESIGNED

Ground-floor flat, total floor area 39 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) 19.72 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 20.49 kgCO□/m²Fail
Excess emissions =0.77 kgCO□/m² (3.9%)

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)40.1 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)43.1 kWh/m²/yrFail
Excess energy =3.0 kWh/m²/yr (7.5%)

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2 Fabric U-values

Element	Average	Highest	
External wall	0.22 (max. 0.30)	0.22 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.20 (max. 0.25)	0.20 (max. 0.70)	OK
Roof	(no roof)		
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

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

---

3 Air permeability
Air permeability at 50 pascals: 4.00 (design value)
Maximum 10.0 OK

---

4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Vaillant ecoFIT sustain 835 VUW 356/6-3 (H-GB)
Combi boiler
Efficiency: 89.3% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

---

5 Cylinder insulation
Hot water storage No cylinder

---

6 Controls
Space heating controls: Programmer, room thermostat and TRVs OK

Hot water controls: No cylinder

Boiler interlock Yes OK

---

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

---

8 Mechanical ventilation
Continuous extract system
Specific fan power: 0.17
Maximum 0.7 OK

---

9 Summertime temperature
Overheating risk (Thames Valley): High Fail
Based on:
Overshading: Average
Windows facing South East: 7.90 m², No overhang
Air change rate: 2.00 ach
Blinds/curtains: None

---

10 Key features
Party wall U-value 0.00 W/m²K

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	38.5600 (1b)	x	2.5000 (2b)	=	96.4000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	38.5600					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	96.4000	(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		4.0000	
Infiltration rate		0.2000	(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) =	0.1550	(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	0.1976	0.1938	0.1899	0.1705	0.1666	0.1473	0.1473	0.1434	0.1550	0.1666	0.1744	0.1821	(22b)

Mechanical extract ventilation - centralised

If mechanical ventilation:	0.5000	(23a)
Effective ac	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	
Opening Type 2 (Uw = 1.30)			7.9000	1.2357	9.7624			(27)
Heat Loss Floor 1			38.5600	0.2000	7.7120			(28a)
External Wall 1	14.6500	7.9000	6.7500	0.2200	1.4850			(29a)
Total net area of external elements Aum(A, m2)			53.2100					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		18.9594			(33)
Party Wall 1			47.5500	0.0000	0.0000			(32)
Party Ceilings 1			38.5600					(32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.3232	(36)
Total fabric heat loss (33) + (36) =	28.2826	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	15.9060	15.9060	15.9060	15.9060	15.9060	15.9060	15.9060	15.9060	15.9060	15.9060	15.9060	15.9060	(38)
Heat transfer coeff	44.1886	44.1886	44.1886	44.1886	44.1886	44.1886	44.1886	44.1886	44.1886	44.1886	44.1886	44.1886	(39)
Average = Sum(39)m / 12 =												44.1886	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1460	1.1460	1.1460	1.1460	1.1460	1.1460	1.1460	1.1460	1.1460	1.1460	1.1460	1.1460	(40)
HLP (average)												1.1460	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.3686	(42)
Average daily hot water use (litres/day)	66.7045	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	73.3750	70.7068	68.0386	65.3704	62.7022	60.0341	60.0341	62.7022	65.3704	68.0386	70.7068	73.3750	(44)
Energy conte	108.8129	95.1685	98.2054	85.6178	82.1523	70.8912	65.6911	75.3815	76.2818	88.8991	97.0403	105.3795	(45)
Energy content (annual)										Total = Sum(45)m =		1049.5217	(45)
Distribution loss (46)m = 0.15 x (45)m	16.3219	14.2753	14.7308	12.8427	12.3229	10.6337	9.8537	11.3072	11.4423	13.3349	14.5561	15.8069	(46)
Water storage loss:													
Total storage loss													

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	26.1215	23.5719	26.0629	25.1831	25.9940	25.1227	25.9397	25.9749	25.1556	26.0344	25.2400	26.1102	(61)
Total heat required for water heating calculated for each month													
	134.9345	118.7404	124.2683	110.8009	108.1464	96.0139	91.6308	101.3565	101.4374	114.9335	122.2803	131.4897	(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													
	134.9345	118.7404	124.2683	110.8009	108.1464	96.0139	91.6308	101.3565	101.4374	114.9335	122.2803	131.4897	(64)
								Total per year (kWh/year) = Sum(64)m =				1356.0327	(64)
Heat gains from water heating, kWh/month													
	42.7107	37.5365	39.1690	34.7637	33.8142	29.8520	28.3272	31.5581	31.6526	36.0676	38.5759	41.5662	(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	68.4305	68.4305	68.4305	68.4305	68.4305	68.4305	68.4305	68.4305	68.4305	68.4305	68.4305	68.4305	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	10.5630	9.3820	7.6299	5.7764	4.3179	3.6453	3.9389	5.1200	6.8720	8.7256	10.1841	10.8566	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	117.9296	119.1533	116.0696	109.5045	101.2174	93.4286	88.2253	87.0015	90.0853	96.6503	104.9375	112.7262	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	29.8431	29.8431	29.8431	29.8431	29.8431	29.8431	29.8431	29.8431	29.8431	29.8431	29.8431	29.8431	(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)													
	-54.7444	-54.7444	-54.7444	-54.7444	-54.7444	-54.7444	-54.7444	-54.7444	-54.7444	-54.7444	-54.7444	-54.7444	(71)
Water heating gains (Table 5)													
	57.4068	55.8579	52.6465	48.2829	45.4491	41.4611	38.0742	42.4168	43.9620	48.4779	53.5776	55.8686	(72)
Total internal gains													
	232.4286	230.9224	222.8752	210.0930	197.5136	185.0643	176.7676	181.0675	187.4484	200.3830	215.2283	225.9806	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	7.9000	36.7938	0.5000	0.7000	0.7700	70.5023	(77)

Solar gains	70.5023	120.0915	164.3145	203.5936	228.0418	226.3927	218.2667	200.0273	177.9178	132.7267	84.4455	60.3353	(83)
Total gains	302.9309	351.0139	387.1897	413.6866	425.5554	411.4570	395.0343	381.0947	365.3663	333.1097	299.6739	286.3159	(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	60.5989	60.5989	60.5989	60.5989	60.5989	60.5989	60.5989	60.5989	60.5989	60.5989	60.5989	60.5989	
alpha	5.0399	5.0399	5.0399	5.0399	5.0399	5.0399	5.0399	5.0399	5.0399	5.0399	5.0399	5.0399	
util living area													
	0.9933	0.9854	0.9672	0.9212	0.8195	0.6511	0.4851	0.5227	0.7510	0.9366	0.9861	0.9949	(86)
MIT	19.9348	20.1090	20.3510	20.6256	20.8484	20.9637	20.9931	20.9900	20.9257	20.6403	20.2232	19.8849	(87)
Th 2	19.9635	19.9635	19.9635	19.9635	19.9635	19.9635	19.9635	19.9635	19.9635	19.9635	19.9635	19.9635	(88)
util rest of house													
	0.9912	0.9808	0.9567	0.8957	0.7647	0.5603	0.3745	0.4104	0.6674	0.9105	0.9808	0.9933	(89)
MIT 2	19.0083	19.1802	19.4163	19.6750	19.8667	19.9477	19.9618	19.9608	19.9263	19.6942	19.2944	18.9589	(90)
Living area fraction										fLA = Living area / (4) =		0.4756	(91)
MIT	19.4490	19.6220	19.8609	20.1271	20.3336	20.4309	20.4523	20.4504	20.4016	20.1442	19.7362	19.3993	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.4490	19.6220	19.8609	20.1271	20.3336	20.4309	20.4523	20.4504	20.4016	20.1442	19.7362	19.3993	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9898	0.9789	0.9555	0.9002	0.7858	0.6027	0.4274	0.4641	0.7049	0.9157	0.9794	0.9921	(94)
Useful gains	299.8560	343.6244	369.9441	372.3992	334.3816	247.9846	168.8290	176.8527	257.5601	305.0411	293.4995	284.0677	(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													
	669.4107	650.5427	590.3972	496.1102	381.5064	257.6598	170.2296	178.9792	278.4597	421.7438	558.3734	671.6354	(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													
	274.9487	206.2491	164.0171	89.0720	35.0609	0.0000	0.0000	0.0000	0.0000	86.8269	190.7092	288.3504	(98)
Space heating												1335.2342	(98)
Space heating per m2											(98) / (4) =	34.6274	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	93.2000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	1432.6547	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	274.9487	206.2491	164.0171	89.0720	35.0609	0.0000	0.0000	0.0000	0.0000	86.8269	190.7092	288.3504	(98)
Space heating efficiency (main heating system 1)	93.2000	93.2000	93.2000	93.2000	93.2000	0.0000	0.0000	0.0000	0.0000	93.2000	93.2000	93.2000	(210)
Space heating fuel (main heating system)	295.0093	221.2973	175.9840	95.5708	37.6190	0.0000	0.0000	0.0000	0.0000	93.1619	204.6236	309.3888	(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	134.9345	118.7404	124.2683	110.8009	108.1464	96.0139	91.6308	101.3565	101.4374	114.9335	122.2803	131.4897	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.2243	89.1184	88.9266	88.5690	87.9926	87.3000	87.3000	87.3000	87.3000	88.5248	89.0444	89.2712	(217)
Fuel for water heating, kWh/month	151.2307	133.2390	139.7425	125.1012	122.9039	109.9816	104.9609	116.1013	116.1941	129.8320	137.3251	147.2924	(219)
Water heating fuel used												1533.9046	(219)

Annual totals kWh/year		
Space heating fuel - main system	1432.6547	(211)
Space heating fuel - secondary	0.0000	(215)

Electricity for pumps and fans:
(MEVCentralised, Database: in-use factor = 1.3000, SFP = 0.2210)

mechanical ventilation fans (SFP = 0.2210)	25.9914	(230a)
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	100.9914	(231)
Electricity for lighting (calculated in Appendix L)	186.5463	(232)
Total delivered energy for all uses	3254.0970	(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	1432.6547	0.2160	309.4534	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1533.9046	0.2160	331.3234	(264)
Space and water heating			640.7768	(265)
Pumps and fans	100.9914	0.5190	52.4145	(267)
Energy for lighting	186.5463	0.5190	96.8175	(268)
Total CO2, kg/year			790.0088	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			20.4900	(273)

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

DER		20.4900	ZC1
Total Floor Area	TFA	38.5600	
Assumed number of occupants	N	1.3686	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		18.1231	ZC2
CO2 emissions from cooking, equation (L16)		3.9379	ZC3
Total CO2 emissions		42.5510	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		42.5510	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	38.5600 (1b)	x	2.5000 (2b)	=	96.4000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	38.5600					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	96.4000	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							2 * 10 =		20.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.2075	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4575	(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) =	0.3545	(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	0.4520	0.4432	0.4343	0.3900	0.3811	0.3368	0.3368	0.3279	0.3545	0.3811	0.3989	0.4166	(22b)
Effective ac	0.6022	0.5982	0.5943	0.5760	0.5726	0.5567	0.5567	0.5538	0.5628	0.5726	0.5795	0.5868	(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 Opening Type (Uw = 1.40)			7.9000	1.3258	10.4735			(27)
Heat Loss Floor 1			38.5600	0.1300	5.0128			(28a)
External Wall 1	14.6500	7.9000	6.7500	0.1800	1.2150			(29a)
Total net area of external elements Aum(A, m2)			53.2100					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	16.7013			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							6.9497	(36)
Total fabric heat loss						(33) + (36) =	23.6510	(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	19.1562	19.0300	18.9063	18.3252	18.2165	17.7104	17.7104	17.6167	17.9053	18.2165	18.4364	18.6663	(38)
Heat transfer coeff	42.8072	42.6810	42.5573	41.9762	41.8675	41.3614	41.3614	41.2677	41.5563	41.8675	42.0874	42.3173	(39)
Average = Sum(39)m / 12 =												41.9757	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1101	1.1069	1.1037	1.0886	1.0858	1.0727	1.0727	1.0702	1.0777	1.0858	1.0915	1.0974	(40)
HLP (average)												1.0886	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.3686	(42)
Average daily hot water use (litres/day)	66.7045	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	73.3750	70.7068	68.0386	65.3704	62.7022	60.0341	60.0341	62.7022	65.3704	68.0386	70.7068	73.3750	(44)
Energy conte	108.8129	95.1685	98.2054	85.6178	82.1523	70.8912	65.6911	75.3815	76.2818	88.8991	97.0403	105.3795	(45)
Energy content (annual)										Total = Sum(45)m =		1049.5217	(45)
Distribution loss (46)m = 0.15 x (45)m	16.3219	14.2753	14.7308	12.8427	12.3229	10.6337	9.8537	11.3072	11.4423	13.3349	14.5561	15.8069	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	37.3911	32.5445	34.6717	32.2375	31.9524	29.6058	30.5927	31.9524	32.2375	34.6717	34.8691	37.3911	(61)
Total heat required for water heating calculated for each month													

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	146.2040	127.7130	132.8771	117.8553	114.1047	100.4971	96.2838	107.3339	108.5193	123.5708	131.9094	142.7706	(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													
	146.2040	127.7130	132.8771	117.8553	114.1047	100.4971	96.2838	107.3339	108.5193	123.5708	131.9094	142.7706	(64)
								Total per year (kWh/year) = Sum(64)m =				1449.6391	(64)
Heat gains from water heating, kWh/month													
	45.5281	39.7796	41.3212	36.5273	35.3037	30.9728	29.4905	33.0525	33.4231	38.2269	40.9832	44.3865	(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	68.4305	68.4305	68.4305	68.4305	68.4305	68.4305	68.4305	68.4305	68.4305	68.4305	68.4305	68.4305	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	10.5630	9.3820	7.6299	5.7764	4.3179	3.6453	3.9389	5.1200	6.8720	8.7256	10.1841	10.8566	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	117.9296	119.1533	116.0696	109.5045	101.2174	93.4286	88.2253	87.0015	90.0853	96.6503	104.9375	112.7262	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	29.8431	29.8431	29.8431	29.8431	29.8431	29.8431	29.8431	29.8431	29.8431	29.8431	29.8431	29.8431	(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)													
	-54.7444	-54.7444	-54.7444	-54.7444	-54.7444	-54.7444	-54.7444	-54.7444	-54.7444	-54.7444	-54.7444	-54.7444	(71)
Water heating gains (Table 5)													
	61.1936	59.1959	55.5393	50.7323	47.4513	43.0178	39.6377	44.4253	46.4209	51.3802	56.9211	59.6592	(72)
Total internal gains													
	236.2154	234.2604	225.7679	212.5424	199.5157	186.6209	178.3311	183.0760	189.9074	203.2853	218.5718	229.7712	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	7.9000	36.7938	0.6300	0.7000	0.7700	88.8329	(77)

Solar gains	88.8329	151.3153	207.0362	256.5279	287.3327	285.2548	275.0161	252.0344	224.1765	167.2357	106.4014	76.0225	(83)
Total gains	325.0484	385.5757	432.8042	469.0703	486.8484	471.8757	453.3472	435.1104	414.0839	370.5210	324.9732	305.7937	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	62.5544	62.7394	62.9218	63.7928	63.9584	64.7410	64.7410	64.8880	64.4373	63.9584	63.6242	63.2785	
alpha	5.1703	5.1826	5.1948	5.2529	5.2639	5.3161	5.3161	5.3259	5.2958	5.2639	5.2416	5.2186	
util living area													
	0.9907	0.9774	0.9468	0.8715	0.7342	0.5493	0.3996	0.4333	0.6587	0.8998	0.9791	0.9930	(86)
MIT	20.0361	20.2382	20.4908	20.7559	20.9213	20.9864	20.9979	20.9968	20.9655	20.7486	20.3431	19.9984	(87)
Th 2	19.9926	19.9952	19.9978	20.0102	20.0125	20.0232	20.0232	20.0252	20.0191	20.0125	20.0078	20.0029	(88)
util rest of house													
	0.9878	0.9707	0.9315	0.8376	0.6752	0.4705	0.3119	0.3431	0.5781	0.8651	0.9717	0.9908	(89)
MIT 2	18.7324	19.0244	19.3816	19.7452	19.9428	20.0150	20.0225	20.0240	19.9953	19.7470	19.1875	18.6855	(90)
Living area fraction									fLA = Living area / (4) =			0.4756	(91)
MIT	19.3525	19.6018	19.9092	20.2259	20.4082	20.4770	20.4864	20.4867	20.4568	20.2234	19.7371	19.3100	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.3525	19.6018	19.9092	20.2259	20.4082	20.4770	20.4864	20.4867	20.4568	20.2234	19.7371	19.3100	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9854	0.9675	0.9299	0.8457	0.6998	0.5077	0.3537	0.3861	0.6152	0.8734	0.9692	0.9888	(94)
Useful gains	320.2955	373.0443	402.4729	396.6761	340.7063	239.5604	160.3282	167.9832	254.7610	323.6028	314.9532	302.3616	(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													
	644.3551	627.4852	570.6576	475.4176	364.5897	243.0806	160.7478	168.6483	264.1633	402.9064	531.8644	639.4143	(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													
	241.1003	170.9843	125.1295	56.6939	17.7693	0.0000	0.0000	0.0000	0.0000	59.0019	156.1761	250.7672	(98)
Space heating												1077.6224	(98)
Space heating per m2											(98) / (4) =	27.9466	(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 %)	93.4000	(206)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												1153.7713	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	241.1003	170.9843	125.1295	56.6939	17.7693	0.0000	0.0000	0.0000	0.0000	59.0019	156.1761	250.7672	(98)
Space heating efficiency (main heating system 1)	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)	258.1374	183.0667	133.9716	60.7001	19.0249	0.0000	0.0000	0.0000	0.0000	63.1712	167.2121	268.4873	(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	146.2040	127.7130	132.8771	117.8553	114.1047	100.4971	96.2838	107.3339	108.5193	123.5708	131.9094	142.7706	(64)
Efficiency of water heater												80.3000	(216)
(217)m	86.3023	85.7865	84.9004	83.3237	81.5273	80.3000	80.3000	80.3000	80.3000	83.3079	85.4772	86.4550	(217)
Fuel for water heating, kWh/month	169.4091	148.8730	156.5095	141.4427	139.9588	125.1520	119.9051	133.6661	135.1423	148.3302	154.3212	165.1387	(219)
Water heating fuel used												1737.8487	(219)
Annual totals kWh/year													
Space heating fuel - main system												1153.7713	(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)												186.5463	(232)
Total delivered energy for all uses												3153.1663	(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	1153.7713	0.2160	249.2146	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1737.8487	0.2160	375.3753	(264)
Space and water heating			624.5899	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	186.5463	0.5190	96.8175	(268)
Total CO2, kg/m2/year			760.3324	(272)
Emissions per m2 for space and water heating			16.1979	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.5108	(272b)
Emissions per m2 for pumps and fans			1.0095	(272c)
Target Carbon Dioxide Emission Rate (TER) = (16.1979 * 1.00) + 2.5108 + 1.0095, rounded to 2 d.p.			19.7200	(273)

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

Design SAP
elmhurst energy

Property Reference	Plot 167	**Issued on Date**	13/02/2020
Assessment Reference	001	**Prop Type Ref**	GF
Property	Epping College Site B, Plot 167		

SAP Rating	81 B	**DER**	23.93	**TER**	22.66
Environmental	85 B	**% DER<TER**	-5.62		
CO_2 Emissions (t/year)	1.01	**DFEE**	63.64	**TFEE**	62.51
General Requirements Compliance	Fail	**% DFEE<TFEE**	-1.82		

Assessor Details	Miss Georgia Dimitriou, Georgia Dimitriou, Tel: 07599467602, erieta.dimitriou@lowenergyconsultancy.co.uk	**Assessor ID**	P864-0001
Client			

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

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DWELLING AS DESIGNED

Ground-floor flat, total floor area 50 m²

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

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 22.66 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 23.93 kgCO□/m²Fail
Excess emissions =1.27 kgCO□/m² (5.6%)

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)62.5 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)63.6 kWh/m²/yrFail
Excess energy =1.1 kWh/m²/yr (1.8%)

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2 Fabric U-values

Element	Average	Highest	
External wall	0.22 (max. 0.30)	0.22 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.20 (max. 0.25)	0.20 (max. 0.70)	OK
Roof	(no roof)		
Openings	1.34 (max. 2.00)	1.50 (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: 4.00 (design value)
Maximum 10.0 OK

---

4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Vaillant ecoFIT sustain 835 VUW 356/6-3 (H-GB)
Combi boiler
Efficiency: 89.3% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

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5 Cylinder insulation
Hot water storage No cylinder

---

6 Controls
Space heating controls: Programmer, room thermostat and TRVs OK

Hot water controls: No cylinder

Boiler interlock Yes OK

---

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

---

8 Mechanical ventilation
Continuous extract system
Specific fan power: 0.17
Maximum 0.7 OK

---

9 Summertime temperature
Overheating risk (Thames Valley): Medium OK
Based on:
Overshading: Average
Windows facing North East: 9.18 m², No overhang
Air change rate: 2.00 ach
Blinds/curtains: None

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10 Key features
Party wall U-value 0.00 W/m²K

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.2100 (1b)	x	2.5000 (2b)	=	125.5250	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	50.2100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		125.5250	(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		4.0000	
Infiltration rate		0.2000	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1700	(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	0.2168	0.2125	0.2083	0.1870	0.1828	0.1615	0.1615	0.1573	0.1700	0.1828	0.1913	0.1998	(22b)

Mechanical extract ventilation - centralised

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	
Opening Type 1			2.3000	1.5000	3.4500			(26)
Opening Type 2 (Uw = 1.30)			9.1800	1.2357	11.3441			(27)
Heat Loss Floor 1			50.2100	0.2000	10.0420			(28a)
External Wall 1	66.1800	11.4800	54.7000	0.2200	12.0340			(29a)
Total net area of external elements Aum(A, m2)			116.3900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		36.8701			(33)
Party Wall 1			11.4800	0.0000	0.0000			(32)
Party Ceilings 1			50.2100					(32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.9027	(36)
Total fabric heat loss (33) + (36) =	46.7728	(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	20.7116	20.7116	20.7116	20.7116	20.7116	20.7116	20.7116	20.7116	20.7116	20.7116	20.7116	20.7116	(38)
Heat transfer coeff	67.4844	67.4844	67.4844	67.4844	67.4844	67.4844	67.4844	67.4844	67.4844	67.4844	67.4844	67.4844	(39)
Average = Sum(39)m / 12 =												67.4844	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3440	1.3440	1.3440	1.3440	1.3440	1.3440	1.3440	1.3440	1.3440	1.3440	1.3440	1.3440	(40)
HLP (average)												1.3440	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.6963	(42)
Average daily hot water use (litres/day)	74.4868	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	81.9354	78.9560	75.9765	72.9970	70.0176	67.0381	67.0381	70.0176	72.9970	75.9765	78.9560	81.9354	(44)
Energy conte	121.5079	106.2716	109.6628	95.6067	91.7369	79.1619	73.3552	84.1761	85.1815	99.2708	108.3618	117.6739	(45)
Energy content (annual)										Total = Sum(45)m =		1171.9670	(45)
Distribution loss (46)m = 0.15 x (45)m	18.2262	15.9407	16.4494	14.3410	13.7605	11.8743	11.0033	12.6264	12.7772	14.8906	16.2543	17.6511	(46)
Water storage loss:													

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	26.2103	23.6467	26.1372	25.2453	26.0513	25.1700	25.9835	26.0275	25.2110	26.1016	25.3162	26.1961	(61)
Total heat required for water heating calculated for each month													
	147.7182	129.9183	135.7999	120.8519	117.7881	104.3319	99.3387	110.2036	110.3925	125.3724	133.6780	143.8700	(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													
	147.7182	129.9183	135.7999	120.8519	117.7881	104.3319	99.3387	110.2036	110.3925	125.3724	133.6780	143.8700	(64)
								Total per year (kWh/year) = Sum(64)m =				1479.2636	(64)
Heat gains from water heating, kWh/month													
	46.9539	41.2470	42.9972	38.1005	37.0153	32.6138	30.8865	34.4954	34.6256	39.5329	42.3594	45.6756	(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	84.8143	84.8143	84.8143	84.8143	84.8143	84.8143	84.8143	84.8143	84.8143	84.8143	84.8143	84.8143	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	13.4232	11.9224	9.6959	7.3404	5.4871	4.6324	5.0055	6.5063	8.7328	11.0882	12.9416	13.7963	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	147.7793	149.3128	145.4485	137.2218	126.8370	117.0768	110.5564	109.0229	112.8873	121.1140	131.4987	141.2589	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	31.4814	31.4814	31.4814	31.4814	31.4814	31.4814	31.4814	31.4814	31.4814	31.4814	31.4814	31.4814	(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)													
	-67.8514	-67.8514	-67.8514	-67.8514	-67.8514	-67.8514	-67.8514	-67.8514	-67.8514	-67.8514	-67.8514	-67.8514	(71)
Water heating gains (Table 5)													
	63.1101	61.3794	57.7919	52.9174	49.7518	45.2970	41.5141	46.3648	48.0911	53.1357	58.8324	61.3919	(72)
Total internal gains													
	275.7570	274.0589	264.3806	248.9239	233.5201	218.4505	208.5202	213.3383	221.1554	236.7822	254.7171	267.8914	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	9.1800	11.2829	0.5000	0.7000	0.7700	25.1227	(75)

Solar gains	25.1227	51.1380	92.1344	151.3111	203.3918	216.8372	202.8468	161.7118	112.2672	62.4947	31.6109	20.5165	(83)
Total gains	300.8797	325.1969	356.5149	400.2350	436.9120	435.2877	411.3670	375.0501	333.4226	299.2768	286.3279	288.4079	(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	51.6683	51.6683	51.6683	51.6683	51.6683	51.6683	51.6683	51.6683	51.6683	51.6683	51.6683	51.6683	
alpha	4.4446	4.4446	4.4446	4.4446	4.4446	4.4446	4.4446	4.4446	4.4446	4.4446	4.4446	4.4446	
util living area													
	0.9979	0.9967	0.9928	0.9781	0.9294	0.8131	0.6650	0.7320	0.9232	0.9869	0.9964	0.9983	(86)
MIT	19.5064	19.6227	19.8716	20.2320	20.5998	20.8592	20.9578	20.9351	20.7149	20.2656	19.8208	19.4719	(87)
Th 2	19.8065	19.8065	19.8065	19.8065	19.8065	19.8065	19.8065	19.8065	19.8065	19.8065	19.8065	19.8065	(88)
util rest of house													
	0.9972	0.9955	0.9900	0.9684	0.8950	0.7199	0.5112	0.5840	0.8699	0.9794	0.9949	0.9977	(89)
MIT 2	18.4580	18.5740	18.8218	19.1770	19.5246	19.7379	19.7955	19.7869	19.6348	19.2136	18.7720	18.4236	(90)
Living area fraction									fLA = Living area / (4) =			0.5117	(91)
MIT	18.9944	19.1106	19.3590	19.7168	20.0747	20.3116	20.3902	20.3744	20.1874	19.7519	19.3086	18.9600	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9944	19.1106	19.3590	19.7168	20.0747	20.3116	20.3902	20.3744	20.1874	19.7519	19.3086	18.9600	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9965	0.9946	0.9886	0.9675	0.9041	0.7635	0.5910	0.6604	0.8903	0.9790	0.9940	0.9971	(94)
Useful gains	299.8327	323.4348	352.4535	387.2335	395.0083	332.3560	243.1205	247.6865	296.8400	292.9920	284.6190	287.5768	(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													
	991.6453	958.9914	867.7803	729.9674	565.1638	385.4431	255.7790	268.2092	410.8047	617.6099	823.8905	996.0695	(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													
	514.7086	427.0940	383.4031	246.7684	126.5956	0.0000	0.0000	0.0000	0.0000	241.5157	388.2755	527.1185	(98)
Space heating												2855.4794	(98)
Space heating per m2											(98) / (4) =	56.8707	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	93.2000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3063.8191	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	514.7086	427.0940	383.4031	246.7684	126.5956	0.0000	0.0000	0.0000	0.0000	241.5157	388.2755	527.1185	(98)
Space heating efficiency (main heating system 1)	93.2000	93.2000	93.2000	93.2000	93.2000	0.0000	0.0000	0.0000	0.0000	93.2000	93.2000	93.2000	(210)
Space heating fuel (main heating system)	552.2624	458.2554	411.3767	264.7729	135.8322	0.0000	0.0000	0.0000	0.0000	259.1370	416.6046	565.5778	(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	147.7182	129.9183	135.7999	120.8519	117.7881	104.3319	99.3387	110.2036	110.3925	125.3724	133.6780	143.8700	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.5367	89.5065	89.4230	89.2256	88.7786	87.3000	87.3000	87.3000	87.3000	89.1876	89.4391	89.5621	(217)
Fuel for water heating, kWh/month	164.9805	145.1496	151.8623	135.4453	132.6763	119.5097	113.7900	126.2355	126.4519	140.5716	149.4627	160.6372	(219)
Water heating fuel used												1666.7725	(219)

Annual totals kWh/year		
Space heating fuel - main system	3063.8191	(211)
Space heating fuel - secondary	0.0000	(215)
Electricity for pumps and fans:		
(MEVCentralised, Database: in-use factor = 1.3000, SFP = 0.2210)		
mechanical ventilation fans (SFP = 0.2210)	33.8441	(230a)
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	108.8441	(231)
Electricity for lighting (calculated in Appendix L)	237.0579	(232)
Total delivered energy for all uses	5076.4935	(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	3063.8191	0.2160	661.7849	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1666.7725	0.2160	360.0229	(264)
Space and water heating			1021.8078	(265)
Pumps and fans	108.8441	0.5190	56.4901	(267)
Energy for lighting	237.0579	0.5190	123.0330	(268)
Total CO2, kg/year			1201.3309	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			23.9300	(273)

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

DER		23.9300	ZC1
Total Floor Area	TFA	50.2100	
Assumed number of occupants	N	1.6963	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		17.4409	ZC2
CO2 emissions from cooking, equation (L16)		3.1809	ZC3
Total CO2 emissions		44.5518	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		44.5518	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.2100 (1b)	x	2.5000 (2b)	=	125.5250	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	50.2100					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	125.5250	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							2 * 10 =		20.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1593	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4093	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3479	(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	0.4436	0.4349	0.4262	0.3827	0.3740	0.3305	0.3305	0.3218	0.3479	0.3740	0.3914	0.4088	(22b)
Effective ac	0.5984	0.5946	0.5908	0.5732	0.5699	0.5546	0.5546	0.5518	0.5605	0.5699	0.5766	0.5836	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.3000	1.0000	2.3000			(26)
TER Opening Type (Uw = 1.40)			9.1800	1.3258	12.1705			(27)
Heat Loss Floor 1			50.2100	0.1300	6.5273			(28a)
External Wall 1	66.1800	11.4800	54.7000	0.1800	9.8460			(29a)
Total net area of external elements Aum(A, m2)			116.3900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		30.8438			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							8.2918	(36)
Total fabric heat loss					(33) + (36) =		39.1356	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	24.7875	24.6292	24.4741	23.7454	23.6091	22.9744	22.9744	22.8569	23.2189	23.6091	23.8849	24.1732	(38)
Heat transfer coeff	63.9231	63.7648	63.6096	62.8810	62.7446	62.1100	62.1100	61.9925	62.3544	62.7446	63.0204	63.3088	(39)
Average = Sum(39)m / 12 =												62.8803	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2731	1.2700	1.2669	1.2524	1.2496	1.2370	1.2370	1.2347	1.2419	1.2496	1.2551	1.2609	(40)
HLP (average)												1.2523	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.6963	(42)
Average daily hot water use (litres/day)	74.4868	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	81.9354	78.9560	75.9765	72.9970	70.0176	67.0381	67.0381	70.0176	72.9970	75.9765	78.9560	81.9354	(44)
Energy conte	121.5079	106.2716	109.6628	95.6067	91.7369	79.1619	73.3552	84.1761	85.1815	99.2708	108.3618	117.6739	(45)
Energy content (annual)										Total = Sum(45)m =		1171.9670	(45)
Distribution loss (46)m = 0.15 x (45)m	18.2262	15.9407	16.4494	14.3410	13.7605	11.8743	11.0033	12.6264	12.7772	14.8906	16.2543	17.6511	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	41.7534	36.3414	38.7168	35.9985	35.6802	33.0599	34.1619	35.6802	35.9985	38.7168	38.9372	41.7534	(61)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Total heat required for water heating calculated for each month

	163.2613	142.6130	148.3796	131.6052	127.4170	112.2218	107.5170	119.8563	121.1800	137.9876	147.2990	159.4273	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
Solar input (sum of months) = Sum(63)m =												0.0000	(63)
Output from w/h													
	163.2613	142.6130	148.3796	131.6052	127.4170	112.2218	107.5170	119.8563	121.1800	137.9876	147.2990	159.4273	(64)
Total per year (kWh/year) = Sum(64)m =												1618.7651	(64)
Heat gains from water heating, kWh/month													
	50.8397	44.4206	46.1421	40.7888	39.4226	34.5863	32.9311	36.9086	37.3225	42.6867	45.7646	49.5649	(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	84.8143	84.8143	84.8143	84.8143	84.8143	84.8143	84.8143	84.8143	84.8143	84.8143	84.8143	84.8143	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	13.4232	11.9224	9.6959	7.3404	5.4871	4.6324	5.0055	6.5063	8.7328	11.0882	12.9416	13.7963	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	147.7793	149.3128	145.4485	137.2218	126.8370	117.0768	110.5564	109.0229	112.8873	121.1140	131.4987	141.2589	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	31.4814	31.4814	31.4814	31.4814	31.4814	31.4814	31.4814	31.4814	31.4814	31.4814	31.4814	31.4814	(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)													
	-67.8514	-67.8514	-67.8514	-67.8514	-67.8514	-67.8514	-67.8514	-67.8514	-67.8514	-67.8514	-67.8514	-67.8514	(71)
Water heating gains (Table 5)													
	68.3330	66.1022	62.0189	56.6512	52.9873	48.0365	44.2622	49.6083	51.8368	57.3746	63.5619	66.6195	(72)
Total internal gains													
	280.9798	278.7816	268.6076	252.6577	236.7557	221.1900	211.2683	216.5818	224.9011	241.0211	259.4466	273.1190	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	9.1800	11.2829	0.6300	0.7000	0.7700	31.6546	(75)

Solar gains	31.6546	64.4339	116.0893	190.6520	256.2737	273.2149	255.8569	203.7569	141.4566	78.7433	39.8297	25.8507	(83)
Total gains	312.6344	343.2155	384.6969	443.3097	493.0294	494.4049	466.8553	420.3387	366.3577	319.7644	299.2762	298.9697	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	54.5469	54.6823	54.8157	55.4509	55.5714	56.1392	56.1392	56.2456	55.9191	55.5714	55.3282	55.0762	
alpha	4.6365	4.6455	4.6544	4.6967	4.7048	4.7426	4.7426	4.7497	4.7279	4.7048	4.6885	4.6717	
util living area													
	0.9976	0.9959	0.9900	0.9654	0.8864	0.7256	0.5653	0.6397	0.8846	0.9819	0.9957	0.9981	(86)
MIT	19.6176	19.7465	20.0083	20.3887	20.7308	20.9286	20.9827	20.9700	20.8047	20.3780	19.9392	19.5971	(87)
Th 2	19.8620	19.8644	19.8669	19.8783	19.8805	19.8905	19.8905	19.8924	19.8866	19.8805	19.8761	19.8716	(88)
util rest of house													
	0.9968	0.9944	0.9862	0.9514	0.8409	0.6291	0.4328	0.5041	0.8191	0.9722	0.9939	0.9974	(89)
MIT 2	18.0315	18.2213	18.6038	19.1561	19.6149	19.8432	19.8843	19.8800	19.7230	19.1502	18.5114	18.0081	(90)
Living area fraction									fLA = Living area / (4) =			0.5117	(91)
MIT	18.8430	19.0016	19.3224	19.7868	20.1859	20.3985	20.4463	20.4377	20.2764	19.7784	19.2419	18.8211	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8430	19.0016	19.3224	19.7868	20.1859	20.3985	20.4463	20.4377	20.2764	19.7784	19.2419	18.8211	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9957	0.9929	0.9838	0.9500	0.8548	0.6759	0.5011	0.5739	0.8454	0.9711	0.9925	0.9965	(94)
Useful gains	311.3051	340.7859	378.4565	421.1471	421.4653	334.1726	233.9258	241.2132	309.7111	310.5125	297.0314	297.9371	(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													
	929.6359	899.1885	815.6265	684.5702	532.4428	360.1475	238.8947	250.3070	385.1278	575.8952	765.1898	925.6443	(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													
	460.0381	375.2465	325.2545	189.6646	82.5673	0.0000	0.0000	0.0000	0.0000	197.4447	337.0740	467.0142	(98)
Space heating												2434.3041	(98)
Space heating per m2											(98) / (4) =	48.4825	(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)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												2606.3213	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	460.0381	375.2465	325.2545	189.6646	82.5673	0.0000	0.0000	0.0000	0.0000	197.4447	337.0740	467.0142	(98)
Space heating efficiency (main heating system 1)	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)	492.5462	401.7629	348.2383	203.0671	88.4018	0.0000	0.0000	0.0000	0.0000	211.3969	360.8930	500.0152	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)

Water heating													
Water heating requirement	163.2613	142.6130	148.3796	131.6052	127.4170	112.2218	107.5170	119.8563	121.1800	137.9876	147.2990	159.4273	(64)
Efficiency of water heater												80.3000	(216)
(217)m	87.5167	87.3736	86.9729	85.9705	83.9898	80.3000	80.3000	80.3000	80.3000	85.9527	87.0696	87.5960	(217)
Fuel for water heating, kWh/month	186.5487	163.2221	170.6043	153.0819	151.7054	139.7532	133.8942	149.2607	150.9091	160.5390	169.1738	182.0029	(219)
Water heating fuel used												1910.6952	(219)
Annual totals kWh/year													
Space heating fuel - main system												2606.3213	(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)	237.0579	(232)
Total delivered energy for all uses	4829.0744	(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	2606.3213	0.2160	562.9654	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1910.6952	0.2160	412.7102	(264)
Space and water heating			975.6756	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	237.0579	0.5190	123.0330	(268)
Total CO2, kg/m2/year			1137.6336	(272)
Emissions per m2 for space and water heating			19.4319	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.4504	(272b)
Emissions per m2 for pumps and fans			0.7752	(272c)
Target Carbon Dioxide Emission Rate (TER) = (19.4319 * 1.00) + 2.4504 + 0.7752, rounded to 2 d.p.			22.6600	(273)

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

Design SAP
elmhurst energy

Property Reference	Plot 180	**Issued on Date**	13/02/2020
Assessment Reference	001	**Prop Type Ref**	LGF
Property	Epping College Site B, Plot 180		

SAP Rating	82 B	**DER**	20.71	**TER**	19.07
Environmental	85 B	**% DER<TER**	-8.62		
CO_2 Emissions (t/year)	1.20	**DFEE**	55.58	**TFEE**	51.69
General Requirements Compliance	Fail	**% DFEE<TFEE**	-7.52		

Assessor Details	Miss Georgia Dimitriou, Georgia Dimitriou, Tel: 07599467602, erieta.dimitriou@lowenergyconsultancy.co.uk	**Assessor ID**	P864-0001
Client			

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

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

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DWELLING AS DESIGNED

Ground-floor flat, total floor area 69 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) 19.07 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 20.71 kgCO□/m²Fail
Excess emissions =1.64 kgCO□/m² (8.6%)

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)51.7 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)55.6 kWh/m²/yrFail
Excess energy =3.9 kWh/m²/yr (7.5%)

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2 Fabric U-values

Element	Average	Highest	
External wall	0.22 (max. 0.30)	0.22 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.20 (max. 0.25)	0.20 (max. 0.70)	OK
Roof	(no roof)		
Openings	1.36 (max. 2.00)	1.50 (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: 4.00 (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 database
Vaillant ecoFIT sustain 835 VUW 356/6-3 (H-GB)
Combi boiler
Efficiency: 89.3% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

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5 Cylinder insulation
Hot water storage No cylinder

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6 Controls
Space heating controls: Programmer, room thermostat and TRVs OK

Hot water controls: No cylinder

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
Specific fan power: 0.17
Maximum 0.7 OK

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9 Summertime temperature
Overheating risk (Thames Valley): Medium OK
Based on:
Overshading: Average
Windows facing South West: 11.32 m², No overhang
Air change rate: 2.00 ach
Blinds/curtains: None

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10 Key features
Party wall U-value 0.00 W/m²K

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	69.1700 (1b)	x	2.5000 (2b)	=	172.9250	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	69.1700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		172.9250	(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		4.0000	
Infiltration rate		0.2000	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1850	(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	0.2359	0.2313	0.2266	0.2035	0.1989	0.1758	0.1758	0.1711	0.1850	0.1989	0.2081	0.2174	(22b)

Mechanical extract ventilation - centralised

If mechanical ventilation:	0.5000	(23a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
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	
Opening Type 1			4.6000	1.5000	6.9000			(26)
Opening Type 2 (Uw = 1.30)			11.3200	1.2357	13.9886			(27)
Heat Loss Floor 1			69.1700	0.2000	13.8340			(28a)
External Wall 1	76.3800	15.9200	60.4600	0.2200	13.3012			(29a)
Total net area of external elements Aum(A, m2)			145.5500					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		48.0238			(33)
Party Wall 1			19.3800	0.0000	0.0000			(32)
Party Ceilings 1			69.1700					(32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	12.8387	(36)
Total fabric heat loss (33) + (36) =	60.8625	(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	28.5326	28.5326	28.5326	28.5326	28.5326	28.5326	28.5326	28.5326	28.5326	28.5326	28.5326	28.5326	(38)
Heat transfer coeff	89.3951	89.3951	89.3951	89.3951	89.3951	89.3951	89.3951	89.3951	89.3951	89.3951	89.3951	89.3951	(39)
Average = Sum(39)m / 12 =												89.3951	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2924	1.2924	1.2924	1.2924	1.2924	1.2924	1.2924	1.2924	1.2924	1.2924	1.2924	1.2924	(40)
HLP (average)												1.2924	(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	2.2258	(42)
Average daily hot water use (litres/day)	87.0629	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	95.7692	92.2867	88.8042	85.3216	81.8391	78.3566	78.3566	81.8391	85.3216	88.8042	92.2867	95.7692	(44)
Energy conte	142.0230	124.2142	128.1779	111.7486	107.2254	92.5274	85.7402	98.3882	99.5633	116.0314	126.6573	137.5416	(45)
Energy content (annual)										Total = Sum(45)m =		1369.8385	(45)
Distribution loss (46)m = 0.15 x (45)m	21.3034	18.6321	19.2267	16.7623	16.0838	13.8791	12.8610	14.7582	14.9345	17.4047	18.9986	20.6312	(46)
Water storage loss:													

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	26.3743	23.7850	26.2745	25.3603	26.1571	25.2575	26.0646	26.1246	25.3135	26.2259	25.4572	26.3550	(61)
Total heat required for water heating calculated for each month													
	168.3973	147.9991	154.4524	137.1089	133.3826	117.7849	111.8048	124.5128	124.8767	142.2573	152.1145	163.8966	(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													
	168.3973	147.9991	154.4524	137.1089	133.3826	117.7849	111.8048	124.5128	124.8767	142.2573	152.1145	163.8966	(64)
								Total per year (kWh/year) = Sum(64)m =				1678.5878	(64)
Heat gains from water heating, kWh/month													
	53.8162	47.2475	49.1878	43.4965	42.1917	37.0797	35.0248	39.2452	39.4331	45.1369	48.4779	52.3213	(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	111.2903	111.2903	111.2903	111.2903	111.2903	111.2903	111.2903	111.2903	111.2903	111.2903	111.2903	111.2903	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	18.0899	16.0673	13.0668	9.8924	7.3947	6.2429	6.7457	8.7683	11.7688	14.9432	17.4409	18.5926	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	195.3522	197.3793	192.2710	181.3959	167.6682	154.7660	146.1465	144.1194	149.2277	160.1027	173.8305	186.7327	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	34.1290	34.1290	34.1290	34.1290	34.1290	34.1290	34.1290	34.1290	34.1290	34.1290	34.1290	34.1290	(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)													
	-89.0323	-89.0323	-89.0323	-89.0323	-89.0323	-89.0323	-89.0323	-89.0323	-89.0323	-89.0323	-89.0323	-89.0323	(71)
Water heating gains (Table 5)													
	72.3336	70.3087	66.1126	60.4118	56.7093	51.4996	47.0763	52.7489	54.7683	60.6679	67.3304	70.3244	(72)
Total internal gains													
	345.1628	343.1424	330.8375	311.0872	291.1593	271.8956	259.3556	265.0237	275.1518	295.1009	317.9889	335.0369	(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	
Southwest	11.3200	36.7938	0.5000	0.7000	0.7700	101.0236	(79)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	101.0236	172.0805	235.4481	291.7316	326.7637	324.4007	312.7569	286.6214	254.9405	190.1856	121.0030	86.4551	(83)
Total gains	446.1863	515.2229	566.2855	602.8188	617.9229	596.2963	572.1125	551.6451	530.0923	485.2865	438.9918	421.4920	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	53.7330	53.7330	53.7330	53.7330	53.7330	53.7330	53.7330	53.7330	53.7330	53.7330	53.7330	53.7330	
alpha	4.5822	4.5822	4.5822	4.5822	4.5822	4.5822	4.5822	4.5822	4.5822	4.5822	4.5822	4.5822	
util living area													
	0.9972	0.9942	0.9872	0.9684	0.9185	0.8035	0.6435	0.6842	0.8770	0.9750	0.9945	0.9979	(86)
MIT	19.6131	19.7731	20.0244	20.3411	20.6509	20.8769	20.9667	20.9553	20.7989	20.3958	19.9333	19.5690	(87)
Th 2	19.8468	19.8468	19.8468	19.8468	19.8468	19.8468	19.8468	19.8468	19.8468	19.8468	19.8468	19.8468	(88)
util rest of house													
	0.9963	0.9922	0.9825	0.9553	0.8811	0.7109	0.4959	0.5408	0.8078	0.9621	0.9922	0.9971	(89)
MIT 2	18.5958	18.7550	19.0040	19.3138	19.6035	19.7871	19.8382	19.8338	19.7336	19.3707	18.9152	18.5519	(90)
Living area fraction									fLA = Living area / (4) =			0.3781	(91)
MIT	18.9804	19.1399	19.3898	19.7022	19.9995	20.1991	20.2648	20.2578	20.1363	19.7583	19.3001	18.9364	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9804	19.1399	19.3898	19.7022	19.9995	20.1991	20.2648	20.2578	20.1363	19.7583	19.3001	18.9364	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9953	0.9905	0.9800	0.9533	0.8870	0.7425	0.5527	0.5958	0.8281	0.9608	0.9907	0.9963	(94)
Useful gains	444.0816	510.3309	554.9625	574.6438	548.0919	442.7422	316.2251	328.6696	438.9647	466.2668	434.9132	419.9422	(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													
	1312.3545	1272.9774	1152.2841	965.6619	741.9339	500.5296	327.6144	344.8668	539.6186	818.7032	1090.6276	1317.3634	(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													
	645.9950	512.4984	444.4073	281.5331	144.2184	0.0000	0.0000	0.0000	0.0000	262.2127	472.1144	667.6814	(98)
Space heating												3430.6608	(98)
Space heating per m2											(98) / (4) =	49.5975	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	93.2000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3680.9665	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	645.9950	512.4984	444.4073	281.5331	144.2184	0.0000	0.0000	0.0000	0.0000	262.2127	472.1144	667.6814	(98)
Space heating efficiency (main heating system 1)	93.2000	93.2000	93.2000	93.2000	93.2000	0.0000	0.0000	0.0000	0.0000	93.2000	93.2000	93.2000	(210)
Space heating fuel (main heating system)	693.1277	549.8910	476.8319	302.0741	154.7408	0.0000	0.0000	0.0000	0.0000	281.3441	506.5605	716.3964	(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	168.3973	147.9991	154.4524	137.1089	133.3826	117.7849	111.8048	124.5128	124.8767	142.2573	152.1145	163.8966	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.5847	89.5336	89.4338	89.2292	88.7829	87.3000	87.3000	87.3000	87.3000	89.1583	89.4757	89.6133	(217)
Fuel for water heating, kWh/month	187.9756	165.3002	172.7003	153.6591	150.2345	134.9197	128.0697	142.6263	143.0432	159.5558	170.0065	182.8932	(219)
Water heating fuel used												1890.9840	(219)

Annual totals kWh/year		
Space heating fuel - main system	3680.9665	(211)
Space heating fuel - secondary	0.0000	(215)

Electricity for pumps and fans:
(MEVCentralised, Database: in-use factor = 1.3000, SFP = 0.2210)

mechanical ventilation fans (SFP = 0.2210)	46.6240	(230a)
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	121.6240	(231)
Electricity for lighting (calculated in Appendix L)	319.4728	(232)
Total delivered energy for all uses	6013.0473	(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	3680.9665	0.2160	795.0888	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1890.9840	0.2160	408.4525	(264)
Space and water heating			1203.5413	(265)
Pumps and fans	121.6240	0.5190	63.1229	(267)
Energy for lighting	319.4728	0.5190	165.8064	(268)
Total CO2, kg/year			1432.4705	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			20.7100	(273)

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

DER		20.7100	ZC1
Total Floor Area	TFA	69.1700	
Assumed number of occupants	N	2.2258	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		16.7358	ZC2
CO2 emissions from cooking, equation (L16)		2.4927	ZC3
Total CO2 emissions		39.9385	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		39.9385	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	69.1700 (1b)	x	2.5000 (2b)	=	172.9250	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	69.1700					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	172.9250	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							2 * 10 =		20.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1157	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3657	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3382	(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	0.4312	0.4228	0.4143	0.3721	0.3636	0.3213	0.3213	0.3129	0.3382	0.3636	0.3805	0.3974	(22b)
Effective ac	0.5930	0.5894	0.5858	0.5692	0.5661	0.5516	0.5516	0.5489	0.5572	0.5661	0.5724	0.5790	(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			4.6000	1.0000	4.6000			(26)
TER Opening Type (Uw = 1.40)			11.3200	1.3258	15.0076			(27)
Heat Loss Floor 1			69.1700	0.1300	8.9921			(28a)
External Wall 1	76.3800	15.9200	60.4600	0.1800	10.8828			(29a)
Total net area of external elements Aum(A, m2)			145.5500					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		39.4825			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.3515	(36)
Total fabric heat loss					(33) + (36) =		49.8340	(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	33.8389	33.6329	33.4309	32.4823	32.3048	31.4785	31.4785	31.3255	31.7968	32.3048	32.6638	33.0392	(38)
Heat transfer coeff	83.6729	83.4669	83.2649	82.3163	82.1388	81.3125	81.3125	81.1595	81.6308	82.1388	82.4978	82.8732	(39)
Average = Sum(39)m / 12 =												82.3154	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2097	1.2067	1.2038	1.1901	1.1875	1.1755	1.1755	1.1733	1.1801	1.1875	1.1927	1.1981	(40)
HLP (average)												1.1900	(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	2.2258	(42)
Average daily hot water use (litres/day)	87.0629	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	95.7692	92.2867	88.8042	85.3216	81.8391	78.3566	78.3566	81.8391	85.3216	88.8042	92.2867	95.7692	(44)
Energy conte	142.0230	124.2142	128.1779	111.7486	107.2254	92.5274	85.7402	98.3882	99.5633	116.0314	126.6573	137.5416	(45)
Energy content (annual)										Total = Sum(45)m =		1369.8385	(45)
Distribution loss (46)m = 0.15 x (45)m	21.3034	18.6321	19.2267	16.7623	16.0838	13.8791	12.8610	14.7582	14.9345	17.4047	18.9986	20.6312	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	48.8029	42.4772	45.2536	42.0764	41.7043	38.6416	39.9297	41.7043	42.0764	45.2536	45.5112	48.8029	(61)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Total heat required for water heating calculated for each month	190.8259	166.6913	173.4315	153.8250	148.9298	131.1690	125.6699	140.0925	141.6397	161.2850	172.1686	186.3446	(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	190.8259	166.6913	173.4315	153.8250	148.9298	131.1690	125.6699	140.0925	141.6397	161.2850	172.1686	186.3446	(64)
Total per year (kWh/year) = Sum(64)m =												1892.0728	(64)
Heat gains from water heating, kWh/month	59.4234	51.9205	53.9326	47.6755	46.0785	40.4258	38.4910	43.1402	43.6239	49.8938	53.4914	57.9333	(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	111.2903	111.2903	111.2903	111.2903	111.2903	111.2903	111.2903	111.2903	111.2903	111.2903	111.2903	111.2903	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	18.0899	16.0673	13.0668	9.8924	7.3947	6.2429	6.7457	8.7683	11.7688	14.9432	17.4409	18.5926	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	195.3522	197.3793	192.2710	181.3959	167.6682	154.7660	146.1465	144.1194	149.2277	160.1027	173.8305	186.7327	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.1290	34.1290	34.1290	34.1290	34.1290	34.1290	34.1290	34.1290	34.1290	34.1290	34.1290	34.1290	(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)	-89.0323	-89.0323	-89.0323	-89.0323	-89.0323	-89.0323	-89.0323	-89.0323	-89.0323	-89.0323	-89.0323	-89.0323	(71)
Water heating gains (Table 5)	79.8701	77.2627	72.4900	66.2160	61.9335	56.1469	51.7353	57.9841	60.5887	67.0616	74.2936	77.8674	(72)
Total internal gains	352.6993	350.0963	337.2149	316.8914	296.3835	276.5429	264.0146	270.2588	280.9723	301.4946	324.9521	342.5799	(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	
Southwest	11.3200	36.7938	0.6300	0.7000	0.7700	127.2897	(79)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	127.2897	216.8215	296.6646	367.5818	411.7222	408.7449	394.0737	361.1429	321.2250	239.6339	152.4637	108.9335	(83)
Total gains	479.9890	566.9178	633.8794	684.4732	708.1057	685.2877	658.0882	631.4017	602.1973	541.1285	477.4158	451.5133	(84)

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, ni1,m (see Table 9a)													
tau	57.4077	57.5494	57.6890	58.3539	58.4800	59.0742	59.0742	59.1856	58.8439	58.4800	58.2254	57.9617	
alpha	4.8272	4.8366	4.8459	4.8903	4.8987	4.9383	4.9383	4.9457	4.9229	4.8987	4.8817	4.8641	
util living area	0.9962	0.9910	0.9786	0.9439	0.8603	0.7011	0.5311	0.5725	0.8022	0.9580	0.9919	0.9972	(86)
MIT	19.7654	19.9491	20.2107	20.5283	20.7914	20.9460	20.9888	20.9840	20.8918	20.5471	20.0930	19.7321	(87)
Th 2	19.9123	19.9147	19.9170	19.9280	19.9300	19.9396	19.9396	19.9414	19.9359	19.9300	19.9259	19.9215	(88)
util rest of house	0.9949	0.9881	0.9712	0.9237	0.8106	0.6075	0.4096	0.4501	0.7216	0.9387	0.9886	0.9962	(89)
MIT 2	18.2819	18.5505	18.9293	19.3840	19.7286	19.9042	19.9356	19.9350	19.8532	19.4196	18.7693	18.2398	(90)
Living area fraction									fLA = Living area / (4) =			0.3781	(91)
MIT	18.8427	19.0792	19.4137	19.8166	20.1304	20.2980	20.3338	20.3316	20.2458	19.8459	19.2697	18.8039	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8427	19.0792	19.4137	19.8166	20.1304	20.2980	20.3338	20.3316	20.2458	19.8459	19.2697	18.8039	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9932	0.9850	0.9668	0.9212	0.8211	0.6410	0.4558	0.4967	0.7475	0.9368	0.9859	0.9948	(94)
Useful gains	476.7147	558.4008	612.8236	630.5288	581.3980	439.2481	299.9813	313.5904	450.1257	506.9281	470.6829	449.1672	(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	1216.8339	1183.4968	1075.2585	898.6134	692.4619	463.3228	303.6027	319.0840	501.6873	759.4449	1003.9751	1210.2752	(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	550.6487	420.0645	344.0515	193.0209	82.6316	0.0000	0.0000	0.0000	0.0000	187.8725	383.9703	566.2644	(98)
Space heating												2728.5244	(98)
Space heating per m2											(98) / (4) =	39.4466	(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)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Efficiency of main space heating system 1 (in %)	93.4000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2921.3323	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	550.6487	420.0645	344.0515	193.0209	82.6316	0.0000	0.0000	0.0000	0.0000	187.8725	383.9703	566.2644	(98)
Space heating efficiency (main heating system 1)	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)	589.5596	449.7478	368.3635	206.6605	88.4707	0.0000	0.0000	0.0000	0.0000	201.1483	411.1032	606.2787	(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	190.8259	166.6913	173.4315	153.8250	148.9298	131.1690	125.6699	140.0925	141.6397	161.2850	172.1686	186.3446	(64)
Efficiency of water heater												80.3000	(216)
(217)m	87.5655	87.2812	86.7434	85.6237	83.6344	80.3000	80.3000	80.3000	80.3000	85.4361	87.0119	87.6697	(217)
Fuel for water heating, kWh/month	217.9236	190.9819	199.9362	179.6524	178.0724	163.3487	156.5005	174.4614	176.3881	188.7784	197.8678	212.5529	(219)
Water heating fuel used												2236.4644	(219)

Annual totals kWh/year		
Space heating fuel - main system	2921.3323	(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)	319.4728	(232)
Total delivered energy for all uses	5552.2695	(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	2921.3323	0.2160	631.0078	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2236.4644	0.2160	483.0763	(264)
Space and water heating			1114.0841	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	319.4728	0.5190	165.8064	(268)
Total CO2, kg/m2/year			1318.8155	(272)
Emissions per m2 for space and water heating			16.1065	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.3971	(272b)
Emissions per m2 for pumps and fans			0.5627	(272c)
Target Carbon Dioxide Emission Rate (TER) = (16.1065 * 1.00) + 2.3971 + 0.5627, rounded to 2 d.p.			19.0700	(273)

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

Design SAP
elmhurst energy

Property Reference	Plot 186	**Issued on Date**	13/02/2020
Assessment Reference	001	**Prop Type Ref**	MF
Property	Epping College Site B, Plot 186		

SAP Rating	87 B	**DER**	12.85	**TER**	13.51
Environmental	90 B	**% DER<TER**	4.88		
CO_2 Emissions (t/year)	0.98	**DFEE**	27.71	**TFEE**	30.24
General Requirements Compliance	Pass	**% DFEE<TFEE**	8.39		

Assessor Details	Miss Georgia Dimitriou, Georgia Dimitriou, Tel: 07599467602, erieta.dimitriou@lowenergyconsultancy.co.uk	**Assessor ID**	P864-0001
Client			

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DWELLING AS DESIGNED

Mid-floor flat, total floor area 94 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) 13.51 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 12.85 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)30.2 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)27.7 kWh/m²/yrOK

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2 Fabric U-values

Element	Average	Highest	
External wall	0.22 (max. 0.30)	0.22 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	(no floor)		
Roof	(no roof)		
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

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

---

3 Air permeability
Air permeability at 50 pascals: 4.00 (design value)
Maximum 10.0 OK

---

4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Vaillant ecoFIT sustain 835 VUW 356/6-3 (H-GB)
Combi boiler
Efficiency: 89.3% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

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5 Cylinder insulation
Hot water storage No cylinder

---

6 Controls
Space heating controls: Programmer, room thermostat and TRVs OK

Hot water controls: No cylinder

Boiler interlock Yes OK

---

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

---

8 Mechanical ventilation
Continuous extract system
Specific fan power: 0.16
Maximum 0.7 OK

---

9 Summertime temperature
Overheating risk (Thames Valley): Slight OK
Based on:
Overshading: Average
Windows facing North East: 4.59 m², No overhang
Windows facing South East: 5.60 m², No overhang
Windows facing North West: 3.58 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

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	93.8000 (1b)	x	2.5000 (2b)	=	234.5000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	93.8000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	234.5000	(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			4.0000	
Infiltration rate			0.2000	(18)
Number of sides sheltered			2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.1700	(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	0.2168	0.2125	0.2083	0.1870	0.1828	0.1615	0.1615	0.1573	0.1700	0.1828	0.1913	0.1998	(22b)

Mechanical extract ventilation - centralised

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	
Opening Type 2 (Uw = 1.30)			13.7700	1.2357	17.0162			(27)
External Wall 1	41.7500	13.7700	27.9800	0.2200	6.1556			(29a)
Total net area of external elements Aum(A, m2)			41.7500					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		23.1718			(33)
Party Wall 1			86.9500	0.0000	0.0000			(32)
Party Floor 1			93.8000					(32d)
Party Ceilings 1			93.8000					(32b)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							6.1428	(36)
Total fabric heat loss					(33) + (36) =		29.3146	(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	38.6925	38.6925	38.6925	38.6925	38.6925	38.6925	38.6925	38.6925	38.6925	38.6925	38.6925	38.6925	(38)
Heat transfer coeff	68.0071	68.0071	68.0071	68.0071	68.0071	68.0071	68.0071	68.0071	68.0071	68.0071	68.0071	68.0071	(39)
Average = Sum(39)m / 12 =												68.0071	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.7250	0.7250	0.7250	0.7250	0.7250	0.7250	0.7250	0.7250	0.7250	0.7250	0.7250	0.7250	(40)
HLP (average)												0.7250	(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	2.6742	(42)
Average daily hot water use (litres/day)	97.7133	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	107.4846	103.5761	99.6676	95.7590	91.8505	87.9420	87.9420	91.8505	95.7590	99.6676	103.5761	107.4846	(44)
Energy conte	159.3966	139.4093	143.8579	125.4188	120.3423	103.8463	96.2289	110.4240	111.7428	130.2255	142.1513	154.3671	(45)
Energy content (annual)										Total = Sum(45)m =		1537.4109	(45)
Distribution loss (46)m = 0.15 x (45)m	23.9095	20.9114	21.5787	18.8128	18.0514	15.5769	14.4343	16.5636	16.7614	19.5338	21.3227	23.1551	(46)
Water storage loss:													
Total storage loss													

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	26.4795	23.8965	26.4074	25.4716	26.2596	25.3422	26.1431	26.2187	25.4127	26.3463	25.5709	26.4569	(61)
Total heat required for water heating calculated for each month													
	185.8761	163.3058	170.2654	150.8905	146.6020	129.1884	122.3719	136.6427	137.1555	156.5718	167.7222	180.8240	(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													
	185.8761	163.3058	170.2654	150.8905	146.6020	129.1884	122.3719	136.6427	137.1555	156.5718	167.7222	180.8240	(64)
								Total per year (kWh/year) = Sum(64)m =				1847.4163	(64)
Heat gains from water heating, kWh/month													
	59.6193	52.3277	54.4346	48.0697	46.5787	40.8644	38.5319	43.2706	43.5077	49.8866	53.6580	57.9413	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	133.7122	133.7122	133.7122	133.7122	133.7122	133.7122	133.7122	133.7122	133.7122	133.7122	133.7122	133.7122	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	23.2793	20.6765	16.8152	12.7302	9.5160	8.0338	8.6808	11.2836	15.1449	19.2299	22.4441	23.9263	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	245.8977	248.4494	242.0193	228.3304	211.0507	194.8102	183.9605	181.4089	187.8390	201.5278	218.8076	235.0481	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.3712	36.3712	36.3712	36.3712	36.3712	36.3712	36.3712	36.3712	36.3712	36.3712	36.3712	36.3712	(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)													
	-106.9698	-106.9698	-106.9698	-106.9698	-106.9698	-106.9698	-106.9698	-106.9698	-106.9698	-106.9698	-106.9698	-106.9698	(71)
Water heating gains (Table 5)													
	80.1334	77.8686	73.1648	66.7634	62.6058	56.7562	51.7901	58.1595	60.4273	67.0518	74.5250	77.8781	(72)
Total internal gains													
	415.4241	413.1081	398.1130	373.9378	349.2862	325.7138	310.5451	316.9657	329.5248	353.9232	381.8904	402.9661	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	4.5900	11.2829	0.5000	0.7000	0.7700	12.5613	(75)
Southeast	5.6000	36.7938	0.5000	0.7000	0.7700	49.9763	(77)
Northwest	3.5800	11.2829	0.5000	0.7000	0.7700	9.7973	(81)

Solar gains	72.3350	130.6399	198.4737	278.9831	342.6642	353.4613	335.2499	285.7115	226.0343	149.7037	87.9931	61.0285	(83)
Total gains	487.7591	543.7480	596.5867	652.9209	691.9504	679.1751	645.7951	602.6771	555.5591	503.6269	469.8835	463.9946	(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	95.7825	95.7825	95.7825	95.7825	95.7825	95.7825	95.7825	95.7825	95.7825	95.7825	95.7825	95.7825	
alpha	7.3855	7.3855	7.3855	7.3855	7.3855	7.3855	7.3855	7.3855	7.3855	7.3855	7.3855	7.3855	
util living area													
	0.9989	0.9971	0.9902	0.9563	0.8376	0.6320	0.4625	0.5171	0.7948	0.9751	0.9971	0.9992	(86)
MIT	20.2962	20.4002	20.5709	20.7846	20.9426	20.9935	20.9994	20.9987	20.9700	20.7654	20.4826	20.2633	(87)
Th 2	20.3188	20.3188	20.3188	20.3188	20.3188	20.3188	20.3188	20.3188	20.3188	20.3188	20.3188	20.3188	(88)
util rest of house													
	0.9985	0.9962	0.9870	0.9423	0.7965	0.5686	0.3914	0.4416	0.7343	0.9644	0.9960	0.9990	(89)
MIT 2	19.6651	19.7687	19.9379	20.1437	20.2808	20.3158	20.3186	20.3184	20.3025	20.1286	19.8511	19.6322	(90)
Living area fraction										fLA = Living area / (4) =		0.3479	(91)
MIT	19.8846	19.9884	20.1581	20.3667	20.5110	20.5516	20.5554	20.5551	20.5347	20.3501	20.0708	19.8517	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.8846	19.9884	20.1581	20.3667	20.5110	20.5516	20.5554	20.5551	20.5347	20.3501	20.0708	19.8517	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9982	0.9957	0.9861	0.9434	0.8088	0.5906	0.4162	0.4679	0.7545	0.9650	0.9955	0.9988	(94)
Useful gains	486.9044	541.3887	588.2705	615.9668	559.6187	401.1251	268.7542	282.0136	419.1705	485.9866	467.7765	463.4257	(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													
	1059.8657	1026.1144	928.8486	779.8134	599.2109	404.7482	268.9980	282.5729	437.6054	663.0765	882.1038	1064.4272	(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													
	426.2832	325.7357	253.3901	117.9696	29.4566	0.0000	0.0000	0.0000	0.0000	131.7549	298.3157	447.1451	(98)
Space heating												2030.0509	(98)
Space heating per m2											(98) / (4) =	21.6423	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	93.2000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2178.1662	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	426.2832	325.7357	253.3901	117.9696	29.4566	0.0000	0.0000	0.0000	0.0000	131.7549	298.3157	447.1451	(98)
Space heating efficiency (main heating system 1)	93.2000	93.2000	93.2000	93.2000	93.2000	0.0000	0.0000	0.0000	0.0000	93.2000	93.2000	93.2000	(210)
Space heating fuel (main heating system)	457.3855	349.5018	271.8778	126.5768	31.6058	0.0000	0.0000	0.0000	0.0000	141.3679	320.0812	479.7694	(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	185.8761	163.3058	170.2654	150.8905	146.6020	129.1884	122.3719	136.6427	137.1555	156.5718	167.7222	180.8240	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.2993	89.2104	89.0117	88.5492	87.7721	87.3000	87.3000	87.3000	87.3000	88.6017	89.1344	89.3454	(217)
Fuel for water heating, kWh/month	208.1497	183.0568	191.2844	170.4030	167.0256	147.9822	140.1740	156.5208	157.1083	176.7142	188.1678	202.3876	(219)
Water heating fuel used												2088.9745	(219)

Annual totals kWh/year

Space heating fuel - main system	2178.1662	(211)
Space heating fuel - secondary	0.0000	(215)

Electricity for pumps and fans:
(MEVCentralised, Database: in-use factor = 1.3000, SFP = 0.2080)

mechanical ventilation fans (SFP = 0.2080)	59.5067	(230a)
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	134.5067	(231)
Electricity for lighting (calculated in Appendix L)	411.1198	(232)
Total delivered energy for all uses	4812.7671	(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	2178.1662	0.2160	470.4839	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2088.9745	0.2160	451.2185	(264)
Space and water heating			921.7024	(265)
Pumps and fans	134.5067	0.5190	69.8090	(267)
Energy for lighting	411.1198	0.5190	213.3712	(268)
Total CO2, kg/year			1204.8825	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			12.8500	(273)

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

DER		12.8500	ZC1
Total Floor Area	TFA	93.8000	
Assumed number of occupants	N	2.6742	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		15.5345	ZC2
CO2 emissions from cooking, equation (L16)		1.9529	ZC3
Total CO2 emissions		30.3374	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		30.3374	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	93.8000 (1b)	x	2.5000 (2b)	=	234.5000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	93.8000					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	234.5000	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							3 * 10 =		30.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1279	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3779	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3212	(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	0.4096	0.4016	0.3935	0.3534	0.3453	0.3052	0.3052	0.2971	0.3212	0.3453	0.3614	0.3775	(22b)
Effective ac	0.5839	0.5806	0.5774	0.5624	0.5596	0.5466	0.5466	0.5441	0.5516	0.5596	0.5653	0.5712	(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 Opening Type (Uw = 1.40)			13.7700	1.3258	18.2557			(27)
External Wall 1	41.7500	13.7700	27.9800	0.1800	5.0364			(29a)
Total net area of external elements Aum(A, m2)			41.7500					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	23.2921			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							4.3550	(36)
Total fabric heat loss						(33) + (36) =	27.6471	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	45.1835	44.9314	44.6844	43.5239	43.3068	42.2961	42.2961	42.1089	42.6854	43.3068	43.7460	44.2052	(38)
Heat transfer coeff	72.8306	72.5785	72.3315	71.1710	70.9539	69.9432	69.9432	69.7560	70.3325	70.9539	71.3931	71.8523	(39)
Average = Sum(39)m / 12 =												71.1700	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.7764	0.7738	0.7711	0.7588	0.7564	0.7457	0.7457	0.7437	0.7498	0.7564	0.7611	0.7660	(40)
HLP (average)												0.7587	(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	2.6742	(42)
Average daily hot water use (litres/day)	97.7133	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	107.4846	103.5761	99.6676	95.7590	91.8505	87.9420	87.9420	91.8505	95.7590	99.6676	103.5761	107.4846	(44)
Energy conte	159.3966	139.4093	143.8579	125.4188	120.3423	103.8463	96.2289	110.4240	111.7428	130.2255	142.1513	154.3671	(45)
Energy content (annual)										Total = Sum(45)m =		1537.4109	(45)
Distribution loss (46)m = 0.15 x (45)m	23.9095	20.9114	21.5787	18.8128	18.0514	15.5769	14.4343	16.5636	16.7614	19.5338	21.3227	23.1551	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	46.0274	50.7895	47.2236	46.8060	43.3686	44.8143	46.8060	47.2236	50.7895	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month	210.3555	185.4367	194.6474	172.6425	167.1484	147.2149	141.0431	157.2300	158.9665	181.0150	191.4664	205.3260	(62)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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													
	210.3555	185.4367	194.6474	172.6425	167.1484	147.2149	141.0431	157.2300	158.9665	181.0150	191.4664	205.3260	(64)
									Total per year (kWh/year) = Sum(64)m =			2112.4924	(64)
Heat gains from water heating, kWh/month													
	65.7391	57.8604	60.5301	53.5077	51.7153	45.3711	43.1997	48.4175	48.9604	55.9974	59.5941	64.0668	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	133.7122	133.7122	133.7122	133.7122	133.7122	133.7122	133.7122	133.7122	133.7122	133.7122	133.7122	133.7122	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	23.2793	20.6765	16.8152	12.7302	9.5160	8.0338	8.6808	11.2836	15.1449	19.2299	22.4441	23.9263	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	245.8977	248.4494	242.0193	228.3304	211.0507	194.8102	183.9605	181.4089	187.8390	201.5278	218.8076	235.0481	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.3712	36.3712	36.3712	36.3712	36.3712	36.3712	36.3712	36.3712	36.3712	36.3712	36.3712	36.3712	(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)													
	-106.9698	-106.9698	-106.9698	-106.9698	-106.9698	-106.9698	-106.9698	-106.9698	-106.9698	-106.9698	-106.9698	-106.9698	(71)
Water heating gains (Table 5)													
	88.3590	86.1018	81.3577	74.3162	69.5099	63.0154	58.0641	65.0773	68.0006	75.2653	82.7696	86.1113	(72)
Total internal gains													
	423.6497	421.3414	406.3059	381.4905	356.1902	331.9730	316.8191	323.8835	337.0981	362.1366	390.1349	411.1993	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	4.5900	11.2829	0.6300	0.7000	0.7700	15.8273	(75)
Southeast	5.6000	36.7938	0.6300	0.7000	0.7700	62.9702	(77)
Northwest	3.5800	11.2829	0.6300	0.7000	0.7700	12.3446	(81)

Solar gains	91.1421	164.6062	250.0768	351.5187	431.7569	445.3612	422.4149	359.9964	284.8032	188.6266	110.8713	76.8959	(83)
Total gains	514.7918	585.9476	656.3827	733.0092	787.9471	777.3343	739.2340	683.8799	621.9013	550.7633	501.0062	488.0953	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	89.4389	89.7495	90.0561	91.5245	91.8045	93.1311	93.1311	93.3810	92.6156	91.8045	91.2397	90.6566	
alpha	6.9626	6.9833	7.0037	7.1016	7.1203	7.2087	7.2087	7.2254	7.1744	7.1203	7.0826	7.0438	
util living area													
	0.9985	0.9960	0.9856	0.9350	0.7870	0.5712	0.4159	0.4681	0.7470	0.9652	0.9961	0.9990	(86)
MIT	20.2456	20.3713	20.5678	20.8105	20.9571	20.9961	20.9996	20.9992	20.9776	20.7774	20.4684	20.2254	(87)
Th 2	20.2738	20.2761	20.2784	20.2892	20.2912	20.3007	20.3007	20.3024	20.2970	20.2912	20.2872	20.2829	(88)
util rest of house													
	0.9981	0.9947	0.9810	0.9160	0.7415	0.5109	0.3500	0.3977	0.6835	0.9509	0.9946	0.9987	(89)
MIT 2	19.2517	19.4368	19.7229	20.0695	20.2512	20.2982	20.3005	20.3021	20.2800	20.0323	19.5877	19.2294	(90)
Living area fraction									fLA = Living area / (4) =			0.3479	(91)
MIT	19.5974	19.7619	20.0168	20.3272	20.4968	20.5410	20.5437	20.5446	20.5227	20.2915	19.8941	19.5759	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.5974	19.7619	20.0168	20.3272	20.4968	20.5410	20.5437	20.5446	20.5227	20.2915	19.8941	19.5759	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9975	0.9935	0.9790	0.9171	0.7552	0.5318	0.3729	0.4223	0.7047	0.9509	0.9935	0.9982	(94)
Useful gains	513.5073	582.1442	642.5726	672.2357	595.0936	413.4005	275.6955	288.7786	438.2665	523.7367	497.7659	487.2304	(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													
	1114.1202	1078.6517	977.6901	813.2876	624.1657	415.5296	275.8373	289.1106	451.7237	687.6524	913.4098	1104.7924	(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													
	446.8560	333.6531	249.3274	101.5573	21.6296	0.0000	0.0000	0.0000	0.0000	121.9533	299.2636	459.4661	(98)
Space heating												2033.7064	(98)
Space heating per m2											(98) / (4) =	21.6813	(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)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Efficiency of main space heating system 1 (in %)	93.4000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2177.4158	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	446.8560	333.6531	249.3274	101.5573	21.6296	0.0000	0.0000	0.0000	0.0000	121.9533	299.2636	459.4661	(98)
Space heating efficiency (main heating system 1)	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)	478.4326	357.2303	266.9458	108.7337	23.1581	0.0000	0.0000	0.0000	0.0000	130.5710	320.4107	491.9337	(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	210.3555	185.4367	194.6474	172.6425	167.1484	147.2149	141.0431	157.2300	158.9665	181.0150	191.4664	205.3260	(64)
Efficiency of water heater												80.3000	(216)
(217)m	86.9015	86.5128	85.6755	83.7663	81.3413	80.3000	80.3000	80.3000	80.3000	84.0814	86.1712	87.0195	(217)
Fuel for water heating, kWh/month	242.0620	214.3460	227.1914	206.1001	205.4902	183.3312	175.6452	195.8033	197.9657	215.2855	222.1930	235.9540	(219)
Water heating fuel used												2521.3677	(219)

Annual totals kWh/year		
Space heating fuel - main system	2177.4158	(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)	411.1198	(232)
Total delivered energy for all uses	5184.9033	(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	2177.4158	0.2160	470.3218	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2521.3677	0.2160	544.6154	(264)
Space and water heating			1014.9372	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	411.1198	0.5190	213.3712	(268)
Total CO2, kg/m2/year			1267.2334	(272)
Emissions per m2 for space and water heating			10.8202	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.2747	(272b)
Emissions per m2 for pumps and fans			0.4150	(272c)
Target Carbon Dioxide Emission Rate (TER) = (10.8202 * 1.00) + 2.2747 + 0.4150, rounded to 2 d.p.			13.5100	(273)

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

Design SAP
elmhurst energy

Property Reference	Plot 207	**Issued on Date**	13/02/2020
Assessment Reference	001	**Prop Type Ref**	GF
Property	Epping College Site B, Plot 207		

SAP Rating	84 B	**DER**	17.57	**TER**	16.75
Environmental	86 B	**% DER<TER**	-4.89		
CO_2 Emissions (t/year)	1.25	**DFEE**	46.68	**TFEE**	45.56
General Requirements Compliance	Fail	**% DFEE<TFEE**	-2.45		

Assessor Details	Miss Georgia Dimitriou, Georgia Dimitriou, Tel: 07599467602, erieta.dimitriou@lowenergyconsultancy.co.uk	**Assessor ID**	P864-0001
Client			

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

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

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DWELLING AS DESIGNED

Ground-floor flat, total floor area 86 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) 16.75 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 17.57 kgCO□/m²Fail
Excess emissions =0.82 kgCO□/m² (4.9%)

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)45.6 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)46.7 kWh/m²/yrFail
Excess energy =1.1 kWh/m²/yr (2.4%)

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2 Fabric U-values

Element	Average	Highest	
External wall	0.22 (max. 0.30)	0.22 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.20 (max. 0.25)	0.20 (max. 0.70)	OK
Roof	(no roof)		
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

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

---

3 Air permeability
Air permeability at 50 pascals: 4.00 (design value)
Maximum 10.0 OK

---

4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Vaillant ecoFIT sustain 835 VUW 356/6-3 (H-GB)
Combi boiler
Efficiency: 89.3% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

---

5 Cylinder insulation
Hot water storage No cylinder

---

6 Controls
Space heating controls: Programmer, room thermostat and TRVs OK

Hot water controls: No cylinder

Boiler interlock Yes OK

---

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

---

8 Mechanical ventilation
Continuous extract system
Specific fan power: 0.16
Maximum 0.7 OK

---

9 Summertime temperature
Overheating risk (Thames Valley): Medium OK
Based on:
Overshading: Average
Windows facing South West: 4.73 m², No overhang
Windows facing North West: 11.48 m², No overhang
Air change rate: 2.00 ach
Blinds/curtains: None

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10 Key features
Party wall U-value 0.00 W/m²K

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	86.3600 (1b)	x	2.5000 (2b)	=	215.9000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	86.3600					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	215.9000	(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		4.0000	
Infiltration rate		0.2000	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1700	(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	0.2168	0.2125	0.2083	0.1870	0.1828	0.1615	0.1615	0.1573	0.1700	0.1828	0.1913	0.1998	(22b)

Mechanical extract ventilation - centralised

If mechanical ventilation:		0.5000	(23a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
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	
Opening Type 2 (Uw = 1.30)			16.2100	1.2357	20.0314			(27)
Heat Loss Floor 1			86.3600	0.2000	17.2720			(28a)
External Wall 1	48.9800	16.2100	32.7700	0.2200	7.2094			(29a)
Total net area of external elements Aum(A, m2)			135.3400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		44.5128			(33)
Party Wall 1			45.5800	0.0000	0.0000			(32)
Party Ceilings 1			86.3600					(32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	11.9189	(36)
Total fabric heat loss (33) + (36) =	56.4317	(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	35.6235	35.6235	35.6235	35.6235	35.6235	35.6235	35.6235	35.6235	35.6235	35.6235	35.6235	35.6235	(38)
Heat transfer coeff	92.0552	92.0552	92.0552	92.0552	92.0552	92.0552	92.0552	92.0552	92.0552	92.0552	92.0552	92.0552	(39)
Average = Sum(39)m / 12 =												92.0552	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0659	1.0659	1.0659	1.0659	1.0659	1.0659	1.0659	1.0659	1.0659	1.0659	1.0659	1.0659	(40)
HLP (average)												1.0659	(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	2.5725	(42)
Average daily hot water use (litres/day)	95.2980	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	104.8278	101.0159	97.2040	93.3921	89.5802	85.7682	85.7682	89.5802	93.3921	97.2040	101.0159	104.8278	(44)
Energy conte	155.4567	135.9634	140.3020	122.3187	117.3677	101.2794	93.8503	107.6946	108.9808	127.0066	138.6376	150.5515	(45)
Energy content (annual)										Total = Sum(45)m =		1499.4092	(45)
Distribution loss (46)m = 0.15 x (45)m	23.3185	20.3945	21.0453	18.3478	17.6052	15.1919	14.0775	16.1542	16.3471	19.0510	20.7956	22.5827	(46)
Water storage loss:													
Total storage loss													

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	26.4618	23.8810	26.3759	25.4453	26.2354	25.3221	26.1245	26.1964	25.3892	26.3178	25.5551	26.4397	(61)
Total heat required for water heating calculated for each month													
	181.9185	159.8443	166.6780	147.7640	143.6031	126.6015	119.9747	133.8909	134.3700	153.3244	164.1927	176.9912	(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													
	181.9185	159.8443	166.6780	147.7640	143.6031	126.6015	119.9747	133.8909	134.3700	153.3244	164.1927	176.9912	(64)
								Total per year (kWh/year) = Sum(64)m =				1809.1533	(64)
Heat gains from water heating, kWh/month													
	58.3048	51.1781	53.2444	47.0323	45.5836	40.0059	37.7363	42.3575	42.5834	48.8091	52.4858	56.6683	(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	128.6275	128.6275	128.6275	128.6275	128.6275	128.6275	128.6275	128.6275	128.6275	128.6275	128.6275	128.6275	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	21.0119	18.6626	15.1774	11.4903	8.5891	7.2513	7.8353	10.1846	13.6697	17.3569	20.2581	21.5959	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	232.2195	234.6292	228.5568	215.6294	199.3109	183.9737	173.7276	171.3179	177.3903	190.3177	206.6362	221.9734	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.8627	35.8627	35.8627	35.8627	35.8627	35.8627	35.8627	35.8627	35.8627	35.8627	35.8627	35.8627	(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)													
	-102.9020	-102.9020	-102.9020	-102.9020	-102.9020	-102.9020	-102.9020	-102.9020	-102.9020	-102.9020	-102.9020	-102.9020	(71)
Water heating gains (Table 5)													
	78.3667	76.1578	71.5651	65.3226	61.2683	55.5638	50.7209	56.9322	59.1436	65.6037	72.8969	76.1671	(72)
Total internal gains													
	396.1863	394.0379	379.8875	357.0305	333.7565	311.3771	296.8720	303.0229	314.7919	337.8665	364.3794	384.3245	(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	
Southwest	4.7300	36.7938	0.5000	0.7000	0.7700	42.2121	(79)
Northwest	11.4800	11.2829	0.5000	0.7000	0.7700	31.4171	(81)

Solar gains	73.6292	135.8532	213.5988	311.1197	390.8870	406.7137	384.3527	321.9910	246.9206	157.6204	90.0912	61.7816	(83)
Total gains	469.8155	529.8911	593.4864	668.1503	724.6435	718.0907	681.2247	625.0139	561.7125	495.4869	454.4706	446.1061	(84)

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	65.1481	65.1481	65.1481	65.1481	65.1481	65.1481	65.1481	65.1481	65.1481	65.1481	65.1481	65.1481	
alpha	5.3432	5.3432	5.3432	5.3432	5.3432	5.3432	5.3432	5.3432	5.3432	5.3432	5.3432	5.3432	
util living area													
	0.9988	0.9974	0.9926	0.9729	0.9035	0.7489	0.5790	0.6477	0.8892	0.9855	0.9974	0.9991	(86)
MIT	19.8204	19.9468	20.1765	20.4877	20.7775	20.9432	20.9883	20.9794	20.8501	20.4819	20.0875	19.7842	(87)
Th 2	20.0287	20.0287	20.0287	20.0287	20.0287	20.0287	20.0287	20.0287	20.0287	20.0287	20.0287	20.0287	(88)
util rest of house													
	0.9983	0.9964	0.9899	0.9620	0.8651	0.6620	0.4592	0.5255	0.8300	0.9779	0.9964	0.9988	(89)
MIT 2	18.9477	19.0738	19.3022	19.6072	19.8743	20.0019	20.0256	20.0226	19.9409	19.6053	19.2144	18.9116	(90)
Living area fraction									fLA = Living area / (4) =			0.3375	(91)
MIT	19.2423	19.3685	19.5973	19.9044	20.1792	20.3196	20.3506	20.3456	20.2478	19.9012	19.5091	19.2061	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.2423	19.3685	19.5973	19.9044	20.1792	20.3196	20.3506	20.3456	20.2478	19.9012	19.5091	19.2061	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9979	0.9956	0.9884	0.9603	0.8719	0.6899	0.5001	0.5673	0.8455	0.9766	0.9956	0.9984	(94)
Useful gains	468.8198	527.5665	586.5809	641.6455	631.8188	495.4146	340.6894	354.5634	474.9216	483.8974	452.4769	445.3858	(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													
	1375.5117	1331.8989	1205.6731	1013.0141	780.5549	526.5198	345.2603	363.2088	565.9357	856.2231	1142.3237	1381.3915	(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													
	674.5788	540.5114	460.6046	267.3855	110.6597	0.0000	0.0000	0.0000	0.0000	277.0103	496.6897	696.3883	(98)
Space heating												3523.8281	(98)
Space heating per m2											(98) / (4) =	40.8039	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	93.2000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3780.9315	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	674.5788	540.5114	460.6046	267.3855	110.6597	0.0000	0.0000	0.0000	0.0000	277.0103	496.6897	696.3883	(98)
Space heating efficiency (main heating system 1)	93.2000	93.2000	93.2000	93.2000	93.2000	0.0000	0.0000	0.0000	0.0000	93.2000	93.2000	93.2000	(210)
Space heating fuel (main heating system)	723.7970	579.9478	494.2109	286.8943	118.7336	0.0000	0.0000	0.0000	0.0000	297.2213	532.9288	747.1977	(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	181.9185	159.8443	166.6780	147.7640	143.6031	126.6015	119.9747	133.8909	134.3700	153.3244	164.1927	176.9912	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.5680	89.5213	89.4108	89.1460	88.5389	87.3000	87.3000	87.3000	87.3000	89.1449	89.4617	89.5969	(217)
Fuel for water heating, kWh/month	203.1064	178.5546	186.4182	165.7551	162.1921	145.0189	137.4281	153.3688	153.9175	171.9945	183.5341	197.5418	(219)
Water heating fuel used												2038.8301	(219)

Annual totals kWh/year

Space heating fuel - main system	3780.9315	(211)
Space heating fuel - secondary	0.0000	(215)

Electricity for pumps and fans:
(MEVCentralised, Database: in-use factor = 1.3000, SFP = 0.2080)

mechanical ventilation fans (SFP = 0.2080)	54.7868	(230a)
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	129.7868	(231)
Electricity for lighting (calculated in Appendix L)	371.0765	(232)
Total delivered energy for all uses	6320.6248	(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	3780.9315	0.2160	816.6812	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2038.8301	0.2160	440.3873	(264)
Space and water heating			1257.0685	(265)
Pumps and fans	129.7868	0.5190	67.3593	(267)
Energy for lighting	371.0765	0.5190	192.5887	(268)
Total CO2, kg/year			1517.0165	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			17.5700	(273)

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

DER		17.5700	ZC1
Total Floor Area	TFA	86.3600	
Assumed number of occupants	N	2.5725	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		15.9343	ZC2
CO2 emissions from cooking, equation (L16)		2.0929	ZC3
Total CO2 emissions		35.5972	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		35.5972	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	86.3600 (1b)	x	2.5000 (2b)	=	215.9000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	86.3600					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	215.9000	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							3 * 10 =		30.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1390	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3890	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3306	(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	0.4215	0.4133	0.4050	0.3637	0.3554	0.3141	0.3141	0.3058	0.3306	0.3554	0.3719	0.3885	(22b)
Effective ac	0.5888	0.5854	0.5820	0.5661	0.5632	0.5493	0.5493	0.5468	0.5547	0.5632	0.5692	0.5755	(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 Opening Type (Uw = 1.40)			16.2100	1.3258	21.4905			(27)
Heat Loss Floor 1			86.3600	0.1300	11.2268			(28a)
External Wall 1	48.9800	16.2100	32.7700	0.1800	5.8986			(29a)
Total net area of external elements Aum(A, m2)			135.3400					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	38.6159			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							8.4506	(36)
Total fabric heat loss						(33) + (36) =	47.0665	(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	41.9533	41.7075	41.4666	40.3349	40.1232	39.1376	39.1376	38.9551	39.5173	40.1232	40.5515	40.9993	(38)
Heat transfer coeff	89.0198	88.7740	88.5331	87.4015	87.1898	86.2041	86.2041	86.0216	86.5838	87.1898	87.6181	88.0659	(39)
Average = Sum(39)m / 12 =												87.4005	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0308	1.0280	1.0252	1.0121	1.0096	0.9982	0.9982	0.9961	1.0026	1.0096	1.0146	1.0198	(40)
HLP (average)												1.0120	(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	2.5725	(42)
Average daily hot water use (litres/day)	95.2980	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	104.8278	101.0159	97.2040	93.3921	89.5802	85.7682	85.7682	89.5802	93.3921	97.2040	101.0159	104.8278	(44)
Energy conte	155.4567	135.9634	140.3020	122.3187	117.3677	101.2794	93.8503	107.6946	108.9808	127.0066	138.6376	150.5515	(45)
Energy content (annual)										Total = Sum(45)m =		1499.4092	(45)
Distribution loss (46)m = 0.15 x (45)m	23.3185	20.3945	21.0453	18.3478	17.6052	15.1919	14.0775	16.1542	16.3471	19.0510	20.7956	22.5827	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	46.0274	49.5341	46.0564	45.6491	42.2967	43.7066	45.6491	46.0564	49.5341	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month													

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	206.4156	181.9908	189.8361	168.3751	163.0168	143.5761	137.5568	153.3436	155.0371	176.5407	187.9527	201.5104	(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													
	206.4156	181.9908	189.8361	168.3751	163.0168	143.5761	137.5568	153.3436	155.0371	176.5407	187.9527	201.5104	(64)
								Total per year (kWh/year) = Sum(64)m =				2065.1518	(64)
Heat gains from water heating, kWh/month													
	64.4291	56.7147	59.0340	52.1851	50.4370	44.2496	42.1319	47.2207	47.7502	54.6132	58.4258	62.7981	(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	128.6275	128.6275	128.6275	128.6275	128.6275	128.6275	128.6275	128.6275	128.6275	128.6275	128.6275	128.6275	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	21.0119	18.6626	15.1774	11.4903	8.5891	7.2513	7.8353	10.1846	13.6697	17.3569	20.2581	21.5959	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	232.2195	234.6292	228.5568	215.6294	199.3109	183.9737	173.7276	171.3179	177.3903	190.3177	206.6362	221.9734	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.8627	35.8627	35.8627	35.8627	35.8627	35.8627	35.8627	35.8627	35.8627	35.8627	35.8627	35.8627	(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)													
	-102.9020	-102.9020	-102.9020	-102.9020	-102.9020	-102.9020	-102.9020	-102.9020	-102.9020	-102.9020	-102.9020	-102.9020	(71)
Water heating gains (Table 5)													
	86.5982	84.3968	79.3467	72.4793	67.7917	61.4577	56.6288	63.4687	66.3197	73.4049	81.1469	84.4060	(72)
Total internal gains													
	404.4178	402.2769	387.6692	364.1872	340.2799	317.2710	302.7800	309.5594	321.9680	345.6677	372.6294	392.5635	(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	
Southwest	4.7300	36.7938	0.6300	0.7000	0.7700	53.1873	(79)
Northwest	11.4800	11.2829	0.6300	0.7000	0.7700	39.5855	(81)

Solar gains	92.7728	171.1751	269.1345	392.0109	492.5176	512.4592	484.2844	405.7086	311.1200	198.6017	113.5149	77.8448	(83)
Total gains	497.1906	573.4519	656.8037	756.1981	832.7975	829.7302	787.0644	715.2681	633.0879	544.2694	486.1444	470.4083	(84)

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	67.3695	67.5560	67.7399	68.6169	68.7836	69.5700	69.5700	69.7176	69.2650	68.7836	68.4473	68.0993	
alpha	5.4913	5.5037	5.5160	5.5745	5.5856	5.6380	5.6380	5.6478	5.6177	5.5856	5.5632	5.5400	
util living area													
	0.9984	0.9961	0.9877	0.9506	0.8366	0.6410	0.4778	0.5443	0.8232	0.9761	0.9964	0.9988	(86)
MIT	19.8992	20.0456	20.2934	20.6222	20.8726	20.9778	20.9964	20.9929	20.9148	20.5809	20.1821	19.8753	(87)
Th 2	20.0577	20.0601	20.0624	20.0733	20.0753	20.0848	20.0848	20.0866	20.0812	20.0753	20.0712	20.0669	(88)
util rest of house													
	0.9978	0.9947	0.9834	0.9334	0.7874	0.5593	0.3806	0.4409	0.7525	0.9646	0.9949	0.9984	(89)
MIT 2	18.5816	18.7970	19.1582	19.6309	19.9535	20.0705	20.0835	20.0837	20.0133	19.5830	19.0051	18.5534	(90)
Living area fraction									fLA = Living area / (4) =			0.3375	(91)
MIT	19.0263	19.2185	19.5413	19.9655	20.2637	20.3768	20.3916	20.3906	20.3176	19.9199	19.4024	18.9996	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.0263	19.2185	19.5413	19.9655	20.2637	20.3768	20.3916	20.3906	20.3176	19.9199	19.4024	18.9996	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9970	0.9931	0.9803	0.9310	0.7983	0.5862	0.4136	0.4759	0.7725	0.9621	0.9934	0.9977	(94)
Useful gains	495.6838	569.4905	643.8672	703.9964	664.8183	486.3954	325.5034	340.4276	489.0886	523.6372	482.9467	469.3449	(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													
	1310.9370	1271.1072	1154.5910	967.1417	746.6708	497.9808	326.8549	343.2743	538.3428	812.5967	1077.9099	1303.3398	(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													
	606.5484	471.4864	379.9785	189.4646	60.8983	0.0000	0.0000	0.0000	0.0000	214.9858	428.3735	620.4922	(98)
Space heating												2972.2278	(98)
Space heating per m2											(98) / (4) =	34.4167	(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)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Efficiency of main space heating system 1 (in %)	93.4000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3182.2568	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	606.5484	471.4864	379.9785	189.4646	60.8983	0.0000	0.0000	0.0000	0.0000	214.9858	428.3735	620.4922	(98)
Space heating efficiency (main heating system 1)	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)	649.4095	504.8034	406.8292	202.8529	65.2016	0.0000	0.0000	0.0000	0.0000	230.1776	458.6440	664.3386	(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	206.4156	181.9908	189.8361	168.3751	163.0168	143.5761	137.5568	153.3436	155.0371	176.5407	187.9527	201.5104	(64)
Efficiency of water heater												80.3000	(216)
(217)m	87.6024	87.3406	86.7643	85.3488	82.8165	80.3000	80.3000	80.3000	80.3000	85.5482	87.0606	87.6960	(217)
Fuel for water heating, kWh/month	235.6279	208.3691	218.7953	197.2787	196.8410	178.7996	171.3036	190.9634	193.0724	206.3639	215.8871	229.7829	(219)
Water heating fuel used												2443.0851	(219)

Annual totals kWh/year		
Space heating fuel - main system	3182.2568	(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)	371.0765	(232)
Total delivered energy for all uses	6071.4185	(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	3182.2568	0.2160	687.3675	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2443.0851	0.2160	527.7064	(264)
Space and water heating			1215.0739	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	371.0765	0.5190	192.5887	(268)
Total CO2, kg/m2/year			1446.5876	(272)
Emissions per m2 for space and water heating			14.0699	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.2301	(272b)
Emissions per m2 for pumps and fans			0.4507	(272c)
Target Carbon Dioxide Emission Rate (TER) = (14.0699 * 1.00) + 2.2301 + 0.4507, rounded to 2 d.p.			16.7500	(273)

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

Design SAP
elmhurst energy

Property Reference	Plot 208	**Issued on Date**	13/02/2020
Assessment Reference	001	**Prop Type Ref**	GF
Property	Epping College Site B, Plot 208		

SAP Rating	84 B	**DER**	17.91	**TER**	17.31
Environmental	87 B	**% DER<TER**	-3.47		
CO_2 Emissions (t/year)	1.03	**DFEE**	43.66	**TFEE**	42.23
General Requirements Compliance	Fail	**% DFEE<TFEE**	-3.38		

Assessor Details	Miss Georgia Dimitriou, Georgia Dimitriou, Tel: 07599467602, erieta.dimitriou@lowenergyconsultancy.co.uk	**Assessor ID**	P864-0001
Client			

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

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

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DWELLING AS DESIGNED

Ground-floor flat, total floor area 70 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) 17.31 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 17.91 kgCO□/m²Fail
Excess emissions =0.60 kgCO□/m² (3.5%)

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)42.2 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)43.7 kWh/m²/yrFail
Excess energy =1.5 kWh/m²/yr (3.6%)

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2 Fabric U-values

Element	Average	Highest	
External wall	0.22 (max. 0.30)	0.22 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.20 (max. 0.25)	0.20 (max. 0.70)	OK
Roof	(no roof)		
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

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

---

3 Air permeability
Air permeability at 50 pascals: 4.00 (design value)
Maximum 10.0 OK

---

4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Vaillant ecoFIT sustain 835 VUW 356/6-3 (H-GB)
Combi boiler
Efficiency: 89.3% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

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5 Cylinder insulation
Hot water storage No cylinder

---

6 Controls
Space heating controls: Programmer, room thermostat and TRVs OK

Hot water controls: No cylinder

Boiler interlock Yes OK

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

---

8 Mechanical ventilation
Continuous extract system
Specific fan power: 0.17
Maximum 0.7 OK

---

9 Summertime temperature
Overheating risk (Thames Valley): Medium OK
Based on:
Overshading: Average
Windows facing North West: 10.19 m², No overhang
Air change rate: 2.00 ach
Blinds/curtains: None

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10 Key features
Party wall U-value 0.00 W/m²K

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	70.3300 (1b)	x	2.5000 (2b)	=	175.8250	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	70.3300					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	175.8250	(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		4.0000	
Infiltration rate		0.2000	(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) =	0.1550	(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	0.1976	0.1938	0.1899	0.1705	0.1666	0.1473	0.1473	0.1434	0.1550	0.1666	0.1744	0.1821	(22b)

Mechanical extract ventilation - centralised

If mechanical ventilation:	0.5000	(23a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
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	
Opening Type 2 (Uw = 1.30)			10.1900	1.2357	12.5922			(27)
Heat Loss Floor 1			70.3300	0.2000	14.0660			(28a)
External Wall 1	27.4300	10.1900	17.2400	0.2200	3.7928			(29a)
Total net area of external elements Aum(A, m2)			97.7600					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		30.4510			(33)
Party Wall 1			60.1800	0.0000	0.0000			(32)
Party Ceilings 1			70.3300					(32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.0015	(36)
Total fabric heat loss (33) + (36) =	39.4525	(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	29.0111	29.0111	29.0111	29.0111	29.0111	29.0111	29.0111	29.0111	29.0111	29.0111	29.0111	29.0111	(38)
Heat transfer coeff	68.4636	68.4636	68.4636	68.4636	68.4636	68.4636	68.4636	68.4636	68.4636	68.4636	68.4636	68.4636	(39)
Average = Sum(39)m / 12 =												68.4636	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9735	0.9735	0.9735	0.9735	0.9735	0.9735	0.9735	0.9735	0.9735	0.9735	0.9735	0.9735	(40)
HLP (average)												0.9735	(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	2.2541	(42)
Average daily hot water use (litres/day)	87.7351	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	96.5086	92.9992	89.4898	85.9804	82.4710	78.9616	78.9616	82.4710	85.9804	89.4898	92.9992	96.5086	(44)
Energy conte	143.1195	125.1732	129.1676	112.6114	108.0533	93.2418	86.4022	99.1478	100.3320	116.9272	127.6352	138.6036	(45)
Energy content (annual)										Total = Sum(45)m =		1380.4149	(45)
Distribution loss (46)m = 0.15 x (45)m	21.4679	18.7760	19.3751	16.8917	16.2080	13.9863	12.9603	14.8722	15.0498	17.5391	19.1453	20.7905	(46)
Water storage loss:													
Total storage loss													

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	26.3838	23.7930	26.2824	25.3669	26.1632	25.2625	26.0693	26.1302	25.3194	26.2331	25.4653	26.3642	(61)
Total heat required for water heating calculated for each month													
	169.5033	148.9662	155.4500	137.9783	134.2166	118.5043	112.4715	125.2780	125.6514	143.1603	153.1006	164.9678	(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													
	169.5033	148.9662	155.4500	137.9783	134.2166	118.5043	112.4715	125.2780	125.6514	143.1603	153.1006	164.9678	(64)
								Total per year (kWh/year) = Sum(64)m =				1689.2482	(64)
Heat gains from water heating, kWh/month													
	54.1832	47.5683	49.5188	43.7850	42.4685	37.3185	35.2461	39.4992	39.6902	45.4366	48.8050	52.6767	(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	112.7055	112.7055	112.7055	112.7055	112.7055	112.7055	112.7055	112.7055	112.7055	112.7055	112.7055	112.7055	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	18.8036	16.7012	13.5823	10.2827	7.6864	6.4892	7.0118	9.1142	12.2331	15.5327	18.1290	19.3262	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	198.0660	200.1213	194.9420	183.9159	169.9974	156.9160	148.1768	146.1215	151.3008	162.3269	176.2454	189.3268	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	34.2705	34.2705	34.2705	34.2705	34.2705	34.2705	34.2705	34.2705	34.2705	34.2705	34.2705	34.2705	(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)													
	-90.1644	-90.1644	-90.1644	-90.1644	-90.1644	-90.1644	-90.1644	-90.1644	-90.1644	-90.1644	-90.1644	-90.1644	(71)
Water heating gains (Table 5)													
	72.8269	70.7862	66.5575	60.8125	57.0814	51.8313	47.3737	53.0903	55.1253	61.0707	67.7848	70.8021	(72)
Total internal gains													
	349.5081	347.4204	334.8936	314.8228	294.5769	275.0481	262.3740	268.1377	278.4709	298.7420	321.9708	339.2668	(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	
Northwest	10.1900	11.2829	0.5000	0.7000	0.7700	27.8867	(81)

Solar gains	27.8867	56.7643	102.2712	167.9586	225.7694	240.6940	225.1643	179.5036	124.6190	69.3704	35.0887	22.7737	(83)
Total gains	377.3949	404.1847	437.1647	482.7814	520.3462	515.7422	487.5383	447.6413	403.0899	368.1124	357.0596	362.0405	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	71.3376	71.3376	71.3376	71.3376	71.3376	71.3376	71.3376	71.3376	71.3376	71.3376	71.3376	71.3376	
alpha	5.7558	5.7558	5.7558	5.7558	5.7558	5.7558	5.7558	5.7558	5.7558	5.7558	5.7558	5.7558	
util living area													
	0.9989	0.9980	0.9950	0.9809	0.9231	0.7747	0.6025	0.6732	0.9105	0.9890	0.9978	0.9991	(86)
MIT	19.9426	20.0357	20.2305	20.5104	20.7843	20.9467	20.9897	20.9812	20.8546	20.5199	20.1785	19.9121	(87)
Th 2	20.1055	20.1055	20.1055	20.1055	20.1055	20.1055	20.1055	20.1055	20.1055	20.1055	20.1055	20.1055	(88)
util rest of house													
	0.9985	0.9974	0.9931	0.9730	0.8913	0.6941	0.4880	0.5572	0.8603	0.9833	0.9969	0.9988	(89)
MIT 2	19.1324	19.2254	19.4193	19.6952	19.9514	20.0793	20.1026	20.0996	20.0167	19.7070	19.3681	19.1020	(90)
Living area fraction									fLA = Living area / (4) =			0.4386	(91)
MIT	19.4878	19.5808	19.7751	20.0528	20.3167	20.4598	20.4917	20.4863	20.3842	20.0636	19.7236	19.4574	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.4878	19.5808	19.7751	20.0528	20.3167	20.4598	20.4917	20.4863	20.3842	20.0636	19.7236	19.4574	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9981	0.9968	0.9923	0.9725	0.8998	0.7280	0.5387	0.6086	0.8783	0.9830	0.9964	0.9985	(94)
Useful gains	376.6903	402.9055	433.7810	469.4949	468.2161	375.4828	262.6469	272.4467	354.0191	361.8364	355.7633	361.5089	(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													
	1039.8121	1005.1033	908.8642	763.5582	589.9328	401.1830	266.4418	279.7650	430.2407	647.9123	864.2573	1044.5736	(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													
	493.3627	404.6769	353.4619	211.7255	90.5572	0.0000	0.0000	0.0000	0.0000	212.8404	366.1157	508.2001	(98)
Space heating												2640.9405	(98)
Space heating per m2											(98) / (4) =	37.5507	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	93.2000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2833.6271	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	493.3627	404.6769	353.4619	211.7255	90.5572	0.0000	0.0000	0.0000	0.0000	212.8404	366.1157	508.2001	(98)
Space heating efficiency (main heating system 1)	93.2000	93.2000	93.2000	93.2000	93.2000	0.0000	0.0000	0.0000	0.0000	93.2000	93.2000	93.2000	(210)
Space heating fuel (main heating system)	529.3591	434.2027	379.2510	227.1733	97.1644	0.0000	0.0000	0.0000	0.0000	228.3696	392.8280	545.2791	(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	169.5033	148.9662	155.4500	137.9783	134.2166	118.5043	112.4715	125.2780	125.6514	143.1603	153.1006	164.9678	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.4403	89.4009	89.2939	89.0331	88.4456	87.3000	87.3000	87.3000	87.3000	89.0110	89.3250	89.4716	(217)
Fuel for water heating, kWh/month	189.5157	166.6271	174.0879	154.9742	151.7504	135.7438	128.8333	143.5029	143.9305	160.8345	171.3971	184.3799	(219)

Water heating fuel used	1905.5774	(219)
Annual totals kWh/year		
Space heating fuel - main system	2833.6271	(211)
Space heating fuel - secondary	0.0000	(215)

Electricity for pumps and fans:
(MEVCentralised, Database: in-use factor = 1.3000, SFP = 0.2210)

mechanical ventilation fans (SFP = 0.2210)	47.4059	(230a)
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	122.4059	(231)
Electricity for lighting (calculated in Appendix L)	332.0776	(232)
Total delivered energy for all uses	5193.6881	(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	2833.6271	0.2160	612.0635	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1905.5774	0.2160	411.6047	(264)
Space and water heating			1023.6682	(265)
Pumps and fans	122.4059	0.5190	63.5287	(267)
Energy for lighting	332.0776	0.5190	172.3483	(268)
Total CO2, kg/year			1259.5451	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			17.9100	(273)

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

DER		17.9100	ZC1
Total Floor Area	TFA	70.3300	
Assumed number of occupants	N	2.2541	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		16.6884	ZC2
CO2 emissions from cooking, equation (L16)		2.4612	ZC3
Total CO2 emissions		37.0597	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		37.0597	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	70.3300 (1b)	x	2.5000 (2b)	=	175.8250	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	70.3300					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	175.8250	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1706	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4206	(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) =	0.3260	(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	0.4156	0.4075	0.3993	0.3586	0.3504	0.3097	0.3097	0.3015	0.3260	0.3504	0.3667	0.3830	(22b)
Effective ac	0.5864	0.5830	0.5797	0.5643	0.5614	0.5480	0.5480	0.5455	0.5531	0.5614	0.5672	0.5734	(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 Opening Type (Uw = 1.40)			10.1900	1.3258	13.5095			(27)
Heat Loss Floor 1			70.3300	0.1300	9.1429			(28a)
External Wall 1	27.4300	10.1900	17.2400	0.1800	3.1032			(29a)
Total net area of external elements Aum(A, m2)			97.7600					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	25.7556			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							5.8292	(36)
Total fabric heat loss						(33) + (36) =	31.5848	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	34.0227	33.8281	33.6374	32.7414	32.5738	31.7934	31.7934	31.6489	32.0940	32.5738	32.9129	33.2674	(38)
Heat transfer coeff	65.6075	65.4129	65.2221	64.3262	64.1585	63.3782	63.3782	63.2337	63.6788	64.1585	64.4977	64.8522	(39)
Average = Sum(39)m / 12 =												64.3254	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9329	0.9301	0.9274	0.9146	0.9123	0.9012	0.9012	0.8991	0.9054	0.9123	0.9171	0.9221	(40)
HLP (average)												0.9146	(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	2.2541	(42)
Average daily hot water use (litres/day)	87.7351	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	96.5086	92.9992	89.4898	85.9804	82.4710	78.9616	78.9616	82.4710	85.9804	89.4898	92.9992	96.5086	(44)
Energy conte	143.1195	125.1732	129.1676	112.6114	108.0533	93.2418	86.4022	99.1478	100.3320	116.9272	127.6352	138.6036	(45)
Energy content (annual)										Total = Sum(45)m =		1380.4149	(45)
Distribution loss (46)m = 0.15 x (45)m	21.4679	18.7760	19.3751	16.8917	16.2080	13.9863	12.9603	14.8722	15.0498	17.5391	19.1453	20.7905	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	49.1797	42.8051	45.6030	42.4013	42.0263	38.9400	40.2380	42.0263	42.4013	45.6030	45.8626	49.1797	(61)
Total heat required for water heating calculated for each month													

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	192.2992	167.9783	174.7706	155.0127	150.0796	132.1818	126.6402	141.1741	142.7333	162.5303	173.4978	187.7833	(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													
	192.2992	167.9783	174.7706	155.0127	150.0796	132.1818	126.6402	141.1741	142.7333	162.5303	173.4978	187.7833	(64)
								Total per year (kWh/year) = Sum(64)m =				1906.6813	(64)
Heat gains from water heating, kWh/month													
	59.8822	52.3214	54.3490	48.0436	46.4343	40.7379	38.7882	43.4732	43.9607	50.2791	53.9044	58.3806	(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	112.7055	112.7055	112.7055	112.7055	112.7055	112.7055	112.7055	112.7055	112.7055	112.7055	112.7055	112.7055	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	18.8036	16.7012	13.5823	10.2827	7.6864	6.4892	7.0118	9.1142	12.2331	15.5327	18.1290	19.3262	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	198.0660	200.1213	194.9420	183.9159	169.9974	156.9160	148.1768	146.1215	151.3008	162.3269	176.2454	189.3268	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	34.2705	34.2705	34.2705	34.2705	34.2705	34.2705	34.2705	34.2705	34.2705	34.2705	34.2705	34.2705	(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)													
	-90.1644	-90.1644	-90.1644	-90.1644	-90.1644	-90.1644	-90.1644	-90.1644	-90.1644	-90.1644	-90.1644	-90.1644	(71)
Water heating gains (Table 5)													
	80.4868	77.8592	73.0497	66.7272	62.4117	56.5804	52.1347	58.4318	61.0565	67.5794	74.8672	78.4686	(72)
Total internal gains													
	357.1681	354.4934	341.3857	320.7375	299.9072	279.7972	267.1350	273.4791	284.4021	305.2507	329.0532	346.9333	(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	
Northwest	10.1900	11.2829	0.6300	0.7000	0.7700	35.1373	(81)

Solar gains	35.1373	71.5230	128.8617	211.6279	284.4694	303.2745	283.7071	226.1746	157.0200	87.4068	44.2118	28.6949	(83)
Total gains	392.3054	426.0164	470.2474	532.3654	584.3766	583.0717	550.8420	499.6537	441.4220	392.6574	373.2650	375.6282	(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	74.4431	74.6646	74.8830	75.9260	76.1244	77.0616	77.0616	77.2378	76.6979	76.1244	75.7241	75.3101	
alpha	5.9629	5.9776	5.9922	6.0617	6.0750	6.1374	6.1374	6.1492	6.1132	6.0750	6.0483	6.0207	
util living area													
	0.9986	0.9973	0.9923	0.9661	0.8674	0.6710	0.5024	0.5732	0.8574	0.9832	0.9971	0.9989	(86)
MIT	20.0213	20.1260	20.3332	20.6316	20.8747	20.9799	20.9970	20.9938	20.9149	20.6075	20.2688	20.0049	(87)
Th 2	20.1397	20.1420	20.1443	20.1551	20.1571	20.1665	20.1665	20.1683	20.1629	20.1571	20.1530	20.1487	(88)
util rest of house													
	0.9981	0.9964	0.9896	0.9537	0.8249	0.5938	0.4093	0.4743	0.7959	0.9749	0.9959	0.9986	(89)
MIT 2	18.8208	18.9755	19.2788	19.7131	20.0333	20.1531	20.1654	20.1656	20.0918	19.6862	19.1927	18.8036	(90)
Living area fraction									fLA = Living area / (4) =			0.4386	(91)
MIT	19.3474	19.4802	19.7413	20.1160	20.4024	20.5157	20.5302	20.5288	20.4528	20.0903	19.6647	19.3305	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.3474	19.4802	19.7413	20.1160	20.4024	20.5157	20.5302	20.5288	20.4528	20.0903	19.6647	19.3305	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9975	0.9955	0.9879	0.9530	0.8384	0.6271	0.4503	0.5179	0.8193	0.9741	0.9950	0.9981	(94)
Useful gains	391.3404	424.1030	464.5574	507.3360	489.9129	365.6272	248.0373	258.7567	361.6593	382.4967	371.4054	374.9121	(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													
	987.2250	953.7320	863.6268	721.4822	558.3335	374.9293	249.0870	261.0823	404.5406	608.8849	810.3970	981.2472	(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													
	443.3381	355.9107	296.9076	154.1853	50.9050	0.0000	0.0000	0.0000	0.0000	168.4328	316.0740	451.1133	(98)
Space heating												2236.8668	(98)
Space heating per m2											(98) / (4) =	31.8053	(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 %)	93.4000	(206)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												2394.9323	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	443.3381	355.9107	296.9076	154.1853	50.9050	0.0000	0.0000	0.0000	0.0000	168.4328	316.0740	451.1133	(98)
Space heating efficiency (main heating system 1)	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)	474.6661	381.0607	317.8882	165.0806	54.5021	0.0000	0.0000	0.0000	0.0000	180.3349	338.4089	482.9907	(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	192.2992	167.9783	174.7706	155.0127	150.0796	132.1818	126.6402	141.1741	142.7333	162.5303	173.4978	187.7833	(64)
Efficiency of water heater												80.3000	(216)
(217)m	87.0862	86.8956	86.3746	85.0377	82.6385	80.3000	80.3000	80.3000	80.3000	85.1410	86.5424	87.1772	(217)
Fuel for water heating, kWh/month	220.8148	193.3106	202.3404	182.2870	181.6099	164.6099	157.7088	175.8084	177.7500	190.8953	200.4772	215.4042	(219)
Water heating fuel used												2263.0165	(219)
Annual totals kWh/year													
Space heating fuel - main system												2394.9323	(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)												332.0776	(232)
Total delivered energy for all uses												5065.0264	(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	2394.9323	0.2160	517.3054	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2263.0165	0.2160	488.8116	(264)
Space and water heating			1006.1169	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	332.0776	0.5190	172.3483	(268)
Total CO2, kg/m2/year			1217.3902	(272)
Emissions per m2 for space and water heating			14.3057	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.4506	(272b)
Emissions per m2 for pumps and fans			0.5535	(272c)
Target Carbon Dioxide Emission Rate (TER) = (14.3057 * 1.00) + 2.4506 + 0.5535, rounded to 2 d.p.			17.3100	(273)

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

Design SAP
elmhurst energy

Property Reference	Plot 218	**Issued on Date**	13/02/2020
Assessment Reference	001	**Prop Type Ref**	MF
Property	Epping College Site B, Plot 218		

SAP Rating	85 B	**DER**	16.04	**TER**	16.96
Environmental	90 B	**% DER<TER**	5.45		
CO_2 Emissions (t/year)	0.67	**DFEE**	30.66	**TFEE**	34.53
General Requirements Compliance	Fail	**% DFEE<TFEE**	11.21		

Assessor Details	Miss Georgia Dimitriou, Georgia Dimitriou, Tel: 07599467602, erieta.dimitriou@lowenergyconsultancy.co.uk	**Assessor ID**	P864-0001
Client			

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

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DWELLING AS DESIGNED

Mid-floor flat, total floor area 50 m²

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

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 16.96 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 16.04 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)34.5 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)30.7 kWh/m²/yrOK

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2 Fabric U-values

Element	Average	Highest	
External wall	0.22 (max. 0.30)	0.22 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	(no floor)		
Roof	(no roof)		
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

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

---

3 Air permeability
Air permeability at 50 pascals: 4.00 (design value)
Maximum 10.0 OK

---

4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Vaillant ecoFIT sustain 835 VUW 356/6-3 (H-GB)
Combi boiler
Efficiency: 89.3% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

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5 Cylinder insulation
Hot water storage No cylinder

---

6 Controls
Space heating controls: Programmer, room thermostat and TRVs OK

Hot water controls: No cylinder

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
Specific fan power: 0.17
Maximum 0.7 OK

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9 Summertime temperature
Overheating risk (Thames Valley): High Fail
Based on:
Overshading: Average
Windows facing North West: 11.75 m², No overhang
Air change rate: 2.00 ach
Blinds/curtains: None

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10 Key features
Party wall U-value 0.00 W/m²K

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.1200 (1b)	x	2.5000 (2b)	=	125.3000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	50.1200					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	125.3000	(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		4.0000	
Infiltration rate		0.2000	(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) =	0.1550	(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	0.1976	0.1938	0.1899	0.1705	0.1666	0.1473	0.1473	0.1434	0.1550	0.1666	0.1744	0.1821	(22b)

Mechanical extract ventilation - centralised

If mechanical ventilation:		0.5000	(23a)
Effective ac	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	
Opening Type 2 (Uw = 1.30)			11.7500	1.2357	14.5200			(27)
External Wall 1	18.7500	11.7500	7.0000	0.2200	1.5400			(29a)
Total net area of external elements Aum(A, m2)			18.7500					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	16.0600			(33)
Party Wall 1			64.9500	0.0000	0.0000			(32)
Party Floor 1			50.1200					(32d)
Party Ceilings 1			50.1200					(32b)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							4.0248	(36)
Total fabric heat loss					(33) + (36) =		20.0848	(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	20.6745	20.6745	20.6745	20.6745	20.6745	20.6745	20.6745	20.6745	20.6745	20.6745	20.6745	20.6745	(38)
Heat transfer coeff	40.7593	40.7593	40.7593	40.7593	40.7593	40.7593	40.7593	40.7593	40.7593	40.7593	40.7593	40.7593	(39)
Average = Sum(39)m / 12 =												40.7593	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.8132	0.8132	0.8132	0.8132	0.8132	0.8132	0.8132	0.8132	0.8132	0.8132	0.8132	0.8132	(40)
HLP (average)												0.8132	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.6936	(42)
Average daily hot water use (litres/day)	74.4238	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	81.8662	78.8892	75.9123	72.9353	69.9584	66.9814	66.9814	69.9584	72.9353	75.9123	78.8892	81.8662	(44)
Energy conte	121.4052	106.1818	109.5701	95.5258	91.6593	79.0950	73.2932	84.1050	85.1095	99.1869	108.2702	117.5745	(45)
Energy content (annual)										Total = Sum(45)m =		1170.9764	(45)
Distribution loss (46)m = 0.15 x (45)m	18.2108	15.9273	16.4355	14.3289	13.7489	11.8643	10.9940	12.6157	12.7664	14.8780	16.2405	17.6362	(46)
Water storage loss:													
Total storage loss													

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	26.2095	23.6461	26.1365	25.2447	26.0508	25.1696	25.9832	26.0270	25.2105	26.1011	25.3156	26.1954	(61)
Total heat required for water heating calculated for each month													
	147.6147	129.8278	135.7066	120.7706	117.7101	104.2646	99.2763	110.1320	110.3200	125.2879	133.5858	143.7698	(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													
	147.6147	129.8278	135.7066	120.7706	117.7101	104.2646	99.2763	110.1320	110.3200	125.2879	133.5858	143.7698	(64)
								Total per year (kWh/year) = Sum(64)m =				1478.2664	(64)
Heat gains from water heating, kWh/month													
	46.9196	41.2170	42.9662	38.0735	36.9894	32.5915	30.8658	34.4717	34.6015	39.5049	42.3287	45.6424	(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	84.6817	84.6817	84.6817	84.6817	84.6817	84.6817	84.6817	84.6817	84.6817	84.6817	84.6817	84.6817	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	13.1538	11.6831	9.5013	7.1931	5.3769	4.5394	4.9050	6.3757	8.5575	10.8657	12.6819	13.5194	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	147.5456	149.0767	145.2184	137.0047	126.6364	116.8916	110.3815	108.8505	112.7087	120.9224	131.2907	141.0355	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	31.4682	31.4682	31.4682	31.4682	31.4682	31.4682	31.4682	31.4682	31.4682	31.4682	31.4682	31.4682	(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)													
	-67.7454	-67.7454	-67.7454	-67.7454	-67.7454	-67.7454	-67.7454	-67.7454	-67.7454	-67.7454	-67.7454	-67.7454	(71)
Water heating gains (Table 5)													
	63.0640	61.3348	57.7502	52.8799	49.7170	45.2660	41.4862	46.3329	48.0577	53.0980	58.7899	61.3472	(72)
Total internal gains													
	275.1679	273.4990	263.8745	248.4823	233.1348	218.1016	208.1773	212.9636	220.7284	236.2906	254.1671	267.3066	(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	
Northwest	11.7500	11.2829	0.5000	0.7000	0.7700	32.1560	(81)

Solar gains	32.1560	65.4544	117.9280	193.6716	260.3327	277.5422	259.6350	206.9840	143.6971	79.9904	40.4605	26.2602	(83)
Total gains	307.3239	338.9534	381.8025	442.1539	493.4675	495.6437	467.8123	419.9476	364.4255	316.2811	294.6276	293.5668	(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	85.3930	85.3930	85.3930	85.3930	85.3930	85.3930	85.3930	85.3930	85.3930	85.3930	85.3930	85.3930	
alpha	6.6929	6.6929	6.6929	6.6929	6.6929	6.6929	6.6929	6.6929	6.6929	6.6929	6.6929	6.6929	
util living area													
	0.9973	0.9942	0.9803	0.9124	0.7331	0.5229	0.3830	0.4453	0.7357	0.9600	0.9939	0.9980	(86)
MIT	20.2530	20.3627	20.5674	20.8208	20.9654	20.9966	20.9996	20.9991	20.9738	20.7599	20.4536	20.2179	(87)
Th 2	20.2419	20.2419	20.2419	20.2419	20.2419	20.2419	20.2419	20.2419	20.2419	20.2419	20.2419	20.2419	(88)
util rest of house													
	0.9965	0.9923	0.9742	0.8885	0.6839	0.4625	0.3172	0.3726	0.6685	0.9438	0.9917	0.9974	(89)
MIT 2	19.5561	19.6650	19.8662	20.1033	20.2206	20.2404	20.2418	20.2416	20.2285	20.0532	19.7558	19.5211	(90)
Living area fraction									fLA = Living area / (4) =			0.5211	(91)
MIT	19.9193	20.0286	20.2316	20.4772	20.6088	20.6345	20.6367	20.6364	20.6169	20.4215	20.1195	19.8843	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.9193	20.0286	20.2316	20.4772	20.6088	20.6345	20.6367	20.6364	20.6169	20.4215	20.1195	19.8843	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9960	0.9917	0.9741	0.8965	0.7083	0.4939	0.3515	0.4105	0.7028	0.9482	0.9912	0.9970	(94)
Useful gains	306.1048	336.1438	371.8983	396.3947	349.5190	244.8185	164.4366	172.4050	256.1152	299.8892	292.0464	292.6964	(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													
	636.6311	616.6309	559.6908	471.8787	363.1149	245.9625	164.5346	172.6707	265.6239	400.3188	530.6639	639.2789	(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													
	245.9115	188.4873	139.7177	54.3485	10.1153	0.0000	0.0000	0.0000	0.0000	74.7197	171.8046	257.8574	(98)
Space heating												1142.9619	(98)
Space heating per m2											(98) / (4) =	22.8045	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	93.2000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	1226.3540	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	245.9115	188.4873	139.7177	54.3485	10.1153	0.0000	0.0000	0.0000	0.0000	74.7197	171.8046	257.8574	(98)
Space heating efficiency (main heating system 1)	93.2000	93.2000	93.2000	93.2000	93.2000	0.0000	0.0000	0.0000	0.0000	93.2000	93.2000	93.2000	(210)
Space heating fuel (main heating system)	263.8536	202.2396	149.9116	58.3138	10.8533	0.0000	0.0000	0.0000	0.0000	80.1713	184.3397	276.6710	(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	147.6147	129.8278	135.7066	120.7706	117.7101	104.2646	99.2763	110.1320	110.3200	125.2879	133.5858	143.7698	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.0899	88.9943	88.7474	88.1799	87.5227	87.3000	87.3000	87.3000	87.3000	88.3613	88.9081	89.1400	(217)
Fuel for water heating, kWh/month	165.6919	145.8834	152.9133	136.9594	134.4910	119.4326	113.7186	126.1535	126.3688	141.7905	150.2515	161.2854	(219)
Water heating fuel used												1674.9399	(219)

Annual totals kWh/year

Space heating fuel - main system	1226.3540	(211)
Space heating fuel - secondary	0.0000	(215)

Electricity for pumps and fans:
(MEVCentralised, Database: in-use factor = 1.3000, SFP = 0.2210)

mechanical ventilation fans (SFP = 0.2210)	33.7834	(230a)
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	108.7834	(231)
Electricity for lighting (calculated in Appendix L)	232.3002	(232)
Total delivered energy for all uses	3242.3774	(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	1226.3540	0.2160	264.8925	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1674.9399	0.2160	361.7870	(264)
Space and water heating			626.6795	(265)
Pumps and fans	108.7834	0.5190	56.4586	(267)
Energy for lighting	232.3002	0.5190	120.5638	(268)
Total CO2, kg/year			803.7018	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			16.0400	(273)

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

DER		16.0400	ZC1
Total Floor Area	TFA	50.1200	
Assumed number of occupants	N	1.6936	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		17.4446	ZC2
CO2 emissions from cooking, equation (L16)		3.1853	ZC3
Total CO2 emissions		36.6699	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		36.6699	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.1200 (1b)	x	2.5000 (2b)	=	125.3000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	50.1200					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	125.3000	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							2 * 10 =	20.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1596	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4096	(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) =	0.3175	(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	0.4048	0.3968	0.3889	0.3492	0.3413	0.3016	0.3016	0.2936	0.3175	0.3413	0.3571	0.3730	(22b)
Effective ac	0.5819	0.5787	0.5756	0.5610	0.5582	0.5455	0.5455	0.5431	0.5504	0.5582	0.5638	0.5696	(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 Opening Type (Uw = 1.40)			11.7500	1.3258	15.5777			(27)
External Wall 1	18.7500	11.7500	7.0000	0.1800	1.2600			(29a)
Total net area of external elements Aum(A, m2)			18.7500					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	16.8377			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							2.7720	(36)
Total fabric heat loss						(33) + (36) =	19.6097	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	24.0615	23.9300	23.8011	23.1955	23.0822	22.5549	22.5549	22.4572	22.7580	23.0822	23.3114	23.5510	(38)
Heat transfer coeff	43.6711	43.5396	43.4107	42.8052	42.6919	42.1645	42.1645	42.0668	42.3677	42.6919	42.9211	43.1607	(39)
Average = Sum(39)m / 12 =												42.8046	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.8713	0.8687	0.8661	0.8541	0.8518	0.8413	0.8413	0.8393	0.8453	0.8518	0.8564	0.8611	(40)
HLP (average)												0.8540	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.6936	(42)
Average daily hot water use (litres/day)	74.4238	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	81.8662	78.8892	75.9123	72.9353	69.9584	66.9814	66.9814	69.9584	72.9353	75.9123	78.8892	81.8662	(44)
Energy conte	121.4052	106.1818	109.5701	95.5258	91.6593	79.0950	73.2932	84.1050	85.1095	99.1869	108.2702	117.5745	(45)
Energy content (annual)										Total = Sum(45)m =		1170.9764	(45)
Distribution loss (46)m = 0.15 x (45)m	18.2108	15.9273	16.4355	14.3289	13.7489	11.8643	10.9940	12.6157	12.7664	14.8780	16.2405	17.6362	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	41.7181	36.3107	38.6841	35.9681	35.6500	33.0319	34.1330	35.6500	35.9681	38.6841	38.9043	41.7181	(61)
Total heat required for water heating calculated for each month	163.1233	142.4924	148.2541	131.4940	127.3094	112.1270	107.4262	119.7550	121.0776	137.8709	147.1745	159.2926	(62)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	163.1233	142.4924	148.2541	131.4940	127.3094	112.1270	107.4262	119.7550	121.0776	137.8709	147.1745	159.2926	(64)
								Total per year (kWh/year) = Sum(64)m =				1617.3970	(64)
Heat gains from water heating, kWh/month													
	50.7968	44.3831	46.1031	40.7544	39.3892	34.5571	32.9032	36.8774	37.2909	42.6507	45.7259	49.5230	(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	84.6817	84.6817	84.6817	84.6817	84.6817	84.6817	84.6817	84.6817	84.6817	84.6817	84.6817	84.6817	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	13.1538	11.6831	9.5013	7.1931	5.3769	4.5394	4.9050	6.3757	8.5575	10.8657	12.6819	13.5194	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	147.5456	149.0767	145.2184	137.0047	126.6364	116.8916	110.3815	108.8505	112.7087	120.9224	131.2907	141.0355	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	31.4682	31.4682	31.4682	31.4682	31.4682	31.4682	31.4682	31.4682	31.4682	31.4682	31.4682	31.4682	(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)													
	-67.7454	-67.7454	-67.7454	-67.7454	-67.7454	-67.7454	-67.7454	-67.7454	-67.7454	-67.7454	-67.7454	-67.7454	(71)
Water heating gains (Table 5)													
	68.2752	66.0463	61.9665	56.6033	52.9425	47.9959	44.2248	49.5664	51.7930	57.3261	63.5082	66.5632	(72)
Total internal gains													
	280.3791	278.2106	268.0908	252.2057	236.3604	220.8315	210.9158	216.1971	224.4637	240.5188	258.8854	272.5226	(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	
Northwest	11.7500	11.2829	0.6300	0.7000	0.7700	40.5165	(81)

Solar gains	40.5165	82.4725	148.5893	244.0263	328.0192	349.7031	327.1401	260.7999	181.0583	100.7880	50.9803	33.0878	(83)
Total gains	320.8956	360.6831	416.6800	496.2319	564.3795	570.5347	538.0560	476.9970	405.5220	341.3067	309.8656	305.6104	(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	79.6992	79.9400	80.1773	81.3115	81.5273	82.5470	82.5470	82.7387	82.1512	81.5273	81.0920	80.6418	
alpha	6.3133	6.3293	6.3452	6.4208	6.4352	6.5031	6.5031	6.5159	6.4767	6.4352	6.4061	6.3761	
util living area													
	0.9969	0.9927	0.9741	0.8830	0.6801	0.4711	0.3446	0.4050	0.6944	0.9504	0.9927	0.9977	(86)
MIT	20.1918	20.3227	20.5582	20.8420	20.9738	20.9978	20.9998	20.9994	20.9787	20.7630	20.4279	20.1689	(87)
Th 2	20.1919	20.1942	20.1964	20.2067	20.2087	20.2177	20.2177	20.2194	20.2142	20.2087	20.2047	20.2007	(88)
util rest of house													
	0.9959	0.9904	0.9662	0.8542	0.6296	0.4144	0.2834	0.3366	0.6257	0.9310	0.9900	0.9969	(89)
MIT 2	19.1093	19.3013	19.6407	20.0324	20.1858	20.2164	20.2176	20.2191	20.1988	19.9403	19.4633	19.0826	(90)
Living area fraction									fLA = Living area / (4) =			0.5211	(91)
MIT	19.6734	19.8336	20.1189	20.4543	20.5965	20.6236	20.6252	20.6257	20.6052	20.3691	19.9660	19.6487	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.6734	19.8336	20.1189	20.4543	20.5965	20.6236	20.6252	20.6257	20.6052	20.3691	19.9660	19.6487	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9950	0.9892	0.9653	0.8638	0.6548	0.4439	0.3153	0.3723	0.6607	0.9355	0.9890	0.9962	(94)
Useful gains	319.3035	356.7769	402.2104	428.6455	369.5565	253.2518	169.6579	177.5841	267.9457	319.2772	306.4614	304.4624	(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													
	671.3759	650.2032	591.2054	494.5852	379.8066	253.9834	169.7220	177.7637	275.6116	417.0597	552.2230	666.7780	(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													
	261.9418	197.1825	140.6123	47.4766	7.6261	0.0000	0.0000	0.0000	0.0000	72.7502	176.9483	269.5628	(98)
Space heating												1174.1007	(98)
Space heating per m2											(98) / (4) =	23.4258	(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 %)	93.4000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Space heating requirement													1257.0671 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	261.9418	197.1825	140.6123	47.4766	7.6261	0.0000	0.0000	0.0000	0.0000	72.7502	176.9483	269.5628	(98)
Space heating efficiency (main heating system 1)	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)	280.4516	211.1162	150.5485	50.8315	8.1650	0.0000	0.0000	0.0000	0.0000	77.8910	189.4522	288.6112	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	163.1233	142.4924	148.2541	131.4940	127.3094	112.1270	107.4262	119.7550	121.0776	137.8709	147.1745	159.2926	(64)
Efficiency of water heater												80.3000	(216)
(217)m	86.2374	85.8692	84.9183	82.7526	80.8103	80.3000	80.3000	80.3000	80.3000	83.5232	85.5160	86.3651	(217)
Fuel for water heating, kWh/month	189.1561	165.9412	174.5845	158.9000	157.5411	139.6351	133.7810	149.1345	150.7815	165.0690	172.1017	184.4408	(219)
Water heating fuel used												1941.0666	(219)
Annual totals kWh/year													
Space heating fuel - main system												1257.0671	(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)												232.3002	(232)
Total delivered energy for all uses												3505.4339	(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	1257.0671	0.2160	271.5265	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1941.0666	0.2160	419.2704	(264)
Space and water heating			690.7969	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	232.3002	0.5190	120.5638	(268)
Total CO2, kg/m2/year			850.2857	(272)
Emissions per m2 for space and water heating			13.7829	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.4055	(272b)
Emissions per m2 for pumps and fans			0.7766	(272c)
Target Carbon Dioxide Emission Rate (TER) = (13.7829 * 1.00) + 2.4055 + 0.7766, rounded to 2 d.p.			16.9600	(273)

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

Design SAP
elmhurst energy

Property Reference	Plot 244	**Issued on Date**	13/02/2020
Assessment Reference	001	**Prop Type Ref**	MF
Property	Epping College Site B, Plot 244		

SAP Rating	85 B	**DER**	14.75	**TER**	15.59
Environmental	90 B	**% DER<TER**	5.37		
CO_2 Emissions (t/year)	0.77	**DFEE**	28.64	**TFEE**	32.08
General Requirements Compliance	Pass	**% DFEE<TFEE**	10.72		

Assessor Details	Miss Georgia Dimitriou, Georgia Dimitriou, Tel: 07599467602, erieta.dimitriou@lowenergyconsultancy.co.uk	**Assessor ID**	P864-0001
Client			

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DWELLING AS DESIGNED

Mid-floor flat, total floor area 63 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) 15.59 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 14.75 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)32.1 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)28.6 kWh/m²/yrOK

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2 Fabric U-values

Element	Average	Highest	
External wall	0.22 (max. 0.30)	0.22 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	(no floor)		
Roof	(no roof)		
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

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

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3 Air permeability
Air permeability at 50 pascals: 4.00 (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 database
Vaillant ecoFIT sustain 835 VUW 356/6-3 (H-GB)
Combi boiler
Efficiency: 89.3% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

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5 Cylinder insulation
Hot water storage No cylinder

---

6 Controls
Space heating controls: Programmer, room thermostat and TRVs OK

Hot water controls: No cylinder

Boiler interlock Yes OK

---

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

---

8 Mechanical ventilation
Continuous extract system
Specific fan power: 0.17
Maximum 0.7 OK

---

9 Summertime temperature
Overheating risk (Thames Valley): Slight OK
Based on:
Overshading: Average
Windows facing North West: 11.75 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

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	62.7000 (1b)	x	2.5000 (2b)	=	156.7500	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	62.7000					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	156.7500	(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		4.0000	
Infiltration rate		0.2000	(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) =	0.1550	(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	0.1976	0.1938	0.1899	0.1705	0.1666	0.1473	0.1473	0.1434	0.1550	0.1666	0.1744	0.1821	(22b)

Mechanical extract ventilation - centralised

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	
Opening Type 2 (Uw = 1.30)			11.7500	1.2357	14.5200			(27)
External Wall 1	24.5800	11.7500	12.8300	0.2200	2.8226			(29a)
Total net area of external elements Aum(A, m2)			24.5800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		17.3426			(33)
Party Wall 1			67.8300	0.0000	0.0000			(32)
Party Floor 1			62.7000					(32d)
Party Ceilings 1			62.7000					(32b)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							4.3510	(36)
Total fabric heat loss					(33) + (36) =		21.6936	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	25.8638	25.8638	25.8638	25.8638	25.8638	25.8638	25.8638	25.8638	25.8638	25.8638	25.8638	25.8638	(38)
Heat transfer coeff	47.5573	47.5573	47.5573	47.5573	47.5573	47.5573	47.5573	47.5573	47.5573	47.5573	47.5573	47.5573	(39)
Average = Sum(39)m / 12 =												47.5573	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.7585	0.7585	0.7585	0.7585	0.7585	0.7585	0.7585	0.7585	0.7585	0.7585	0.7585	0.7585	(40)
HLP (average)												0.7585	(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	2.0569	(42)
Average daily hot water use (litres/day)	83.0503	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	91.3553	88.0333	84.7113	81.3893	78.0673	74.7453	74.7453	78.0673	81.3893	84.7113	88.0333	91.3553	(44)
Energy conte	135.4773	118.4893	122.2704	106.5983	102.2836	88.2629	81.7886	93.8536	94.9745	110.6836	120.8198	131.2025	(45)
Energy content (annual)										Total = Sum(45)m =		1306.7044	(45)
Distribution loss (46)m = 0.15 x (45)m	20.3216	17.7734	18.3406	15.9897	15.3425	13.2394	12.2683	14.0780	14.2462	16.6025	18.1230	19.6804	(46)
Water storage loss:													
Total storage loss													

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	26.3192	23.7385	26.2283	25.3216	26.1216	25.2281	26.0373	26.0920	25.2790	26.1842	25.4098	26.3016	(61)
Total heat required for water heating calculated for each month													
	161.7965	142.2278	148.4987	131.9199	128.4051	113.4910	107.8259	119.9456	120.2536	136.8678	146.2297	157.5041	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	161.7965	142.2278	148.4987	131.9199	128.4051	113.4910	107.8259	119.9456	120.2536	136.8678	146.2297	157.5041	(64)
								Total per year (kWh/year) = Sum(64)m =				1614.9657	(64)
Heat gains from water heating, kWh/month													
	51.6260	45.3323	47.2120	41.7743	40.5397	35.6544	33.7040	37.7293	37.8988	43.3484	46.5251	50.2002	(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	102.8427	102.8427	102.8427	102.8427	102.8427	102.8427	102.8427	102.8427	102.8427	102.8427	102.8427	102.8427	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	16.2636	14.4452	11.7476	8.8937	6.6481	5.6126	6.0647	7.8831	10.5806	13.4346	15.6801	16.7156	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	179.7014	181.5662	176.8671	166.8633	154.2353	142.3668	134.4379	132.5731	137.2722	147.2760	159.9040	171.7725	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	33.2843	33.2843	33.2843	33.2843	33.2843	33.2843	33.2843	33.2843	33.2843	33.2843	33.2843	33.2843	(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)													
	-82.2742	-82.2742	-82.2742	-82.2742	-82.2742	-82.2742	-82.2742	-82.2742	-82.2742	-82.2742	-82.2742	-82.2742	(71)
Water heating gains (Table 5)													
	69.3898	67.4588	63.4570	58.0199	54.4888	49.5201	45.3011	50.7114	52.6372	58.2639	64.6181	67.4734	(72)
Total internal gains													
	322.2076	320.3230	308.9245	290.6297	272.2251	254.3523	242.6565	248.0205	257.3429	275.8273	297.0551	312.8144	(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	
Northwest	11.7500	11.2829	0.5000	0.7000	0.7700	32.1560	(81)

Solar gains	32.1560	65.4544	117.9280	193.6716	260.3327	277.5422	259.6350	206.9840	143.6971	79.9904	40.4605	26.2602	(83)
Total gains	354.3636	385.7774	426.8525	484.3013	532.5578	531.8945	502.2915	455.0045	401.0400	355.8177	337.5156	339.0746	(84)

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	91.5562	91.5562	91.5562	91.5562	91.5562	91.5562	91.5562	91.5562	91.5562	91.5562	91.5562	91.5562	
alpha	7.1037	7.1037	7.1037	7.1037	7.1037	7.1037	7.1037	7.1037	7.1037	7.1037	7.1037	7.1037	
util living area													
	0.9982	0.9962	0.9871	0.9382	0.7821	0.5675	0.4161	0.4794	0.7737	0.9709	0.9959	0.9987	(86)
MIT	20.2896	20.3849	20.5674	20.8047	20.9585	20.9960	20.9996	20.9990	20.9712	20.7595	20.4759	20.2575	(87)
Th 2	20.2895	20.2895	20.2895	20.2895	20.2895	20.2895	20.2895	20.2895	20.2895	20.2895	20.2895	20.2895	(88)
util rest of house													
	0.9976	0.9950	0.9829	0.9198	0.7363	0.5066	0.3492	0.4061	0.7103	0.9586	0.9943	0.9983	(89)
MIT 2	19.6332	19.7281	19.9085	20.1343	20.2630	20.2877	20.2893	20.2892	20.2742	20.0964	19.8190	19.6013	(90)
Living area fraction									fLA = Living area / (4) =			0.4786	(91)
MIT	19.9473	20.0425	20.2238	20.4552	20.5959	20.6267	20.6293	20.6289	20.6078	20.4138	20.1334	19.9154	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.9473	20.0425	20.2238	20.4552	20.5959	20.6267	20.6293	20.6289	20.6078	20.4138	20.1334	19.9154	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9973	0.9945	0.9825	0.9245	0.7567	0.5358	0.3812	0.4413	0.7399	0.9611	0.9939	0.9980	(94)
Useful gains	353.4069	383.6382	419.3804	447.7431	403.0011	284.9671	191.4964	200.7749	296.7164	341.9763	335.4518	338.3983	(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													
	744.1458	720.1348	652.6689	549.5337	423.0647	286.6132	191.6226	201.1152	309.4928	466.7159	619.8356	747.3813	(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													
	290.7098	226.1257	173.5667	73.2892	14.9274	0.0000	0.0000	0.0000	0.0000	92.8062	204.7563	304.2833	(98)
Space heating												1380.4645	(98)
Space heating per m2											(98) / (4) =	22.0170	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	93.2000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	1481.1851	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	290.7098	226.1257	173.5667	73.2892	14.9274	0.0000	0.0000	0.0000	0.0000	92.8062	204.7563	304.2833	(98)
Space heating efficiency (main heating system 1)	93.2000	93.2000	93.2000	93.2000	93.2000	0.0000	0.0000	0.0000	0.0000	93.2000	93.2000	93.2000	(210)
Space heating fuel (main heating system)	311.9204	242.6241	186.2303	78.6365	16.0165	0.0000	0.0000	0.0000	0.0000	99.5775	219.6956	326.4843	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)

Water heating

Water heating requirement	161.7965	142.2278	148.4987	131.9199	128.4051	113.4910	107.8259	119.9456	120.2536	136.8678	146.2297	157.5041	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.1412	89.0577	88.8393	88.3141	87.5933	87.3000	87.3000	87.3000	87.3000	88.4491	88.9687	89.1895	(217)
Fuel for water heating, kWh/month	181.5058	159.7030	167.1543	149.3758	146.5924	130.0012	123.5119	137.3947	137.7475	154.7419	164.3608	176.5950	(219)

Water heating fuel used	1828.6844	(219)
Annual totals kWh/year		
Space heating fuel - main system	1481.1851	(211)
Space heating fuel - secondary	0.0000	(215)

Electricity for pumps and fans:
(MEVCentralised, Database: in-use factor = 1.3000, SFP = 0.2210)

mechanical ventilation fans (SFP = 0.2210)	42.2629	(230a)
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	117.2629	(231)
Electricity for lighting (calculated in Appendix L)	287.2202	(232)
Total delivered energy for all uses	3714.3526	(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	1481.1851	0.2160	319.9360	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1828.6844	0.2160	394.9958	(264)
Space and water heating			714.9318	(265)
Pumps and fans	117.2629	0.5190	60.8595	(267)
Energy for lighting	287.2202	0.5190	149.0673	(268)
Total CO2, kg/year			924.8585	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			14.7500	(273)

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

DER		14.7500	ZC1
Total Floor Area	TFA	62.7000	
Assumed number of occupants	N	2.0569	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		16.9836	ZC2
CO2 emissions from cooking, equation (L16)		2.6852	ZC3
Total CO2 emissions		34.4189	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		34.4189	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	62.7000 (1b)	x	2.5000 (2b)	=	156.7500	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	62.7000					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	156.7500	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							2 * 10 =	20.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1276	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3776	(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) =	0.2926	(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	0.3731	0.3658	0.3585	0.3219	0.3146	0.2780	0.2780	0.2707	0.2926	0.3146	0.3292	0.3438	(22b)
Effective ac	0.5696	0.5669	0.5643	0.5518	0.5495	0.5386	0.5386	0.5366	0.5428	0.5495	0.5542	0.5591	(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 Opening Type (Uw = 1.40)			11.7500	1.3258	15.5777			(27)
External Wall 1	24.5800	11.7500	12.8300	0.1800	2.3094			(29a)
Total net area of external elements Aum(A, m2)			24.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	17.8871			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	3.0982	(36)
Total fabric heat loss (33) + (36) =	20.9853	(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	29.4642	29.3244	29.1874	28.5437	28.4233	27.8626	27.8626	27.7588	28.0786	28.4233	28.6669	28.9216	(38)
Heat transfer coeff	50.4495	50.3097	50.1726	49.5289	49.4085	48.8479	48.8479	48.7441	49.0638	49.4085	49.6521	49.9068	(39)
Average = Sum(39)m / 12 =												49.5284	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.8046	0.8024	0.8002	0.7899	0.7880	0.7791	0.7791	0.7774	0.7825	0.7880	0.7919	0.7960	(40)
HLP (average)												0.7899	(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	2.0569	(42)
Average daily hot water use (litres/day)	83.0503	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	91.3553	88.0333	84.7113	81.3893	78.0673	74.7453	74.7453	78.0673	81.3893	84.7113	88.0333	91.3553	(44)
Energy conte	135.4773	118.4893	122.2704	106.5983	102.2836	88.2629	81.7886	93.8536	94.9745	110.6836	120.8198	131.2025	(45)
Energy content (annual)										Total = Sum(45)m =		1306.7044	(45)
Distribution loss (46)m = 0.15 x (45)m	20.3216	17.7734	18.3406	15.9897	15.3425	13.2394	12.2683	14.0780	14.2462	16.6025	18.1230	19.6804	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	46.5537	40.5194	43.1679	40.1372	39.7822	36.8607	38.0894	39.7822	40.1372	43.1679	43.4137	46.5537	(61)
Total heat required for water heating calculated for each month	182.0310	159.0087	165.4383	146.7354	142.0658	125.1236	119.8780	133.6358	135.1117	153.8516	164.2335	177.7562	(62)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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	182.0310	159.0087	165.4383	146.7354	142.0658	125.1236	119.8780	133.6358	135.1117	153.8516	164.2335	177.7562	(64)
									Total per year (kWh/year) = Sum(64)m =			1804.8696	(64)
Heat gains from water heating, kWh/month	56.6846	49.5276	51.4469	45.4782	43.9548	38.5626	36.7170	41.1519	41.6133	47.5943	51.0260	55.2633	(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	102.8427	102.8427	102.8427	102.8427	102.8427	102.8427	102.8427	102.8427	102.8427	102.8427	102.8427	102.8427	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	16.2636	14.4452	11.7476	8.8937	6.6481	5.6126	6.0647	7.8831	10.5806	13.4346	15.6801	16.7156	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	179.7014	181.5662	176.8671	166.8633	154.2353	142.3668	134.4379	132.5731	137.2722	147.2760	159.9040	171.7725	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	33.2843	33.2843	33.2843	33.2843	33.2843	33.2843	33.2843	33.2843	33.2843	33.2843	33.2843	33.2843	(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)	-82.2742	-82.2742	-82.2742	-82.2742	-82.2742	-82.2742	-82.2742	-82.2742	-82.2742	-82.2742	-82.2742	-82.2742	(71)
Water heating gains (Table 5)	76.1890	73.7017	69.1490	63.1642	59.0791	53.5592	49.3509	55.3117	57.7963	63.9708	70.8695	74.2786	(72)
Total internal gains	329.0068	326.5659	314.6165	295.7740	276.8154	258.3914	246.7062	252.6207	262.5020	281.5342	303.3064	319.6195	(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	
Northwest	11.7500	11.2829	0.6300	0.7000	0.7700	40.5165	(81)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	40.5165	82.4725	148.5893	244.0263	328.0192	349.7031	327.1401	260.7999	181.0583	100.7880	50.9803	33.0878	(83)
Total gains	369.5234	409.0384	463.2058	539.8003	604.8345	608.0946	573.8464	513.4206	443.5603	382.3222	354.2867	352.7073	(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	86.3075	86.5473	86.7837	87.9116	88.1258	89.1373	89.1373	89.3271	88.7449	88.1258	87.6934	87.2459	
alpha	6.7538	6.7698	6.7856	6.8608	6.8751	6.9425	6.9425	6.9551	6.9163	6.8751	6.8462	6.8164	
util living area	0.9978	0.9951	0.9825	0.9135	0.7285	0.5116	0.3743	0.4359	0.7316	0.9629	0.9949	0.9984	(86)
MIT	20.2427	20.3557	20.5642	20.8298	20.9698	20.9976	20.9998	20.9994	20.9775	20.7663	20.4589	20.2214	(87)
Th 2	20.2493	20.2513	20.2532	20.2621	20.2637	20.2715	20.2715	20.2729	20.2685	20.2637	20.2604	20.2568	(88)
util rest of house	0.9972	0.9936	0.9770	0.8902	0.6804	0.4545	0.3125	0.3675	0.6661	0.9477	0.9930	0.9979	(89)
MIT 2	19.2282	19.3943	19.6967	20.0690	20.2365	20.2700	20.2714	20.2727	20.2516	19.9933	19.5525	19.2030	(90)
Living area fraction									fLA = Living area / (4) =			0.4786	(91)
MIT	19.7138	19.8544	20.1119	20.4332	20.5875	20.6182	20.6200	20.6205	20.5990	20.3633	19.9863	19.6904	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.7138	19.8544	20.1119	20.4332	20.5875	20.6182	20.6200	20.6205	20.5990	20.3633	19.9863	19.6904	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9965	0.9926	0.9757	0.8961	0.7021	0.4818	0.3421	0.4003	0.6966	0.9500	0.9921	0.9974	(94)
Useful gains	368.2449	405.9962	451.9640	483.7016	424.6398	292.9978	196.2941	205.5107	309.0012	363.2224	351.4962	351.7939	(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	777.6178	752.3519	682.9452	571.2252	439.1162	293.9781	196.3697	205.7238	318.8679	482.3885	639.8330	773.0794	(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	304.5734	232.7510	171.8500	63.0170	10.7704	0.0000	0.0000	0.0000	0.0000	88.6596	207.6025	313.4364	(98)
Space heating												1392.6603	(98)
Space heating per m2											(98) / (4) =	22.2115	(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 %)	93.4000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Space heating requirement												1491.0710	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	304.5734	232.7510	171.8500	63.0170	10.7704	0.0000	0.0000	0.0000	0.0000	88.6596	207.6025	313.4364	(98)
Space heating efficiency (main heating system 1)	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000		(210)
Space heating fuel (main heating system)	326.0957	249.1981	183.9936	67.4700	11.5315	0.0000	0.0000	0.0000	0.0000	94.9246	222.2725	335.5850	(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	182.0310	159.0087	165.4383	146.7354	142.0658	125.1236	119.8780	133.6358	135.1117	153.8516	164.2335	177.7562	(64)
Efficiency of water heater												80.3000	(216)
(217)m	86.3377	86.0091	85.1470	83.0890	80.9372	80.3000	80.3000	80.3000	80.3000	83.7196	85.6422	86.4644	(217)
Fuel for water heating, kWh/month	210.8361	184.8743	194.2973	176.6003	175.5259	155.8202	149.2876	166.4207	168.2586	183.7701	191.7670	205.5832	(219)
Water heating fuel used												2163.0414	(219)
Annual totals kWh/year													
Space heating fuel - main system												1491.0710	(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)												287.2202	(232)
Total delivered energy for all uses												4016.3325	(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	1491.0710	0.2160	322.0713	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2163.0414	0.2160	467.2169	(264)
Space and water heating			789.2883	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	287.2202	0.5190	149.0673	(268)
Total CO2, kg/m2/year			977.2805	(272)
Emissions per m2 for space and water heating			12.5883	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.3775	(272b)
Emissions per m2 for pumps and fans			0.6208	(272c)
Target Carbon Dioxide Emission Rate (TER) = (12.5883 * 1.00) + 2.3775 + 0.6208, rounded to 2 d.p.			15.5900	(273)

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

Design SAP
elmhurst energy

Property Reference	Plot 247	**Issued on Date**	13/02/2020
Assessment Reference	001	**Prop Type Ref**	MF
Property	Epping College Site B, Plot 247		

SAP Rating	87 B	**DER**	13.06	**TER**	13.67
Environmental	90 B	**% DER<TER**	4.50		
CO_2 Emissions (t/year)	0.93	**DFEE**	27.81	**TFEE**	29.87
General Requirements Compliance	Pass	**% DFEE<TFEE**	6.90		

Assessor Details	Miss Georgia Dimitriou, Georgia Dimitriou, Tel: 07599467602, erieta.dimitriou@lowenergyconsultancy.co.uk	**Assessor ID**	P864-0001
Client			

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

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DWELLING AS DESIGNED

Mid-floor flat, total floor area 87 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) 13.67 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 13.06 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)29.9 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)27.8 kWh/m²/yrOK

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2 Fabric U-values

Element	Average	Highest	
External wall	0.22 (max. 0.30)	0.22 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	(no floor)		
Roof	(no roof)		
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

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

---

3 Air permeability
Air permeability at 50 pascals: 4.00 (design value)
Maximum 10.0 OK

---

4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Vaillant ecoFIT sustain 835 VUW 356/6-3 (H-GB)
Combi boiler
Efficiency: 89.3% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

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5 Cylinder insulation
Hot water storage No cylinder

---

6 Controls
Space heating controls: Programmer, room thermostat and TRVs OK

Hot water controls: No cylinder

Boiler interlock Yes OK

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

---

8 Mechanical ventilation
Continuous extract system
Specific fan power: 0.16
Maximum 0.7 OK

---

9 Summertime temperature
Overheating risk (Thames Valley): Slight OK
Based on:
Overshading: Average
Windows facing North East: 3.58 m², No overhang
Windows facing South East: 11.48 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

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	86.5600 (1b)	x	2.5000 (2b)	=	216.4000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	86.5600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		216.4000	(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		4.0000	
Infiltration rate		0.2000	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1700	(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	0.2168	0.2125	0.2083	0.1870	0.1828	0.1615	0.1615	0.1573	0.1700	0.1828	0.1913	0.1998	(22b)

Mechanical extract ventilation - centralised

If mechanical ventilation:		0.5000	(23a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
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	
Opening Type 2 (Uw = 1.30)			15.0600	1.2357	18.6103			(27)
External Wall 1	47.5800	15.0600	32.5200	0.2200	7.1544			(29a)
Total net area of external elements Aum(A, m2)			47.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	25.7647			(33)
Party Wall 1			47.5800	0.0000	0.0000			(32)
Party Floor 1			86.5600					(32d)
Party Ceilings 1			86.5600					(32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	6.3258	(36)
Total fabric heat loss (33) + (36) =	32.0905	(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	35.7060	35.7060	35.7060	35.7060	35.7060	35.7060	35.7060	35.7060	35.7060	35.7060	35.7060	35.7060	(38)
Heat transfer coeff	67.7965	67.7965	67.7965	67.7965	67.7965	67.7965	67.7965	67.7965	67.7965	67.7965	67.7965	67.7965	(39)
Average = Sum(39)m / 12 =												67.7965	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.7832	0.7832	0.7832	0.7832	0.7832	0.7832	0.7832	0.7832	0.7832	0.7832	0.7832	0.7832	(40)
HLP (average)												0.7832	(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	2.5756	(42)
Average daily hot water use (litres/day)	95.3716	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	104.9088	101.0939	97.2791	93.4642	89.6493	85.8345	85.8345	89.6493	93.4642	97.2791	101.0939	104.9088	(44)
Energy conte	155.5767	136.0684	140.4104	122.4132	117.4584	101.3576	93.9227	107.7777	109.0649	127.1047	138.7447	150.6677	(45)
Energy content (annual)										Total = Sum(45)m =		1500.5671	(45)
Distribution loss (46)m = 0.15 x (45)m	23.3365	20.4103	21.0616	18.3620	17.6188	15.2036	14.0884	16.1667	16.3597	19.0657	20.8117	22.6002	(46)
Water storage loss:													
Total storage loss													

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	26.4623	23.8814	26.3769	25.4461	26.2361	25.3227	26.1250	26.1970	25.3899	26.3186	25.5556	26.4402	(61)
Total heat required for water heating calculated for each month													
	182.0390	159.9498	166.7873	147.8592	143.6944	126.6803	120.0478	133.9748	134.4548	153.4233	164.3002	177.1080	(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													
	182.0390	159.9498	166.7873	147.8592	143.6944	126.6803	120.0478	133.9748	134.4548	153.4233	164.3002	177.1080	(64)
								Total per year (kWh/year) = Sum(64)m =				1810.3190	(64)
Heat gains from water heating, kWh/month													
	58.3448	51.2131	53.2807	47.0639	45.6139	40.0321	37.7606	42.3854	42.6116	48.8420	52.5215	56.7071	(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	128.7824	128.7824	128.7824	128.7824	128.7824	128.7824	128.7824	128.7824	128.7824	128.7824	128.7824	128.7824	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	21.2999	18.9184	15.3855	11.6478	8.7069	7.3507	7.9427	10.3242	13.8571	17.5948	20.5357	21.8919	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	232.6048	235.0185	228.9360	215.9872	199.6416	184.2790	174.0159	171.6022	177.6846	190.6335	206.9791	222.3417	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.8782	35.8782	35.8782	35.8782	35.8782	35.8782	35.8782	35.8782	35.8782	35.8782	35.8782	35.8782	(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)													
	-103.0259	-103.0259	-103.0259	-103.0259	-103.0259	-103.0259	-103.0259	-103.0259	-103.0259	-103.0259	-103.0259	-103.0259	(71)
Water heating gains (Table 5)													
	78.4205	76.2100	71.6138	65.3665	61.3090	55.6001	50.7535	56.9696	59.1827	65.6478	72.9465	76.2192	(72)
Total internal gains													
	396.9599	394.7816	380.5700	357.6362	334.2922	311.8645	297.3467	303.5306	315.3592	338.5108	365.0961	385.0875	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	3.5800	11.2829	0.5000	0.7000	0.7700	9.7973	(75)
Southeast	11.4800	36.7938	0.5000	0.7000	0.7700	102.4515	(77)

Solar gains	112.2488	194.4555	274.7064	354.8630	410.7006	413.5477	396.2833	353.7366	302.3256	217.2453	135.0408	95.6781	(83)
Total gains	509.2087	589.2370	655.2764	712.4992	744.9928	725.4122	693.6300	657.2673	617.6848	555.7561	500.1369	480.7656	(84)

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	88.6641	88.6641	88.6641	88.6641	88.6641	88.6641	88.6641	88.6641	88.6641	88.6641	88.6641	88.6641	
alpha	6.9109	6.9109	6.9109	6.9109	6.9109	6.9109	6.9109	6.9109	6.9109	6.9109	6.9109	6.9109	
util living area													
	0.9978	0.9935	0.9789	0.9261	0.7903	0.5911	0.4293	0.4730	0.7271	0.9518	0.9941	0.9985	(86)
MIT	20.2744	20.4115	20.6029	20.8134	20.9515	20.9941	20.9994	20.9989	20.9783	20.7952	20.4824	20.2339	(87)
Th 2	20.2679	20.2679	20.2679	20.2679	20.2679	20.2679	20.2679	20.2679	20.2679	20.2679	20.2679	20.2679	(88)
util rest of house													
	0.9971	0.9914	0.9725	0.9051	0.7439	0.5266	0.3583	0.3985	0.6615	0.9333	0.9919	0.9980	(89)
MIT 2	19.5996	19.7358	19.9235	20.1216	20.2369	20.2653	20.2677	20.2676	20.2568	20.1089	19.8067	19.5592	(90)
Living area fraction									fLA = Living area / (4) =			0.3208	(91)
MIT	19.8161	19.9526	20.1415	20.3436	20.4662	20.4991	20.5025	20.5022	20.4882	20.3291	20.0235	19.7757	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.8161	19.9526	20.1415	20.3436	20.4662	20.4991	20.5025	20.5022	20.4882	20.3291	20.0235	19.7757	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9966	0.9904	0.9712	0.9075	0.7571	0.5472	0.3811	0.4225	0.6820	0.9351	0.9910	0.9976	(94)
Useful gains	507.4576	583.5688	636.3853	646.6264	564.0282	396.9811	264.3643	277.6930	421.2562	519.6663	495.6276	479.6244	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1051.9336	1020.5102	924.8446	775.8344	594.3147	399.9373	264.5739	278.1141	433.1006	659.5962	876.1668	1055.9755	(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													
	405.0901	293.6246	214.6137	93.0298	22.5331	0.0000	0.0000	0.0000	0.0000	104.1079	273.9882	428.8052	(98)
Space heating												1835.7926	(98)
Space heating per m2											(98) / (4) =	21.2083	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	93.2000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	1969.7346	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	405.0901	293.6246	214.6137	93.0298	22.5331	0.0000	0.0000	0.0000	0.0000	104.1079	273.9882	428.8052	(98)
Space heating efficiency (main heating system 1)	93.2000	93.2000	93.2000	93.2000	93.2000	0.0000	0.0000	0.0000	0.0000	93.2000	93.2000	93.2000	(210)
Space heating fuel (main heating system)	434.6461	315.0479	230.2722	99.8173	24.1772	0.0000	0.0000	0.0000	0.0000	111.7037	293.9788	460.0914	(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	182.0390	159.9498	166.7873	147.8592	143.6944	126.6803	120.0478	133.9748	134.4548	153.4233	164.3002	177.1080	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.2805	89.1556	88.9085	88.3976	87.6821	87.3000	87.3000	87.3000	87.3000	88.4496	89.0906	89.3326	(217)
Fuel for water heating, kWh/month	203.8957	179.4052	187.5944	167.2661	163.8811	145.1092	137.5118	153.4648	154.0147	173.4585	184.4193	198.2568	(219)
Water heating fuel used												2048.2777	(219)

Annual totals kWh/year

Space heating fuel - main system	1969.7346	(211)
Space heating fuel - secondary	0.0000	(215)

Electricity for pumps and fans:
(MEVCentralised, Database: in-use factor = 1.3000, SFP = 0.2080)

mechanical ventilation fans (SFP = 0.2080)	54.9137	(230a)
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	129.9137	(231)
Electricity for lighting (calculated in Appendix L)	376.1631	(232)
Total delivered energy for all uses	4524.0890	(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	1969.7346	0.2160	425.4627	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2048.2777	0.2160	442.4280	(264)
Space and water heating			867.8906	(265)
Pumps and fans	129.9137	0.5190	67.4252	(267)
Energy for lighting	376.1631	0.5190	195.2286	(268)
Total CO2, kg/year			1130.5445	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			13.0600	(273)

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

DER		13.0600	ZC1
Total Floor Area	TFA	86.5600	
Assumed number of occupants	N	2.5756	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		15.9238	ZC2
CO2 emissions from cooking, equation (L16)		2.0889	ZC3
Total CO2 emissions		31.0727	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		31.0727	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	86.5600 (1b)	x	2.5000 (2b)	=	216.4000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	86.5600					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	216.4000	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1386	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3886	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3303	(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	0.4212	0.4129	0.4047	0.3634	0.3551	0.3138	0.3138	0.3056	0.3303	0.3551	0.3716	0.3881	(22b)
Effective ac	0.5887	0.5853	0.5819	0.5660	0.5631	0.5492	0.5492	0.5467	0.5546	0.5631	0.5691	0.5753	(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 Opening Type (Uw = 1.40)			15.0600	1.3258	19.9659			(27)
External Wall 1	47.5800	15.0600	32.5200	0.1800	5.8536			(29a)
Total net area of external elements Aum(A, m2)			47.5800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	25.8195			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							4.7107	(36)
Total fabric heat loss						(33) + (36) =	30.5302	(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	42.0400	41.7940	41.5529	40.4206	40.2087	39.2224	39.2224	39.0398	39.6023	40.2087	40.6373	41.0854	(38)
Heat transfer coeff	72.5702	72.3242	72.0832	70.9508	70.7389	69.7527	69.7527	69.5700	70.1325	70.7389	71.1675	71.6156	(39)
Average = Sum(39)m / 12 =												70.9498	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.8384	0.8355	0.8328	0.8197	0.8172	0.8058	0.8058	0.8037	0.8102	0.8172	0.8222	0.8274	(40)
HLP (average)												0.8197	(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	2.5756	(42)
Average daily hot water use (litres/day)	95.3716	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	104.9088	101.0939	97.2791	93.4642	89.6493	85.8345	85.8345	89.6493	93.4642	97.2791	101.0939	104.9088	(44)
Energy conte	155.5767	136.0684	140.4104	122.4132	117.4584	101.3576	93.9227	107.7777	109.0649	127.1047	138.7447	150.6677	(45)
Energy content (annual)										Total = Sum(45)m =		1500.5671	(45)
Distribution loss (46)m = 0.15 x (45)m	23.3365	20.4103	21.0616	18.3620	17.6188	15.2036	14.0884	16.1667	16.3597	19.0657	20.8117	22.6002	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	46.0274	49.5723	46.0919	45.6843	42.3293	43.7403	45.6843	46.0919	49.5723	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month	206.5356	182.0958	189.9827	168.5051	163.1427	143.6870	137.6630	153.4620	155.1569	176.6770	188.0597	201.6266	(62)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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													
	206.5356	182.0958	189.9827	168.5051	163.1427	143.6870	137.6630	153.4620	155.1569	176.6770	188.0597	201.6266	(64)
								Total per year (kWh/year) = Sum(64)m =				2066.5942	(64)
Heat gains from water heating, kWh/month													
	64.4690	56.7496	59.0795	52.2254	50.4760	44.2837	42.1644	47.2572	47.7871	54.6554	58.4614	62.8367	(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	128.7824	128.7824	128.7824	128.7824	128.7824	128.7824	128.7824	128.7824	128.7824	128.7824	128.7824	128.7824	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	21.2999	18.9184	15.3855	11.6478	8.7069	7.3507	7.9427	10.3242	13.8571	17.5948	20.5357	21.8919	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	232.6048	235.0185	228.9360	215.9872	199.6416	184.2790	174.0159	171.6022	177.6846	190.6335	206.9791	222.3417	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.8782	35.8782	35.8782	35.8782	35.8782	35.8782	35.8782	35.8782	35.8782	35.8782	35.8782	35.8782	(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)													
	-103.0259	-103.0259	-103.0259	-103.0259	-103.0259	-103.0259	-103.0259	-103.0259	-103.0259	-103.0259	-103.0259	-103.0259	(71)
Water heating gains (Table 5)													
	86.6519	84.4488	79.4080	72.5352	67.8441	61.5052	56.6726	63.5177	66.3709	73.4615	81.1963	84.4580	(72)
Total internal gains													
	405.1913	403.0204	388.3642	364.8049	340.8272	317.7696	303.2658	310.0788	322.5474	346.3245	373.3459	393.3263	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	3.5800	11.2829	0.6300	0.7000	0.7700	12.3446	(75)
Southeast	11.4800	36.7938	0.6300	0.7000	0.7700	129.0889	(77)

Solar gains	141.4335	245.0139	346.1300	447.1274	517.4828	521.0700	499.3170	445.7082	380.9303	273.7291	170.1514	120.5544	(83)
Total gains	546.6247	648.0343	734.4942	811.9323	858.3100	838.8397	802.5828	755.7869	703.4777	620.0537	543.4973	513.8807	(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	82.8317	83.1134	83.3913	84.7223	84.9760	86.1775	86.1775	86.4038	85.7107	84.9760	84.4643	83.9358	
alpha	6.5221	6.5409	6.5594	6.6482	6.6651	6.7452	6.7452	6.7603	6.7140	6.6651	6.6310	6.5957	
util living area													
	0.9969	0.9903	0.9684	0.8922	0.7315	0.5286	0.3820	0.4227	0.6694	0.9312	0.9914	0.9979	(86)
MIT	20.2328	20.3984	20.6155	20.8452	20.9653	20.9965	20.9997	20.9994	20.9850	20.8171	20.4803	20.2042	(87)
Th 2	20.2202	20.2226	20.2250	20.2363	20.2384	20.2483	20.2483	20.2501	20.2445	20.2384	20.2342	20.2297	(88)
util rest of house													
	0.9960	0.9874	0.9592	0.8651	0.6822	0.4681	0.3170	0.3542	0.6035	0.9070	0.9883	0.9972	(89)
MIT 2	19.1910	19.4331	19.7447	20.0640	20.2072	20.2461	20.2482	20.2498	20.2337	20.0364	19.5622	19.1567	(90)
Living area fraction									fLA = Living area / (4) =			0.3208	(91)
MIT	19.5252	19.7428	20.0240	20.3146	20.4504	20.4869	20.4893	20.4903	20.4747	20.2869	19.8568	19.4928	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.5252	19.7428	20.0240	20.3146	20.4504	20.4869	20.4893	20.4903	20.4747	20.2869	19.8568	19.4928	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9948	0.9851	0.9564	0.8681	0.6964	0.4875	0.3379	0.3762	0.6241	0.9087	0.9864	0.9964	(94)
Useful gains	543.8062	638.3595	702.4483	704.8750	597.7223	408.9239	271.1664	284.3218	439.0665	563.4491	536.0856	512.0203	(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													
	1104.8972	1073.4966	974.8558	809.8766	618.9964	410.6243	271.2858	284.5624	447.0764	685.2373	907.8679	1095.2021	(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													
	417.4517	292.4121	202.6712	75.6011	15.8279	0.0000	0.0000	0.0000	0.0000	90.6104	267.6833	433.8873	(98)
Space heating												1796.1451	(98)
Space heating per m2											(98) / (4) =	20.7503	(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 %)	93.4000	(206)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Efficiency of secondary/supplementary heating system, %													0.0000	(208)
Space heating requirement													1923.0675	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Space heating requirement	417.4517	292.4121	202.6712	75.6011	15.8279	0.0000	0.0000	0.0000	0.0000	90.6104	267.6833	433.8873		(98)
Space heating efficiency (main heating system 1)	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000		(210)
Space heating fuel (main heating system)	446.9505	313.0751	216.9927	80.9434	16.9464	0.0000	0.0000	0.0000	0.0000	97.0133	286.5988	464.5474		(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	206.5356	182.0958	189.9827	168.5051	163.1427	143.6870	137.6630	153.4620	155.1569	176.6770	188.0597	201.6266		(64)
Efficiency of water heater												80.3000		(216)
(217)m	86.7869	86.2375	85.2141	83.1781	81.1014	80.3000	80.3000	80.3000	80.3000	83.4611	85.9396	86.9310		(217)
Fuel for water heating, kWh/month	237.9802	211.1562	222.9474	202.5834	201.1590	178.9377	171.4359	191.1109	193.2215	211.6879	218.8278	231.9387		(219)
Water heating fuel used												2472.9866		(219)
Annual totals kWh/year														
Space heating fuel - main system												1923.0675		(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)												376.1631		(232)
Total delivered energy for all uses												4847.2172		(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	1923.0675	0.2160	415.3826	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2472.9866	0.2160	534.1651	(264)
Space and water heating			949.5477	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	376.1631	0.5190	195.2286	(268)
Total CO2, kg/m2/year			1183.7013	(272)
Emissions per m2 for space and water heating			10.9698	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.2554	(272b)
Emissions per m2 for pumps and fans			0.4497	(272c)
Target Carbon Dioxide Emission Rate (TER) = (10.9698 * 1.00) + 2.2554 + 0.4497, rounded to 2 d.p.			13.6700	(273)

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

Design SAP
elmhurst energy

Property Reference	Plot 260	**Issued on Date**	13/02/2020
Assessment Reference	001	**Prop Type Ref**	TF
Property	Epping College Site B, Plot 260		

SAP Rating	84 B	**DER**	17.84	**TER**	17.79
Environmental	86 B	**% DER<TER**	-0.28		
CO_2 Emissions (t/year)	1.28	**DFEE**	47.81	**TFEE**	50.78
General Requirements Compliance	Fail	**% DFEE<TFEE**	5.84		

Assessor Details	Miss Georgia Dimitriou, Georgia Dimitriou, Tel: 07599467602, erieta.dimitriou@lowenergyconsultancy.co.uk	**Assessor ID**	P864-0001
Client			

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

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

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DWELLING AS DESIGNED

Top-floor flat, total floor area 87 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) 17.79 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 17.84 kgCO□/m²Fail
Excess emissions =0.05 kgCO□/m² (0.3%)

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)50.8 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)47.8 kWh/m²/yrOK

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2 Fabric U-values

Element	Average	Highest	
External wall	0.22 (max. 0.30)	0.22 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	(no floor)		
Roof	0.16 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

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

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3 Air permeability
Air permeability at 50 pascals: 4.00 (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 database
Vaillant ecoFIT sustain 835 VUW 356/6-3 (H-GB)
Combi boiler
Efficiency: 89.3% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

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5 Cylinder insulation
Hot water storage No cylinder

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6 Controls
Space heating controls: Programmer, room thermostat and TRVs OK

Hot water controls: No cylinder

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
Specific fan power: 0.16
Maximum 0.7 OK

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9 Summertime temperature
Overheating risk (Thames Valley): Slight OK
Based on:
Overshading: Average
Windows facing South West: 3.58 m², No overhang
Windows facing North West: 11.75 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

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	87.1200 (1b)	x	2.5000 (2b)	=	217.8000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	87.1200					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	217.8000	(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		4.0000	
Infiltration rate		0.2000	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1700	(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	0.2168	0.2125	0.2083	0.1870	0.1828	0.1615	0.1615	0.1573	0.1700	0.1828	0.1913	0.1998	(22b)

Mechanical extract ventilation - centralised

If mechanical ventilation:	0.5000	(23a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
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	
Opening Type 2 (Uw = 1.30)			15.3300	1.2357	18.9439			(27)
External Wall 1	49.5800	15.3300	34.2500	0.2200	7.5350			(29a)
External Roof 1	87.1200		87.1200	0.1600	13.9392			(30)
Total net area of external elements Aum(A, m2)			136.7000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		40.4181			(33)
Party Wall 1			45.2300	0.0000	0.0000			(32)
Party Floor 1			87.1200					(32d)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	16.7953	(36)
Total fabric heat loss (33) + (36) =	57.2134	(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	35.9370	35.9370	35.9370	35.9370	35.9370	35.9370	35.9370	35.9370	35.9370	35.9370	35.9370	35.9370	(38)
Heat transfer coeff	93.1504	93.1504	93.1504	93.1504	93.1504	93.1504	93.1504	93.1504	93.1504	93.1504	93.1504	93.1504	(39)
Average = Sum(39)m / 12 =												93.1504	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0692	1.0692	1.0692	1.0692	1.0692	1.0692	1.0692	1.0692	1.0692	1.0692	1.0692	1.0692	(40)
HLP (average)												1.0692	(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	2.5842	(42)
Average daily hot water use (litres/day)	95.5750	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	105.1325	101.3095	97.4865	93.6635	89.8405	86.0175	86.0175	89.8405	93.6635	97.4865	101.3095	105.1325	(44)
Energy conte	155.9085	136.3586	140.7099	122.6743	117.7089	101.5738	94.1231	108.0076	109.2976	127.3758	139.0406	150.9891	(45)
Energy content (annual)										Total = Sum(45)m =		1503.7676	(45)
Distribution loss (46)m = 0.15 x (45)m	23.3863	20.4538	21.1065	18.4011	17.6563	15.2361	14.1185	16.2011	16.3946	19.1064	20.8561	22.6484	(46)
Water storage loss:													
Total storage loss													

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	26.4638	23.8827	26.3795	25.4483	26.2381	25.3244	26.1266	26.1989	25.3919	26.3210	25.5569	26.4417	(61)
Total heat required for water heating calculated for each month													
	182.3724	160.2413	167.0894	148.1225	143.9470	126.8982	120.2496	134.2065	134.6894	153.6968	164.5975	177.4308	(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													
	182.3724	160.2413	167.0894	148.1225	143.9470	126.8982	120.2496	134.2065	134.6894	153.6968	164.5975	177.4308	(64)
								Total per year (kWh/year) = Sum(64)m =				1813.5414	(64)
Heat gains from water heating, kWh/month													
	58.4555	51.3099	53.3809	47.1513	45.6977	40.1044	37.8276	42.4623	42.6894	48.9327	52.6202	56.8143	(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	129.2106	129.2106	129.2106	129.2106	129.2106	129.2106	129.2106	129.2106	129.2106	129.2106	129.2106	129.2106	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	21.3569	18.9690	15.4266	11.6790	8.7302	7.3704	7.9639	10.3518	13.8942	17.6419	20.5907	21.9505	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	233.6784	236.1032	229.9927	216.9841	200.5630	185.1295	174.8190	172.3942	178.5047	191.5133	207.9344	223.3679	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.9211	35.9211	35.9211	35.9211	35.9211	35.9211	35.9211	35.9211	35.9211	35.9211	35.9211	35.9211	(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)													
	-103.3685	-103.3685	-103.3685	-103.3685	-103.3685	-103.3685	-103.3685	-103.3685	-103.3685	-103.3685	-103.3685	-103.3685	(71)
Water heating gains (Table 5)													
	78.5693	76.3540	71.7485	65.4879	61.4217	55.7005	50.8435	57.0729	59.2908	65.7698	73.0836	76.3633	(72)
Total internal gains													
	398.3677	396.1895	381.9310	358.9141	335.4780	312.9636	298.3896	304.5821	316.4529	339.6882	366.3719	386.4448	(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	
Southwest	3.5800	36.7938	0.5000	0.7000	0.7700	31.9492	(79)
Northwest	11.7500	11.2829	0.5000	0.7000	0.7700	32.1560	(81)

Solar gains	64.1051	119.8756	192.3895	285.9330	363.6731	380.1353	358.5458	297.6293	224.3231	140.1375	78.7282	53.6020	(83)
Total gains	462.4729	516.0651	574.3205	644.8471	699.1512	693.0990	656.9354	602.2114	540.7761	479.8257	445.1001	440.0468	(84)

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	64.9487	64.9487	64.9487	64.9487	64.9487	64.9487	64.9487	64.9487	64.9487	64.9487	64.9487	64.9487	
alpha	5.3299	5.3299	5.3299	5.3299	5.3299	5.3299	5.3299	5.3299	5.3299	5.3299	5.3299	5.3299	
util living area													
	0.9989	0.9978	0.9939	0.9775	0.9171	0.7725	0.6039	0.6737	0.9050	0.9879	0.9978	0.9992	(86)
MIT	19.8034	19.9225	20.1468	20.4565	20.7537	20.9335	20.9856	20.9751	20.8322	20.4587	20.0693	19.7689	(87)
Th 2	20.0260	20.0260	20.0260	20.0260	20.0260	20.0260	20.0260	20.0260	20.0260	20.0260	20.0260	20.0260	(88)
util rest of house													
	0.9985	0.9970	0.9917	0.9683	0.8823	0.6868	0.4804	0.5493	0.8505	0.9815	0.9969	0.9989	(89)
MIT 2	18.9286	19.0474	19.2707	19.5753	19.8524	19.9939	20.0222	20.0184	19.9253	19.5806	19.1941	18.8940	(90)
Living area fraction									fLA = Living area / (4) =			0.3523	(91)
MIT	19.2368	19.3557	19.5793	19.8857	20.1699	20.3249	20.3616	20.3554	20.2448	19.8900	19.5024	19.2022	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.2368	19.3557	19.5793	19.8857	20.1699	20.3249	20.3616	20.3554	20.2448	19.8900	19.5024	19.2022	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9981	0.9963	0.9903	0.9667	0.8882	0.7152	0.5245	0.5937	0.8649	0.9803	0.9962	0.9986	(94)
Useful gains	461.6010	514.1428	568.7590	623.3423	620.9866	495.7186	344.5469	357.5349	467.7326	470.3765	443.4005	439.4089	(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													
	1391.3649	1346.5521	1218.3416	1023.3237	788.9732	533.2746	350.3925	368.4483	572.3910	865.3638	1155.2904	1397.4624	(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													
	691.7443	559.3790	483.2894	287.9866	124.9821	0.0000	0.0000	0.0000	0.0000	293.8706	512.5607	712.7918	(98)
Space heating												3666.6046	(98)
Space heating per m2											(98) / (4) =	42.0868	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	93.2000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3934.1251	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	691.7443	559.3790	483.2894	287.9866	124.9821	0.0000	0.0000	0.0000	0.0000	293.8706	512.5607	712.7918	(98)
Space heating efficiency (main heating system 1)	93.2000	93.2000	93.2000	93.2000	93.2000	0.0000	0.0000	0.0000	0.0000	93.2000	93.2000	93.2000	(210)
Space heating fuel (main heating system)	742.2149	600.1921	518.5509	308.9985	134.1009	0.0000	0.0000	0.0000	0.0000	315.3118	549.9579	764.7981	(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	182.3724	160.2413	167.0894	148.1225	143.9470	126.8982	120.2496	134.2065	134.6894	153.6968	164.5975	177.4308	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.5792	89.5377	89.4367	89.1937	88.6242	87.3000	87.3000	87.3000	87.3000	89.1826	89.4775	89.6067	(217)
Fuel for water heating, kWh/month	203.5879	178.9652	186.8241	166.0684	162.4240	145.3587	137.7430	153.7302	154.2834	172.3393	183.9540	198.0106	(219)
Water heating fuel used												2043.2891	(219)

Annual totals kWh/year

Space heating fuel - main system	3934.1251	(211)
Space heating fuel - secondary	0.0000	(215)

Electricity for pumps and fans:
(MEVCentralised, Database: in-use factor = 1.3000, SFP = 0.2080)

mechanical ventilation fans (SFP = 0.2080)	55.2689	(230a)
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	130.2689	(231)
Electricity for lighting (calculated in Appendix L)	377.1694	(232)
Total delivered energy for all uses	6484.8525	(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	3934.1251	0.2160	849.7710	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2043.2891	0.2160	441.3504	(264)
Space and water heating			1291.1215	(265)
Pumps and fans	130.2689	0.5190	67.6096	(267)
Energy for lighting	377.1694	0.5190	195.7509	(268)
Total CO2, kg/year			1554.4819	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			17.8400	(273)

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

DER		17.8400	ZC1
Total Floor Area	TFA	87.1200	
Assumed number of occupants	N	2.5842	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		15.8945	ZC2
CO2 emissions from cooking, equation (L16)		2.0778	ZC3
Total CO2 emissions		35.8123	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		35.8123	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	87.1200 (1b)	x	2.5000 (2b)	=	217.8000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	87.1200					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	217.8000	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							3 * 10 =		30.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1377	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3877	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3296	(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	0.4202	0.4120	0.4037	0.3625	0.3543	0.3131	0.3131	0.3049	0.3296	0.3543	0.3708	0.3873	(22b)
Effective ac	0.5883	0.5849	0.5815	0.5657	0.5628	0.5490	0.5490	0.5465	0.5543	0.5628	0.5687	0.5750	(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 Opening Type (Uw = 1.40)			15.3300	1.3258	20.3239			(27)
External Wall 1	49.5800	15.3300	34.2500	0.1800	6.1650			(29a)
External Roof 1	87.1200		87.1200	0.1300	11.3256			(30)
Total net area of external elements Aum(A, m2)			136.7000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	37.8145			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							15.0014	(36)
Total fabric heat loss						(33) + (36) =	52.8159	(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	42.2828	42.0363	41.7948	40.6603	40.4481	39.4600	39.4600	39.2770	39.8406	40.4481	40.8775	41.3264	(38)
Heat transfer coeff	95.0986	94.8522	94.6107	93.4762	93.2639	92.2758	92.2758	92.0929	92.6564	93.2639	93.6933	94.1422	(39)
Average = Sum(39)m / 12 =												93.4752	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0916	1.0888	1.0860	1.0730	1.0705	1.0592	1.0592	1.0571	1.0635	1.0705	1.0755	1.0806	(40)
HLP (average)												1.0729	(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	2.5842	(42)
Average daily hot water use (litres/day)	95.5750	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	105.1325	101.3095	97.4865	93.6635	89.8405	86.0175	86.0175	89.8405	93.6635	97.4865	101.3095	105.1325	(44)
Energy conte	155.9085	136.3586	140.7099	122.6743	117.7089	101.5738	94.1231	108.0076	109.2976	127.3758	139.0406	150.9891	(45)
Energy content (annual)										Total = Sum(45)m =		1503.7676	(45)
Distribution loss (46)m = 0.15 x (45)m	23.3863	20.4538	21.1065	18.4011	17.6563	15.2361	14.1185	16.2011	16.3946	19.1064	20.8561	22.6484	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	46.0274	49.6781	46.1902	45.7818	42.4196	43.8336	45.7818	46.1902	49.6781	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month													

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	206.8674	182.3860	190.3879	168.8645	163.4906	143.9934	137.9567	153.7894	155.4878	177.0538	188.3557	201.9480	(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													
	206.8674	182.3860	190.3879	168.8645	163.4906	143.9934	137.9567	153.7894	155.4878	177.0538	188.3557	201.9480	(64)
								Total per year (kWh/year) = Sum(64)m =				2070.5812	(64)
Heat gains from water heating, kWh/month													
	64.5793	56.8461	59.2055	52.3368	50.5836	44.3782	42.2543	47.3580	47.8890	54.7720	58.5598	62.9436	(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	129.2106	129.2106	129.2106	129.2106	129.2106	129.2106	129.2106	129.2106	129.2106	129.2106	129.2106	129.2106	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	21.3569	18.9690	15.4266	11.6790	8.7302	7.3704	7.9639	10.3518	13.8942	17.6419	20.5907	21.9505	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	233.6784	236.1032	229.9927	216.9841	200.5630	185.1295	174.8190	172.3942	178.5047	191.5133	207.9344	223.3679	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.9211	35.9211	35.9211	35.9211	35.9211	35.9211	35.9211	35.9211	35.9211	35.9211	35.9211	35.9211	(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)													
	-103.3685	-103.3685	-103.3685	-103.3685	-103.3685	-103.3685	-103.3685	-103.3685	-103.3685	-103.3685	-103.3685	-103.3685	(71)
Water heating gains (Table 5)													
	86.8002	84.5924	79.5773	72.6899	67.9888	61.6364	56.7934	63.6532	66.5125	73.6182	81.3330	84.6016	(72)
Total internal gains													
	406.5986	404.4278	389.7599	366.1161	342.0451	318.8995	304.3396	311.1624	323.6746	347.5366	374.6213	394.6831	(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	
Southwest	3.5800	36.7938	0.6300	0.7000	0.7700	40.2559	(79)
Northwest	11.7500	11.2829	0.6300	0.7000	0.7700	40.5165	(81)

Solar gains	80.7724	151.0433	242.4107	360.2756	458.2281	478.9705	451.7677	375.0129	282.6472	176.5732	99.1976	67.5385	(83)
Total gains	487.3711	555.4711	632.1706	726.3918	800.2733	797.8700	756.1073	686.1753	606.3218	524.1099	473.8189	462.2217	(84)

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, ni1,m (see Table 9a)													
tau	63.6182	63.7834	63.9463	64.7224	64.8697	65.5643	65.5643	65.6946	65.2950	64.8697	64.5724	64.2645	
alpha	5.2412	5.2522	5.2631	5.3148	5.3246	5.3710	5.3710	5.3796	5.3530	5.3246	5.3048	5.2843	
util living area													
	0.9986	0.9969	0.9908	0.9638	0.8737	0.6954	0.5280	0.5989	0.8640	0.9823	0.9970	0.9989	(86)
MIT	19.7998	19.9388	20.1869	20.5288	20.8161	20.9608	20.9926	20.9861	20.8736	20.5022	20.0930	19.7773	(87)
Th 2	20.0077	20.0100	20.0123	20.0230	20.0250	20.0343	20.0343	20.0360	20.0307	20.0250	20.0209	20.0167	(88)
util rest of house													
	0.9981	0.9958	0.9874	0.9500	0.8289	0.6082	0.4168	0.4827	0.7984	0.9733	0.9958	0.9986	(89)
MIT 2	18.4001	18.6048	18.9672	19.4630	19.8438	20.0083	20.0315	20.0302	19.9257	19.4339	18.8384	18.3737	(90)
Living area fraction									fLA = Living area / (4) =			0.3523	(91)
MIT	18.8932	19.0747	19.3969	19.8385	20.1863	20.3438	20.3701	20.3669	20.2596	19.8103	19.2804	18.8681	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8932	19.0747	19.3969	19.8385	20.1863	20.3438	20.3701	20.3669	20.2596	19.8103	19.2804	18.8681	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9973	0.9943	0.9846	0.9468	0.8372	0.6375	0.4562	0.5239	0.8160	0.9706	0.9945	0.9979	(94)
Useful gains	486.0568	552.3190	622.4469	687.7523	669.9834	508.6636	344.9620	359.4673	494.7796	508.7153	471.1935	461.2741	(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													
	1387.7937	1344.5037	1220.1811	1022.4875	791.4664	530.0164	347.8865	365.3245	570.7301	858.9845	1141.2198	1380.8926	(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													
	670.8922	532.3481	444.7143	241.0094	90.3833	0.0000	0.0000	0.0000	0.0000	260.6003	482.4189	684.1962	(98)
Space heating												3406.5626	(98)
Space heating per m2											(98) / (4) =	39.1020	(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)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3647.2833	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	670.8922	532.3481	444.7143	241.0094	90.3833	0.0000	0.0000	0.0000	0.0000	260.6003	482.4189	684.1962	(98)
Space heating efficiency (main heating system 1)	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)	718.3000	569.9659	476.1395	258.0400	96.7701	0.0000	0.0000	0.0000	0.0000	279.0153	516.5085	732.5441	(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	206.8674	182.3860	190.3879	168.8645	163.4906	143.9934	137.9567	153.7894	155.4878	177.0538	188.3557	201.9480	(64)
Efficiency of water heater												80.3000	(216)
(217)m	87.7974	87.5887	87.1153	85.9463	83.6263	80.3000	80.3000	80.3000	80.3000	86.0228	87.3161	87.8810	(217)
Fuel for water heating, kWh/month	235.6190	208.2300	218.5471	196.4768	195.5014	179.3193	171.8016	191.5185	193.6336	205.8219	215.7170	229.7972	(219)
Water heating fuel used												2441.9834	(219)
Annual totals kWh/year													
Space heating fuel - main system												3647.2833	(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)	377.1694	(232)
Total delivered energy for all uses	6541.4361	(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	3647.2833	0.2160	787.8132	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2441.9834	0.2160	527.4684	(264)
Space and water heating			1315.2816	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	377.1694	0.5190	195.7509	(268)
Total CO2, kg/m2/year			1549.9575	(272)
Emissions per m2 for space and water heating			15.0974	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.2469	(272b)
Emissions per m2 for pumps and fans			0.4468	(272c)
Target Carbon Dioxide Emission Rate (TER) = (15.0974 * 1.00) + 2.2469 + 0.4468, rounded to 2 d.p.			17.7900	(273)

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

Design SAP
elmhurst energy

Property Reference	Plot 267	**Issued on Date**	13/02/2020
Assessment Reference	002	**Prop Type Ref**	
Property	Epping College Site B, Plot 267		

SAP Rating	84 B	**DER**	17.49	**TER**	17.55
Environmental	86 B	**% DER<TER**	0.32		
CO_2 Emissions (t/year)	1.44	**DFEE**	52.28	**TFEE**	53.43
General Requirements Compliance	Pass	**% DFEE<TFEE**	2.15		

Assessor Details	Miss Georgia Dimitriou, Georgia Dimitriou, Tel: 07599467602, erieta.dimitriou@lowenergyconsultancy.co.uk	**Assessor ID**	J135-0001
Client			

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

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

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DWELLING AS DESIGNED

Semi-Detached House, total floor area 101 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) 17.55 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 17.49 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)53.4 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)52.3 kWh/m²/yrOK

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2 Fabric U-values

Element	Average	Highest	
External wall	0.20 (max. 0.30)	0.20 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.20 (max. 0.25)	0.20 (max. 0.70)	OK
Roof	0.11 (max. 0.20)	0.11 (max. 0.35)	OK
Openings	1.32 (max. 2.00)	1.50 (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: 4.00 (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 database
Vaillant ecoFIT sustain 835 VUW 356/6-3 (H-GB)
Combi boiler
Efficiency: 89.3% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

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5 Cylinder insulation
Hot water storage No cylinder

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6 Controls
Space heating controls: Programmer, room thermostat and TRVs OK

Hot water controls: No cylinder

Boiler interlock Yes OK

---

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

---

8 Mechanical ventilation
Continuous extract system
Specific fan power: 0.16
Maximum 0.7 OK

---

9 Summertime temperature
Overheating risk (Thames Valley): Slight OK
Based on:
Overshading: Average
Windows facing North East: 5.75 m², No overhang
Windows facing South West: 8.93 m², No overhang
Windows facing North West: 1.45 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
Roof U-value 0.11 W/m²K

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.2500 (1b)	x	2.5000 (2b)	=	125.6250	(1b) - (3b)
First floor	50.2500 (1c)	x	2.8000 (2c)	=	140.7000	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 100.5000						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	266.3250	(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		4.0000	
Infiltration rate		0.2000	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1850	(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	0.2359	0.2313	0.2266	0.2035	0.1989	0.1758	0.1758	0.1711	0.1850	0.1989	0.2081	0.2174	(22b)
Mechanical extract ventilation - centralised													
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	
Opening Type 1			2.1400	1.5000	3.2100			(26)
Opening Type 2 (Uw = 1.30)			16.1300	1.2357	19.9325			(27)
Heat Loss Floor 1			50.2500	0.2000	10.0500			(28a)
External Wall 1	106.6400	18.2700	88.3700	0.2000	17.6740			(29a)
External Roof 1	50.2500		50.2500	0.1100	5.5275			(30)
Total net area of external elements Aum(A, m2)			207.1400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		56.3940			(33)
Party Wall 1			48.8700	0.0000	0.0000			(32)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							18.3398	(36)
Total fabric heat loss					(33) + (36) =		74.7338	(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	43.9436	43.9436	43.9436	43.9436	43.9436	43.9436	43.9436	43.9436	43.9436	43.9436	43.9436	43.9436	(38)
Heat transfer coeff	118.6774	118.6774	118.6774	118.6774	118.6774	118.6774	118.6774	118.6774	118.6774	118.6774	118.6774	118.6774	(39)
Average = Sum(39)m / 12 =												118.6774	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1809	1.1809	1.1809	1.1809	1.1809	1.1809	1.1809	1.1809	1.1809	1.1809	1.1809	1.1809	(40)
HLP (average)												1.1809	(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	2.7441	(42)
Average daily hot water use (litres/day)	99.3725	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.3098	105.3349	101.3600	97.3851	93.4102	89.4353	89.4353	93.4102	97.3851	101.3600	105.3349	109.3098	(44)
Energy conte	162.1032	141.7765	146.3007	127.5485	122.3858	105.6096	97.8629	112.2991	113.6403	132.4368	144.5651	156.9883	(45)
Energy content (annual)										Total = Sum(45)m =		1563.5168	(45)
Distribution loss (46)m = 0.15 x (45)m	24.3155	21.2665	21.9451	19.1323	18.3579	15.8414	14.6794	16.8449	17.0460	19.8655	21.6848	23.5483	(46)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	25.7622	23.2691	25.7622	24.9312	25.7622	24.9312	25.7622	25.7622	24.9312	25.7622	24.9312	25.7622	(61)
Total heat required for water heating calculated for each month													
	187.8655	165.0457	172.0629	152.4797	148.1480	130.5408	123.6251	138.0613	138.5715	158.1990	169.4963	182.7506	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
FGHRS	-52.8434	-44.4814	-42.5707	-33.6078	-26.9487	-15.7250	-14.6532	-16.6230	-16.8003	-34.2997	-43.5367	-52.7238	eq.(G2)
Output from w/h													
	135.0221	120.5642	129.4922	118.8719	121.1993	114.8158	108.9719	121.4383	121.7712	123.8993	125.9596	130.0268	(64)
								Total per year (kWh/year) = Sum(64)m =				1472.0329	(64)
Heat gains from water heating, kWh/month													
	60.3399	52.9580	55.0855	48.6427	47.1338	41.3480	38.9800	43.7800	44.0182	50.4758	54.3007	58.6392	(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	137.2053	137.2053	137.2053	137.2053	137.2053	137.2053	137.2053	137.2053	137.2053	137.2053	137.2053	137.2053	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	23.9012	21.2288	17.2644	13.0703	9.7702	8.2484	8.9127	11.5850	15.5494	19.7436	23.0437	24.5654	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	257.1336	259.8018	253.0779	238.7636	220.6943	203.7117	192.3663	189.6980	196.4219	210.7363	228.8056	245.7881	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.7205	36.7205	36.7205	36.7205	36.7205	36.7205	36.7205	36.7205	36.7205	36.7205	36.7205	36.7205	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-109.7643	-109.7643	-109.7643	-109.7643	-109.7643	-109.7643	-109.7643	-109.7643	-109.7643	-109.7643	-109.7643	-109.7643	(71)
Water heating gains (Table 5)													
	81.1020	78.8065	74.0397	67.5593	63.3519	57.4278	52.3924	58.8441	61.1364	67.8438	75.4176	78.8161	(72)
Total internal gains													
	429.2983	426.9987	411.5436	386.5547	360.9780	336.5495	320.8330	327.2888	340.2693	365.4852	394.4285	416.3313	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	5.7500	11.2829	0.6000	0.7000	0.7700	18.8831	(75)
Southwest	8.9300	36.7938	0.6000	0.7000	0.7700	95.6333	(79)
Northwest	1.4500	11.2829	0.6000	0.7000	0.7700	4.7618	(81)

Solar gains	119.2782	211.0287	309.6000	418.5761	500.7562	511.1738	486.9838	423.5275	347.0009	238.8564	144.2980	101.1518	(83)
Total gains	548.5765	638.0274	721.1436	805.1309	861.7342	847.7232	807.8167	750.8162	687.2702	604.3417	538.7265	517.4831	(84)

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	58.8079	58.8079	58.8079	58.8079	58.8079	58.8079	58.8079	58.8079	58.8079	58.8079	58.8079	58.8079	
alpha	4.9205	4.9205	4.9205	4.9205	4.9205	4.9205	4.9205	4.9205	4.9205	4.9205	4.9205	4.9205	
util living area													
	0.9987	0.9970	0.9919	0.9737	0.9156	0.7824	0.6175	0.6784	0.8949	0.9846	0.9973	0.9990	(86)
MIT	19.6674	19.8156	20.0656	20.3940	20.7076	20.9106	20.9783	20.9660	20.8106	20.4060	19.9663	19.6277	(87)
Th 2	19.9353	19.9353	19.9353	19.9353	19.9353	19.9353	19.9353	19.9353	19.9353	19.9353	19.9353	19.9353	(88)
util rest of house													
	0.9982	0.9959	0.9889	0.9627	0.8788	0.6922	0.4824	0.5443	0.8342	0.9763	0.9961	0.9987	(89)
MIT 2	18.7199	18.8677	19.1163	19.4386	19.7309	19.8922	19.9296	19.9252	19.8246	19.4541	19.0185	18.6803	(90)
Living area fraction									fLA = Living area / (4) =			0.1848	(91)
MIT	18.8950	19.0428	19.2917	19.6152	19.9113	20.0804	20.1234	20.1175	20.0068	19.6300	19.1936	18.8553	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8950	19.0428	19.2917	19.6152	19.9113	20.0804	20.1234	20.1175	20.0068	19.6300	19.1936	18.8553	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9976	0.9947	0.9864	0.9585	0.8778	0.7060	0.5076	0.5691	0.8392	0.9731	0.9950	0.9982	(94)
Useful gains	547.2663	634.6263	711.3082	771.7372	756.4567	598.4815	410.0878	427.2920	576.7633	588.0631	536.0078	516.5490	(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													
	1732.0948	1678.4335	1518.0890	1271.6494	974.5011	650.4006	418.1496	441.1844	701.0012	1071.6555	1435.2407	1739.2546	(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													
	881.5124	701.4384	600.2450	359.9368	162.2251	0.0000	0.0000	0.0000	0.0000	359.7927	647.4477	909.6929	(98)
Space heating												4622.2910	(98)
Space heating per m2											(98) / (4) =	45.9929	(99)

8c. Space cooling requirement

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.2000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	5124.4911	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	881.5124	701.4384	600.2450	359.9368	162.2251	0.0000	0.0000	0.0000	0.0000	359.7927	647.4477	909.6929	(98)
Space heating efficiency (main heating system 1)	90.2000	90.2000	90.2000	90.2000	90.2000	0.0000	0.0000	0.0000	0.0000	90.2000	90.2000	90.2000	(210)
Space heating fuel (main heating system)	977.2865	777.6479	665.4601	399.0430	179.8504	0.0000	0.0000	0.0000	0.0000	398.8833	717.7912	1008.5288	(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	135.0221	120.5642	129.4922	118.8719	121.1993	114.8158	108.9719	121.4383	121.7712	123.8993	125.9596	130.0268	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8038	89.7627	89.6714	89.4622	88.9366	87.3000	87.3000	87.3000	87.3000	89.4390	89.7146	89.8268	(217)
Fuel for water heating, kWh/month	150.3523	134.3145	144.4075	132.8739	136.2760	131.5187	124.8246	139.1046	139.4859	138.5295	140.4003	144.7528	(219)

Water heating fuel used	1656.8407	(219)
Annual totals kWh/year		
Space heating fuel - main system	5124.4911	(211)
Space heating fuel - secondary	0.0000	(215)

Electricity for pumps and fans:
(MEVCentralised, Database: in-use factor = 1.3000, SFP = 0.2080)

mechanical ventilation fans (SFP = 0.2080)	67.5826	(230a)
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	142.5826	(231)
Electricity for lighting (calculated in Appendix L)	422.1019	(232)
Total delivered energy for all uses	7346.0164	(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	5124.4911	0.2160	1106.8901	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1656.8407	0.2160	357.8776	(264)
Space and water heating			1464.7677	(265)
Pumps and fans	142.5826	0.5190	74.0004	(267)
Energy for lighting	422.1019	0.5190	219.0709	(268)
Total CO2, kg/year			1757.8390	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			17.4900	(273)

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

DER		17.4900	ZC1
Total Floor Area	TFA	100.5000	
Assumed number of occupants	N	2.7441	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		15.1614	ZC2
CO2 emissions from cooking, equation (L16)		1.8394	ZC3
Total CO2 emissions		34.4908	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		34.4908	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	50.2500 (1b)	x	2.5000 (2b)	=	125.6250	(1b) - (3b)
First floor	50.2500 (1c)	x	2.8000 (2c)	=	140.7000	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 100.5000						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	266.3250	(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) =		0.1502	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.4002	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3702	(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	0.4720	0.4627	0.4535	0.4072	0.3979	0.3517	0.3517	0.3424	0.3702	0.3979	0.4165	0.4350	(22b)
Effective ac	0.6114	0.6071	0.6028	0.5829	0.5792	0.5618	0.5618	0.5586	0.5685	0.5792	0.5867	0.5946	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1400	1.0000	2.1400			(26)
TER Opening Type (Uw = 1.40)			16.1300	1.3258	21.3845			(27)
Heat Loss Floor 1			50.2500	0.1300	6.5325			(28a)
External Wall 1	106.6400	18.2700	88.3700	0.1800	15.9066			(29a)
External Roof 1	50.2500		50.2500	0.1300	6.5325			(30)
Total net area of external elements Aum(A, m2)			207.1400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		52.4961			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.5924	(36)
Total fabric heat loss					(33) + (36) =		63.0885	(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	53.7326	53.3525	52.9799	51.2298	50.9024	49.3782	49.3782	49.0959	49.9653	50.9024	51.5648	52.2573	(38)
Heat transfer coeff	116.8211	116.4410	116.0684	114.3183	113.9909	112.4667	112.4667	112.1844	113.0538	113.9909	114.6533	115.3458	(39)
Average = Sum(39)m / 12 =												114.3167	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1624	1.1586	1.1549	1.1375	1.1342	1.1191	1.1191	1.1163	1.1249	1.1342	1.1408	1.1477	(40)
HLP (average)												1.1375	(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	2.7441	(42)
Average daily hot water use (litres/day)	99.3725	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	109.3098	105.3349	101.3600	97.3851	93.4102	89.4353	89.4353	93.4102	97.3851	101.3600	105.3349	109.3098	(44)
Energy conte	162.1032	141.7765	146.3007	127.5485	122.3858	105.6096	97.8629	112.2991	113.6403	132.4368	144.5651	156.9883	(45)
Energy content (annual)										Total = Sum(45)m =		1563.5168	(45)
Distribution loss (46)m = 0.15 x (45)m	24.3155	21.2665	21.9451	19.1323	18.3579	15.8414	14.6794	16.8449	17.0460	19.8655	21.6848	23.5483	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	46.0274	50.9589	48.0255	47.6008	44.1051	45.5752	47.6008	48.0255	50.9589	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month													
	213.0622	187.8039	197.2596	175.5740	169.9866	149.7147	143.4381	159.8999	161.6658	183.3957	193.8802	207.9472	(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													
	213.0622	187.8039	197.2596	175.5740	169.9866	149.7147	143.4381	159.8999	161.6658	183.3957	193.8802	207.9472	(64)
								Total per year (kWh/year) = Sum(64)m =				2143.6279	(64)
Heat gains from water heating, kWh/month													
	66.6391	58.6475	61.3847	54.4163	52.5935	46.1415	43.9332	49.2396	49.7918	56.7750	60.3967	64.9383	(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	137.2053	137.2053	137.2053	137.2053	137.2053	137.2053	137.2053	137.2053	137.2053	137.2053	137.2053	137.2053	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	23.9012	21.2288	17.2644	13.0703	9.7702	8.2484	8.9127	11.5850	15.5494	19.7436	23.0437	24.5654	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	257.1336	259.8018	253.0779	238.7636	220.6943	203.7117	192.3663	189.6980	196.4219	210.7363	228.8056	245.7881	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.7205	36.7205	36.7205	36.7205	36.7205	36.7205	36.7205	36.7205	36.7205	36.7205	36.7205	36.7205	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-109.7643	-109.7643	-109.7643	-109.7643	-109.7643	-109.7643	-109.7643	-109.7643	-109.7643	-109.7643	-109.7643	-109.7643	(71)
Water heating gains (Table 5)													
	89.5686	87.2731	82.5063	75.5781	70.6902	64.0854	59.0500	66.1823	69.1552	76.3104	83.8843	87.2827	(72)
Total internal gains													
	437.7649	435.4653	420.0103	394.5736	368.3162	343.2071	327.4906	334.6270	348.2882	373.9519	402.8951	424.7979	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	5.7500	11.2829	0.6300	0.7000	0.7700	19.8272	(75)
Southwest	8.9300	36.7938	0.6300	0.7000	0.7700	100.4149	(79)
Northwest	1.4500	11.2829	0.6300	0.7000	0.7700	4.9999	(81)

Solar gains	125.2421	221.5801	325.0800	439.5050	525.7940	536.7325	511.3329	444.7039	364.3509	250.7993	151.5129	106.2093	(83)
Total gains	563.0070	657.0455	745.0903	834.0785	894.1102	879.9395	838.8235	779.3308	712.6391	624.7511	554.4080	531.0073	(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	59.7424	59.9374	60.1298	61.0503	61.2257	62.0554	62.0554	62.2116	61.7332	61.2257	60.8719	60.5065	
alpha	4.9828	4.9958	5.0087	5.0700	5.0817	5.1370	5.1370	5.1474	5.1155	5.0817	5.0581	5.0338	
util living area													
	0.9985	0.9965	0.9905	0.9680	0.8978	0.7431	0.5732	0.6331	0.8718	0.9814	0.9969	0.9989	(86)
MIT	19.7052	19.8618	20.1177	20.4606	20.7588	20.9381	20.9868	20.9787	20.8510	20.4636	20.0256	19.6843	(87)
Th 2	19.9502	19.9532	19.9562	19.9703	19.9730	19.9853	19.9853	19.9876	19.9805	19.9730	19.9676	19.9621	(88)
util rest of house													
	0.9980	0.9953	0.9870	0.9553	0.8570	0.6533	0.4496	0.5080	0.8061	0.9717	0.9956	0.9986	(89)
MIT 2	18.2208	18.4516	18.8261	19.3273	19.7303	19.9429	19.9803	19.9785	19.8563	19.3397	18.7017	18.1987	(90)
Living area fraction									fLA = Living area / (4) =			0.1848	(91)
MIT	18.4951	18.7122	19.0648	19.5367	19.9203	20.1268	20.1663	20.1633	20.0401	19.5474	18.9463	18.4732	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.4951	18.7122	19.0648	19.5367	19.9203	20.1268	20.1663	20.1633	20.0401	19.5474	18.9463	18.4732	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9970	0.9932	0.9828	0.9483	0.8545	0.6669	0.4725	0.5309	0.8107	0.9662	0.9936	0.9977	(94)
Useful gains	561.2955	652.5857	732.2514	790.9621	764.0398	586.8581	396.3075	413.7417	577.7173	603.6233	550.8631	529.7973	(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													
	1658.2875	1608.3062	1458.3732	1215.9662	937.0446	621.5758	401.0876	422.1831	671.5502	1019.9208	1358.2202	1646.3488	(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													
	816.1620	642.2442	540.2346	306.0029	128.7156	0.0000	0.0000	0.0000	0.0000	309.7254	581.2971	830.7143	(98)
Space heating												4155.0961	(98)
Space heating per m2											(98) / (4) =	41.3442	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	93.4000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	4448.7110	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	816.1620	642.2442	540.2346	306.0029	128.7156	0.0000	0.0000	0.0000	0.0000	309.7254	581.2971	830.7143	(98)
Space heating efficiency (main heating system 1)	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)	873.8351	687.6276	578.4096	327.6263	137.8111	0.0000	0.0000	0.0000	0.0000	331.6117	622.3738	889.4157	(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	213.0622	187.8039	197.2596	175.5740	169.9866	149.7147	143.4381	159.8999	161.6658	183.3957	193.8802	207.9472	(64)
Efficiency of water heater												80.3000	(216)
(217)m	88.1059	87.8986	87.4577	86.4363	84.3615	80.3000	80.3000	80.3000	80.3000	86.3602	87.6429	88.1795	(217)
Fuel for water heating, kWh/month	241.8250	213.6598	225.5485	203.1252	201.4978	186.4442	178.6278	199.1281	201.3273	212.3612	221.2161	235.8227	(219)

Water heating fuel used	2520.5837	(219)
Annual totals kWh/year		
Space heating fuel - main system	4448.7110	(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)	422.1019	(232)
Total delivered energy for all uses	7466.3966	(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	4448.7110	0.2160	960.9216	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2520.5837	0.2160	544.4461	(264)
Space and water heating			1505.3677	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	422.1019	0.5190	219.0709	(268)
Total CO2, kg/m2/year			1763.3636	(272)
Emissions per m2 for space and water heating			14.9788	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.1798	(272b)
Emissions per m2 for pumps and fans			0.3873	(272c)
Target Carbon Dioxide Emission Rate (TER) = (14.9788 * 1.00) + 2.1798 + 0.3873, rounded to 2 d.p.			17.5500	(273)

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

Design SAP
elmhurst energy

Property Reference	Plot 270	**Issued on Date**	13/02/2020
Assessment Reference	002	**Prop Type Ref**	
Property	Epping College Site B, Plot 270		

SAP Rating	83 B	**DER**	18.47	**TER**	18.46
Environmental	86 B	**% DER<TER**	-0.06		
CO_2 Emissions (t/year)	1.28	**DFEE**	53.62	**TFEE**	54.03
General Requirements Compliance	Fail	**% DFEE<TFEE**	0.77		

Assessor Details	Miss Georgia Dimitriou, Georgia Dimitriou, Tel: 07599467602, erieta.dimitriou@lowenergyconsultancy.co.uk	**Assessor ID**	J135-0001
Client			

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

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

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DWELLING AS DESIGNED

Semi-Detached House, total floor area 84 m²

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

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 18.46 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 18.47 kgCO□/m²Fail
Excess emissions =0.01 kgCO□/m² (0.1%)

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)54.0 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)53.6 kWh/m²/yrOK

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2 Fabric U-values

Element	Average	Highest	
External wall	0.20 (max. 0.30)	0.20 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.20 (max. 0.25)	0.20 (max. 0.70)	OK
Roof	0.11 (max. 0.20)	0.11 (max. 0.35)	OK
Openings	1.32 (max. 2.00)	1.50 (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: 4.00 (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 database
Vaillant ecoFIT sustain 835 VUW 356/6-3 (H-GB)
Combi boiler
Efficiency: 89.3% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

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5 Cylinder insulation
Hot water storage No cylinder

---

6 Controls
Space heating controls: Programmer, room thermostat and TRVs OK

Hot water controls: No cylinder

Boiler interlock Yes OK

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

---

8 Mechanical ventilation
Continuous extract system
Specific fan power: 0.17
Maximum 0.7 OK

---

9 Summertime temperature
Overheating risk (Thames Valley): Slight OK
Based on:
Overshading: Average
Windows facing North East: 5.75 m², No overhang
Windows facing South East: 1.45 m², No overhang
Windows facing South West: 8.93 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
Roof U-value 0.11 W/m²K

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.9500 (1b)	x	2.5000 (2b)	=	104.8750	(1b) - (3b)
First floor	41.9500 (1c)	x	2.8000 (2c)	=	117.4600	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	83.9000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	222.3350	(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			4.0000	
Infiltration rate			0.2000	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.1850	(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	0.2359	0.2313	0.2266	0.2035	0.1989	0.1758	0.1758	0.1711	0.1850	0.1989	0.2081	0.2174	(22b)
Mechanical extract ventilation - centralised													
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	
Opening Type 1			2.1400	1.5000	3.2100			(26)
Opening Type 2 (Uw = 1.30)			16.1300	1.2357	19.9325			(27)
Heat Loss Floor 1			41.9500	0.2000	8.3900			(28a)
External Wall 1	97.1000	18.2700	78.8300	0.2000	15.7660			(29a)
External Roof 1	41.9500		41.9500	0.1100	4.6145			(30)
Total net area of external elements Aum(A, m2)			181.0000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		51.9130			(33)
Party Wall 1			48.8700	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	17.8178	(36)
Total fabric heat loss (33) + (36) =	69.7308	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	36.6853	36.6853	36.6853	36.6853	36.6853	36.6853	36.6853	36.6853	36.6853	36.6853	36.6853	36.6853	(38)
Heat transfer coeff	106.4161	106.4161	106.4161	106.4161	106.4161	106.4161	106.4161	106.4161	106.4161	106.4161	106.4161	106.4161	(39)
Average = Sum(39)m / 12 =												106.4161	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2684	1.2684	1.2684	1.2684	1.2684	1.2684	1.2684	1.2684	1.2684	1.2684	1.2684	1.2684	(40)
HLP (average)												1.2684	(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	2.5327	(42)
Average daily hot water use (litres/day)	94.3518	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	103.7870	100.0129	96.2389	92.4648	88.6907	84.9166	84.9166	88.6907	92.4648	96.2389	100.0129	103.7870	(44)
Energy conte	153.9131	134.6134	138.9090	121.1042	116.2024	100.2738	92.9184	106.6252	107.8987	125.7455	137.2611	149.0566	(45)
Energy content (annual)										Total = Sum(45)m =		1484.5215	(45)
Distribution loss (46)m = 0.15 x (45)m	23.0870	20.1920	20.8363	18.1656	17.4304	15.0411	13.9378	15.9938	16.1848	18.8618	20.5892	22.3585	(46)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	25.7622	23.2691	25.7622	24.9312	25.7622	24.9312	25.7622	25.7622	24.9312	25.7622	24.9312	25.7622	(61)
Total heat required for water heating calculated for each month													
	179.6754	157.8825	164.6712	146.0354	141.9646	125.2050	118.6807	132.3875	132.8299	151.5078	162.1923	174.8189	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
FGHRS	-48.3398	-40.7209	-38.9206	-31.0948	-24.2253	-14.9907	-13.9488	-15.8629	-16.0350	-31.8441	-40.0556	-48.2341	eq.(G2)
Output from w/h													
	131.3356	117.1616	125.7506	114.9407	117.7393	110.2143	104.7318	116.5246	116.7949	119.6637	122.1367	126.5847	(64)
								Total per year (kWh/year) = Sum(64)m =				1423.5786	(64)
Heat gains from water heating, kWh/month													
	57.6167	50.5762	52.6278	46.4999	45.0778	39.5738	37.3359	41.8935	42.1091	48.2509	51.8721	56.0019	(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	126.6354	126.6354	126.6354	126.6354	126.6354	126.6354	126.6354	126.6354	126.6354	126.6354	126.6354	126.6354	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.5096	18.2164	14.8146	11.2156	8.3838	7.0780	7.6480	9.9411	13.3430	16.9420	19.7738	21.0796	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	227.3981	229.7578	223.8115	211.1525	195.1728	180.1541	170.1207	167.7610	173.7073	186.3663	202.3460	217.3647	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.6635	35.6635	35.6635	35.6635	35.6635	35.6635	35.6635	35.6635	35.6635	35.6635	35.6635	35.6635	(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)													
	-101.3083	-101.3083	-101.3083	-101.3083	-101.3083	-101.3083	-101.3083	-101.3083	-101.3083	-101.3083	-101.3083	-101.3083	(71)
Water heating gains (Table 5)													
	77.4418	75.2623	70.7363	64.5833	60.5885	54.9637	50.1827	56.3084	58.4849	64.8534	72.0446	75.2714	(72)
Total internal gains													
	389.3401	387.2271	373.3530	350.9420	328.1357	306.1863	291.9420	298.0011	309.5258	332.1523	358.1550	377.7063	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	5.7500	11.2829	0.6000	0.7000	0.7700	18.8831	(75)
Southeast	1.4500	36.7938	0.6000	0.7000	0.7700	15.5284	(77)
Southwest	8.9300	36.7938	0.6000	0.7000	0.7700	95.6333	(79)

Solar gains	130.0447	227.7864	328.3274	434.7384	512.4317	519.9376	496.6096	436.9329	364.9084	256.2445	156.9058	110.5521	(83)
Total gains	519.3848	615.0136	701.6804	785.6804	840.5674	826.1239	788.5516	734.9340	674.4342	588.3968	515.0608	488.2584	(84)

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	54.7510	54.7510	54.7510	54.7510	54.7510	54.7510	54.7510	54.7510	54.7510	54.7510	54.7510	54.7510	
alpha	4.6501	4.6501	4.6501	4.6501	4.6501	4.6501	4.6501	4.6501	4.6501	4.6501	4.6501	4.6501	
util living area													
	0.9977	0.9945	0.9859	0.9582	0.8830	0.7356	0.5712	0.6287	0.8561	0.9745	0.9952	0.9983	(86)
MIT	19.6205	19.7929	20.0672	20.4140	20.7288	20.9196	20.9805	20.9699	20.8281	20.4156	19.9408	19.5751	(87)
Th 2	19.8657	19.8657	19.8657	19.8657	19.8657	19.8657	19.8657	19.8657	19.8657	19.8657	19.8657	19.8657	(88)
util rest of house													
	0.9969	0.9926	0.9807	0.9419	0.8364	0.6379	0.4352	0.4915	0.7820	0.9614	0.9931	0.9977	(89)
MIT 2	18.6180	18.7895	19.0612	19.3979	19.6839	19.8291	19.8609	19.8574	19.7713	19.4051	18.9376	18.5727	(90)
Living area fraction									fLA = Living area / (4) =			0.2530	(91)
MIT	18.8717	19.0434	19.3158	19.6550	19.9483	20.1051	20.1442	20.1389	20.0387	19.6608	19.1915	18.8264	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8717	19.0434	19.3158	19.6550	19.9483	20.1051	20.1442	20.1389	20.0387	19.6608	19.1915	18.8264	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9959	0.9907	0.9774	0.9381	0.8403	0.6604	0.4701	0.5266	0.7952	0.9582	0.9915	0.9969	(94)
Useful gains	517.2452	609.3099	685.8115	737.0362	706.3648	545.5964	370.6870	387.0198	536.3373	563.8196	510.6627	486.7290	(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													
	1550.6580	1505.0862	1363.8026	1144.5068	877.7528	585.8271	377.1631	397.8775	631.9730	964.2122	1286.7291	1556.4815	(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													
	768.8592	601.9617	504.4254	293.3788	127.5127	0.0000	0.0000	0.0000	0.0000	297.8921	558.7678	795.8958	(98)
Space heating												3948.6934	(98)
Space heating per m2											(98) / (4) =	47.0643	(99)

8c. Space cooling requirement

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.2000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	4377.7089	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	768.8592	601.9617	504.4254	293.3788	127.5127	0.0000	0.0000	0.0000	0.0000	297.8921	558.7678	795.8958	(98)
Space heating efficiency (main heating system 1)	90.2000	90.2000	90.2000	90.2000	90.2000	0.0000	0.0000	0.0000	0.0000	90.2000	90.2000	90.2000	(210)
Space heating fuel (main heating system)	852.3937	667.3633	559.2299	325.2537	141.3666	0.0000	0.0000	0.0000	0.0000	330.2573	619.4765	882.3679	(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	131.3356	117.1616	125.7506	114.9407	117.7393	110.2143	104.7318	116.5246	116.7949	119.6637	122.1367	126.5847	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7650	89.7145	89.6060	89.3644	88.7841	87.3000	87.3000	87.3000	87.3000	89.3494	89.6657	89.7907	(217)
Fuel for water heating, kWh/month	146.3105	130.5939	140.3373	128.6202	132.6130	126.2478	119.9678	133.4761	133.7857	133.9278	136.2133	140.9776	(219)
Water heating fuel used												1603.0709	(219)

Annual totals kWh/year

Space heating fuel - main system	4377.7089	(211)
Space heating fuel - secondary	0.0000	(215)

Electricity for pumps and fans:
(MEVCentralised, Database: in-use factor = 1.3000, SFP = 0.2210)

mechanical ventilation fans (SFP = 0.2210)	59.9460	(230a)
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	134.9460	(231)
Electricity for lighting (calculated in Appendix L)	362.2058	(232)
Total delivered energy for all uses	6477.9316	(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	4377.7089	0.2160	945.5851	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1603.0709	0.2160	346.2633	(264)
Space and water heating			1291.8484	(265)
Pumps and fans	134.9460	0.5190	70.0370	(267)
Energy for lighting	362.2058	0.5190	187.9848	(268)
Total CO2, kg/year			1549.8702	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			18.4700	(273)

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

DER		18.4700	ZC1
Total Floor Area	TFA	83.9000	
Assumed number of occupants	N	2.5327	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		16.0609	ZC2
CO2 emissions from cooking, equation (L16)		2.1428	ZC3
Total CO2 emissions		36.6738	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		36.6738	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	41.9500 (1b)	x	2.5000 (2b)	=	104.8750	(1b) - (3b)
First floor	41.9500 (1c)	x	2.8000 (2c)	=	117.4600	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	83.9000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	222.3350	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =		0.1349	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.3849	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3561	(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	0.4540	0.4451	0.4362	0.3917	0.3828	0.3383	0.3383	0.3294	0.3561	0.3828	0.4006	0.4184	(22b)
Effective ac	0.6030	0.5990	0.5951	0.5767	0.5733	0.5572	0.5572	0.5542	0.5634	0.5733	0.5802	0.5875	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1400	1.0000	2.1400			(26)
TER Opening Type (Uw = 1.40)			16.1300	1.3258	21.3845			(27)
Heat Loss Floor 1			41.9500	0.1300	5.4535			(28a)
External Wall 1	97.1000	18.2700	78.8300	0.1800	14.1894			(29a)
External Roof 1	41.9500		41.9500	0.1300	5.4535			(30)
Total net area of external elements Aum(A, m2)			181.0000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		48.6209			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.1964	(36)
Total fabric heat loss					(33) + (36) =		58.8173	(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	44.2460	43.9524	43.6646	42.3129	42.0600	40.8828	40.8828	40.6647	41.3362	42.0600	42.5716	43.1065	(38)
Heat transfer coeff	103.0633	102.7697	102.4819	101.1302	100.8773	99.7000	99.7000	99.4820	100.1535	100.8773	101.3889	101.9238	(39)
Average = Sum(39)m / 12 =												101.1290	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2284	1.2249	1.2215	1.2054	1.2024	1.1883	1.1883	1.1857	1.1937	1.2024	1.2084	1.2148	(40)
HLP (average)												1.2054	(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	2.5327	(42)
Average daily hot water use (litres/day)	94.3518	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	103.7870	100.0129	96.2389	92.4648	88.6907	84.9166	84.9166	88.6907	92.4648	96.2389	100.0129	103.7870	(44)
Energy conte	153.9131	134.6134	138.9090	121.1042	116.2024	100.2738	92.9184	106.6252	107.8987	125.7455	137.2611	149.0566	(45)
Energy content (annual)										Total = Sum(45)m =		1484.5215	(45)
Distribution loss (46)m = 0.15 x (45)m	23.0870	20.1920	20.8363	18.1656	17.4304	15.0411	13.9378	15.9938	16.1848	18.8618	20.5892	22.3585	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	46.0274	49.0423	45.5991	45.1958	41.8767	43.2726	45.1958	45.5991	49.0423	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month													
	204.8720	180.6408	187.9512	166.7033	161.3982	142.1505	136.1910	151.8211	153.4978	174.7878	186.5761	200.0155	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	204.8720	180.6408	187.9512	166.7033	161.3982	142.1505	136.1910	151.8211	153.4978	174.7878	186.5761	200.0155	(64)
								Total per year (kWh/year) = Sum(64)m =				2046.6053	(64)
Heat gains from water heating, kWh/month													
	63.9158	56.2658	58.4478	51.6669	49.9362	43.8102	41.7135	46.7518	47.2761	54.0710	57.9681	62.3011	(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	126.6354	126.6354	126.6354	126.6354	126.6354	126.6354	126.6354	126.6354	126.6354	126.6354	126.6354	126.6354	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.5096	18.2164	14.8146	11.2156	8.3838	7.0780	7.6480	9.9411	13.3430	16.9420	19.7738	21.0796	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	227.3981	229.7578	223.8115	211.1525	195.1728	180.1541	170.1207	167.7610	173.7073	186.3663	202.3460	217.3647	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.6635	35.6635	35.6635	35.6635	35.6635	35.6635	35.6635	35.6635	35.6635	35.6635	35.6635	35.6635	(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)													
	-101.3083	-101.3083	-101.3083	-101.3083	-101.3083	-101.3083	-101.3083	-101.3083	-101.3083	-101.3083	-101.3083	-101.3083	(71)
Water heating gains (Table 5)													
	85.9084	83.7289	78.5589	71.7596	67.1186	60.8475	56.0666	62.8385	65.6612	72.6760	80.5112	83.7380	(72)
Total internal gains													
	397.8067	395.6937	381.1756	358.1183	334.6658	312.0702	297.8258	304.5312	316.7021	339.9749	366.6216	386.1729	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	5.7500	11.2829	0.6300	0.7000	0.7700	19.8272	(75)
Southeast	1.4500	36.7938	0.6300	0.7000	0.7700	16.3048	(77)
Southwest	8.9300	36.7938	0.6300	0.7000	0.7700	100.4149	(79)

Solar gains	136.5469	239.1757	344.7438	456.4753	538.0533	545.9345	521.4401	458.7795	383.1539	269.0567	164.7511	116.0797	(83)
Total gains	534.3537	634.8695	725.9194	814.5936	872.7191	858.0047	819.2659	763.3107	699.8560	609.0316	531.3727	502.2526	(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	56.5322	56.6937	56.8529	57.6127	57.7572	58.4392	58.4392	58.5673	58.1746	57.7572	57.4657	57.1642	
alpha	4.7688	4.7796	4.7902	4.8408	4.8505	4.8959	4.8959	4.9045	4.8783	4.8505	4.8310	4.8109	
util living area													
	0.9974	0.9936	0.9832	0.9486	0.8576	0.6895	0.5235	0.5790	0.8246	0.9687	0.9944	0.9981	(86)
MIT	19.6887	19.8695	20.1467	20.5003	20.7896	20.9483	20.9891	20.9826	20.8734	20.4909	20.0243	19.6602	(87)
Th 2	19.8973	19.9001	19.9029	19.9157	19.9181	19.9294	19.9294	19.9314	19.9250	19.9181	19.9132	19.9082	(88)
util rest of house													
	0.9965	0.9915	0.9772	0.9296	0.8071	0.5953	0.4023	0.4547	0.7467	0.9534	0.9921	0.9974	(89)
MIT 2	18.1597	18.4249	18.8279	19.3367	19.7157	19.8958	19.9255	19.9245	19.8261	19.3346	18.6610	18.1256	(90)
Living area fraction									fLA = Living area / (4) =			0.2530	(91)
MIT	18.5466	18.7904	19.1616	19.6311	19.9874	20.1622	20.1946	20.1922	20.0911	19.6272	19.0059	18.5139	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.5466	18.7904	19.1616	19.6311	19.9874	20.1622	20.1946	20.1922	20.0911	19.6272	19.0059	18.5139	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9949	0.9883	0.9718	0.9235	0.8108	0.6171	0.4331	0.4862	0.7604	0.9480	0.9893	0.9961	(94)
Useful gains	531.6047	627.4682	705.4132	752.2571	707.5876	529.4879	354.8365	371.1450	532.1707	577.3580	525.6775	500.3004	(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													
	1468.2964	1427.5123	1297.5871	1085.2384	836.0148	554.5476	358.3832	377.2591	600.0322	910.6367	1207.1306	1458.9294	(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													
	696.8986	537.6296	440.5774	239.7466	95.5498	0.0000	0.0000	0.0000	0.0000	247.9594	490.6463	713.2200	(98)
Space heating												3462.2277	(98)
Space heating per m2											(98) / (4) =	41.2661	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	93.4000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3706.8819	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	696.8986	537.6296	440.5774	239.7466	95.5498	0.0000	0.0000	0.0000	0.0000	247.9594	490.6463	713.2200	(98)
Space heating efficiency (main heating system 1)	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)	746.1441	575.6206	471.7103	256.6880	102.3017	0.0000	0.0000	0.0000	0.0000	265.4811	525.3172	763.6189	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)

Water heating													
Water heating requirement	204.8720	180.6408	187.9512	166.7033	161.3982	142.1505	136.1910	151.8211	153.4978	174.7878	186.5761	200.0155	(64)
Efficiency of water heater												80.3000	(216)
(217)m	87.8885	87.6281	87.1231	85.9653	83.7808	80.3000	80.3000	80.3000	80.3000	85.9312	87.3724	87.9764	(217)
Fuel for water heating, kWh/month	233.1043	206.1448	215.7306	193.9193	192.6433	177.0243	169.6028	189.0673	191.1554	203.4042	213.5414	227.3512	(219)
Water heating fuel used												2412.6890	(219)

Annual totals kWh/year		
Space heating fuel - main system	3706.8819	(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)	362.2058	(232)
Total delivered energy for all uses	6556.7767	(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	3706.8819	0.2160	800.6865	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2412.6890	0.2160	521.1408	(264)
Space and water heating			1321.8273	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	362.2058	0.5190	187.9848	(268)
Total CO2, kg/m2/year			1548.7371	(272)
Emissions per m2 for space and water heating			15.7548	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.2406	(272b)
Emissions per m2 for pumps and fans			0.4639	(272c)
Target Carbon Dioxide Emission Rate (TER) = (15.7548 * 1.00) + 2.2406 + 0.4639, rounded to 2 d.p.			18.4600	(273)

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

Design SAP
elmhurst energy

Property Reference	Plot 278	**Issued on Date**	13/02/2020
Assessment Reference	002	**Prop Type Ref**	
Property	Epping College Site B, Plot 278		

SAP Rating	85 B	**DER**	16.51	**TER**	16.82
Environmental	87 B	**% DER<TER**	1.82		
CO_2 Emissions (t/year)	1.18	**DFEE**	45.68	**TFEE**	46.11
General Requirements Compliance	Pass	**% DFEE<TFEE**	0.94		

Assessor Details	Miss Georgia Dimitriou, Georgia Dimitriou, Tel: 07599467602, erieta.dimitriou@lowenergyconsultancy.co.uk	**Assessor ID**	J135-0001
Client			

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

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DWELLING AS DESIGNED

Mid-Terrace House, total floor area 88 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) 16.82 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 16.51 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)46.1 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)45.7 kWh/m²/yrOK

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2 Fabric U-values

Element	Average	Highest	
External wall	0.20 (max. 0.30)	0.20 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.20 (max. 0.25)	0.20 (max. 0.70)	OK
Roof	0.11 (max. 0.20)	0.11 (max. 0.35)	OK
Openings	1.33 (max. 2.00)	1.50 (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: 4.00 (design value)
Maximum 10.0 OK

---

4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Vaillant ecoFIT sustain 835 VUW 356/6-3 (H-GB)
Combi boiler
Efficiency: 89.3% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

---

5 Cylinder insulation
Hot water storage No cylinder

---

6 Controls
Space heating controls: Programmer, room thermostat and TRVs OK

Hot water controls: No cylinder

Boiler interlock Yes OK

---

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

---

8 Mechanical ventilation
Continuous extract system
Specific fan power: 0.17
Maximum 0.7 OK

---

9 Summertime temperature
Overheating risk (Thames Valley): Slight OK
Based on:
Overshading: Average
Windows facing South East: 8.93 m², No overhang
Windows facing North West: 5.75 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
Roof U-value 0.11 W/m²K

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	43.9100 (1b)	x	2.5000 (2b)	=	109.7750	(1b) - (3b)
First floor	43.9100 (1c)	x	2.8000 (2c)	=	122.9480	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 87.8200						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	232.7230	(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		4.0000	
Infiltration rate		0.2000	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1850	(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	0.2359	0.2313	0.2266	0.2035	0.1989	0.1758	0.1758	0.1711	0.1850	0.1989	0.2081	0.2174	(22b)
Mechanical extract ventilation - centralised													
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	
Opening Type 1			2.1400	1.5000	3.2100			(26)
Opening Type 2 (Uw = 1.30)			14.6800	1.2357	18.1407			(27)
Heat Loss Floor 1			43.9100	0.2000	8.7820			(28a)
External Wall 1	47.0600	16.8200	30.2400	0.2000	6.0480			(29a)
External Roof 1	43.9100		43.9100	0.1100	4.8301			(30)
Total net area of external elements Aum(A, m2)			134.8800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		41.0108			(33)
Party Wall 1			52.4200	0.0000	0.0000			(32)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							16.6474	(36)
Total fabric heat loss					(33) + (36) =		57.6582	(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	38.3993	38.3993	38.3993	38.3993	38.3993	38.3993	38.3993	38.3993	38.3993	38.3993	38.3993	38.3993	(38)
Heat transfer coeff	96.0575	96.0575	96.0575	96.0575	96.0575	96.0575	96.0575	96.0575	96.0575	96.0575	96.0575	96.0575	(39)
Average = Sum(39)m / 12 =												96.0575	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0938	1.0938	1.0938	1.0938	1.0938	1.0938	1.0938	1.0938	1.0938	1.0938	1.0938	1.0938	(40)
HLP (average)												1.0938	(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	2.5947	(42)
Average daily hot water use (litres/day)	95.8239	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	105.4063	101.5733	97.7404	93.9074	90.0745	86.2415	86.2415	90.0745	93.9074	97.7404	101.5733	105.4063	(44)
Energy conte	156.3145	136.7136	141.0762	122.9937	118.0153	101.8383	94.3681	108.2888	109.5821	127.7074	139.4026	151.3822	(45)
Energy content (annual)										Total = Sum(45)m =		1507.6829	(45)
Distribution loss (46)m = 0.15 x (45)m	23.4472	20.5070	21.1614	18.4490	17.7023	15.2757	14.1552	16.2433	16.4373	19.1561	20.9104	22.7073	(46)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	25.7622	23.2691	25.7622	24.9312	25.7622	24.9312	25.7622	25.7622	24.9312	25.7622	24.9312	25.7622	(61)
Total heat required for water heating calculated for each month	182.0767	159.9827	166.8385	147.9249	143.7776	126.7695	120.1304	134.0510	134.5133	153.4696	164.3338	177.1444	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
Solar input (sum of months) = Sum(63)m =												0.0000	(63)
FGHRS	-46.3029	-39.2357	-37.5528	-30.2480	-22.8642	-15.2078	-14.1571	-16.0875	-16.2611	-31.0334	-38.6485	-46.1996	eq.(G2)
Output from w/h	135.7738	120.7471	129.2856	117.6769	120.9134	111.5617	105.9733	117.9635	118.2522	122.4363	125.6853	130.9449	(64)
Total per year (kWh/year) = Sum(64)m =												1457.2140	(64)
Heat gains from water heating, kWh/month	58.4151	51.2746	53.3484	47.1282	45.6807	40.0940	37.8180	42.4466	42.6689	48.9033	52.5842	56.7751	(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	129.7345	129.7345	129.7345	129.7345	129.7345	129.7345	129.7345	129.7345	129.7345	129.7345	129.7345	129.7345	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	21.6753	19.2518	15.6566	11.8530	8.8603	7.4802	8.0827	10.5061	14.1013	17.9049	20.8976	22.2777	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	235.0094	237.4481	231.3027	218.2200	201.7054	186.1840	175.8148	173.3761	179.5215	192.6042	209.1188	224.6402	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.9734	35.9734	35.9734	35.9734	35.9734	35.9734	35.9734	35.9734	35.9734	35.9734	35.9734	35.9734	(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)	-103.7876	-103.7876	-103.7876	-103.7876	-103.7876	-103.7876	-103.7876	-103.7876	-103.7876	-103.7876	-103.7876	-103.7876	(71)
Water heating gains (Table 5)	78.5149	76.3014	71.7048	65.4558	61.3987	55.6861	50.8306	57.0519	59.2623	65.7302	73.0336	76.3107	(72)
Total internal gains	400.1200	397.9217	383.5845	360.4492	336.8848	314.2708	299.6484	305.8545	317.8055	341.1596	367.9703	388.1489	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	8.9300	36.7938	0.6000	0.7000	0.7700	95.6333	(77)
Northwest	5.7500	11.2829	0.6000	0.7000	0.7700	18.8831	(81)

Solar gains	114.5163	201.3359	292.1366	389.8963	462.2048	470.0739	448.5357	392.8762	325.7215	227.0110	138.3064	97.2630	(83)
Total gains	514.6363	599.2575	675.7212	750.3455	799.0896	784.3447	748.1841	698.7307	643.5269	568.1707	506.2768	485.4119	(84)

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, ni1,m (see Table 9a)													
tau	63.4892	63.4892	63.4892	63.4892	63.4892	63.4892	63.4892	63.4892	63.4892	63.4892	63.4892	63.4892	
alpha	5.2326	5.2326	5.2326	5.2326	5.2326	5.2326	5.2326	5.2326	5.2326	5.2326	5.2326	5.2326	
util living area	0.9982	0.9957	0.9882	0.9616	0.8825	0.7231	0.5522	0.6100	0.8517	0.9768	0.9961	0.9987	(86)
MIT	19.8218	19.9737	20.2165	20.5238	20.7967	20.9486	20.9897	20.9831	20.8760	20.5203	20.1022	19.7802	(87)
Th 2	20.0059	20.0059	20.0059	20.0059	20.0059	20.0059	20.0059	20.0059	20.0059	20.0059	20.0059	20.0059	(88)
util rest of house	0.9976	0.9942	0.9839	0.9470	0.8389	0.6341	0.4340	0.4893	0.7824	0.9653	0.9945	0.9983	(89)
MIT 2	18.9306	19.0818	19.3225	19.6210	19.8682	19.9822	20.0033	20.0010	19.9369	19.6223	19.2104	18.8890	(90)
Living area fraction									fLA = Living area / (4) =			0.2502	(91)
MIT	19.1535	19.3050	19.5462	19.8469	20.1004	20.2239	20.2500	20.2467	20.1719	19.8469	19.4335	19.1119	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.1535	19.3050	19.5462	19.8469	20.1004	20.2239	20.2500	20.2467	20.1719	19.8469	19.4335	19.1119	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9969	0.9929	0.9814	0.9442	0.8436	0.6550	0.4639	0.5198	0.7956	0.9629	0.9933	0.9977	(94)
Useful gains	513.0491	594.9739	663.1612	708.4747	674.1292	513.7326	347.0520	363.1778	511.9909	547.1097	502.8694	484.2956	(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	1426.7917	1383.7045	1253.1838	1051.5291	806.9255	540.2220	350.6136	369.5058	583.2482	888.2367	1184.7297	1432.4037	(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	679.8245	530.0270	438.9768	246.9991	98.8004	0.0000	0.0000	0.0000	0.0000	253.7985	490.9394	705.3925	(98)
Space heating												3444.7583	(98)
Space heating per m2											(98) / (4) =	39.2252	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.2000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3819.0225	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	679.8245	530.0270	438.9768	246.9991	98.8004	0.0000	0.0000	0.0000	0.0000	253.7985	490.9394	705.3925	(98)
Space heating efficiency (main heating system 1)	90.2000	90.2000	90.2000	90.2000	90.2000	0.0000	0.0000	0.0000	0.0000	90.2000	90.2000	90.2000	(210)
Space heating fuel (main heating system)	753.6857	587.6131	486.6705	273.8350	109.5349	0.0000	0.0000	0.0000	0.0000	281.3731	544.2788	782.0316	(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	135.7738	120.7471	129.2856	117.6769	120.9134	111.5617	105.9733	117.9635	118.2522	122.4363	125.6853	130.9449	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7039	89.6475	89.5234	89.2434	88.5807	87.3000	87.3000	87.3000	87.3000	89.2353	89.5934	89.7333	(217)
Fuel for water heating, kWh/month	151.3576	134.6910	144.4155	131.8607	136.5010	127.7912	121.3898	135.1243	135.4550	137.2060	140.2842	145.9268	(219)

Water heating fuel used	1642.0029	(219)
Annual totals kWh/year		
Space heating fuel - main system	3819.0225	(211)
Space heating fuel - secondary	0.0000	(215)

Electricity for pumps and fans:
(MEVCentralised, Database: in-use factor = 1.3000, SFP = 0.2210)

mechanical ventilation fans (SFP = 0.2210)	62.7468	(230a)
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	137.7468	(231)
Electricity for lighting (calculated in Appendix L)	382.7918	(232)
Total delivered energy for all uses	5981.5641	(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	3819.0225	0.2160	824.9089	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1642.0029	0.2160	354.6726	(264)
Space and water heating			1179.5815	(265)
Pumps and fans	137.7468	0.5190	71.4906	(267)
Energy for lighting	382.7918	0.5190	198.6690	(268)
Total CO2, kg/year			1449.7410	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			16.5100	(273)

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

DER		16.5100	ZC1
Total Floor Area	TFA	87.8200	
Assumed number of occupants	N	2.5947	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		15.8576	ZC2
CO2 emissions from cooking, equation (L16)		2.0641	ZC3
Total CO2 emissions		34.4318	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		34.4318	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	43.9100 (1b)	x	2.5000 (2b)	=	109.7750	(1b) - (3b)
First floor	43.9100 (1c)	x	2.8000 (2c)	=	122.9480	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	87.8200					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	232.7230	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							3 * 10 =		30.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1289	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3789	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3505	(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	0.4469	0.4381	0.4294	0.3855	0.3768	0.3330	0.3330	0.3242	0.3505	0.3768	0.3943	0.4118	(22b)
Effective ac	0.5998	0.5960	0.5922	0.5743	0.5710	0.5554	0.5554	0.5526	0.5614	0.5710	0.5777	0.5848	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1400	1.0000	2.1400			(26)
TER Opening Type (Uw = 1.40)			14.6800	1.3258	19.4621			(27)
Heat Loss Floor 1			43.9100	0.1300	5.7083			(28a)
External Wall 1	47.0600	16.8200	30.2400	0.1800	5.4432			(29a)
External Roof 1	43.9100		43.9100	0.1300	5.7083			(30)
Total net area of external elements Aum(A, m2)			134.8800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	38.4619			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							9.5656	(36)
Total fabric heat loss					(33) + (36) =		48.0275	(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	46.0675	45.7698	45.4779	44.1070	43.8505	42.6565	42.6565	42.4354	43.1164	43.8505	44.3694	44.9119	(38)
Heat transfer coeff	94.0951	93.7973	93.5054	92.1345	91.8780	90.6840	90.6840	90.4629	91.1439	91.8780	92.3969	92.9394	(39)
Average = Sum(39)m / 12 =												92.1333	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0715	1.0681	1.0647	1.0491	1.0462	1.0326	1.0326	1.0301	1.0378	1.0462	1.0521	1.0583	(40)
HLP (average)												1.0491	(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	2.5947	(42)
Average daily hot water use (litres/day)	95.8239	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	105.4063	101.5733	97.7404	93.9074	90.0745	86.2415	86.2415	90.0745	93.9074	97.7404	101.5733	105.4063	(44)
Energy conte	156.3145	136.7136	141.0762	122.9937	118.0153	101.8383	94.3681	108.2888	109.5821	127.7074	139.4026	151.3822	(45)
Energy content (annual)										Total = Sum(45)m =		1507.6829	(45)
Distribution loss (46)m = 0.15 x (45)m	23.4472	20.5070	21.1614	18.4490	17.7023	15.2757	14.1552	16.2433	16.4373	19.1561	20.9104	22.7073	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	46.0274	49.8074	46.3105	45.9010	42.5301	43.9477	45.9010	46.3105	49.8074	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month													
	207.2734	182.7410	190.8836	169.3042	163.9163	144.3683	138.3159	154.1898	155.8926	177.5148	188.7177	202.3411	(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													
	207.2734	182.7410	190.8836	169.3042	163.9163	144.3683	138.3159	154.1898	155.8926	177.5148	188.7177	202.3411	(64)
								Total per year (kWh/year) = Sum(64)m =				2075.4587	(64)
Heat gains from water heating, kWh/month													
	64.7143	56.9641	59.3597	52.4730	50.7153	44.4937	42.3643	47.4813	48.0137	54.9146	58.6801	63.0743	(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	129.7345	129.7345	129.7345	129.7345	129.7345	129.7345	129.7345	129.7345	129.7345	129.7345	129.7345	129.7345	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	21.6753	19.2518	15.6566	11.8530	8.8603	7.4802	8.0827	10.5061	14.1013	17.9049	20.8976	22.2777	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	235.0094	237.4481	231.3027	218.2200	201.7054	186.1840	175.8148	173.3761	179.5215	192.6042	209.1188	224.6402	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.9734	35.9734	35.9734	35.9734	35.9734	35.9734	35.9734	35.9734	35.9734	35.9734	35.9734	35.9734	(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)													
	-103.7876	-103.7876	-103.7876	-103.7876	-103.7876	-103.7876	-103.7876	-103.7876	-103.7876	-103.7876	-103.7876	-103.7876	(71)
Water heating gains (Table 5)													
	86.9816	84.7680	79.7845	72.8792	68.1658	61.7969	56.9413	63.8189	66.6857	73.8099	81.5002	84.7773	(72)
Total internal gains													
	408.5866	406.3883	391.6642	367.8726	343.6519	320.3815	305.7591	312.6215	325.2288	349.2393	376.4370	396.6155	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	8.9300	36.7938	0.6300	0.7000	0.7700	100.4149	(77)
Northwest	5.7500	11.2829	0.6300	0.7000	0.7700	19.8272	(81)

Solar gains	120.2422	211.4027	306.7435	409.3911	485.3150	493.5776	470.9625	412.5200	342.0075	238.3616	145.2217	102.1262	(83)
Total gains	528.8288	617.7910	698.4077	777.2637	828.9669	813.9591	776.7216	725.1416	667.2364	587.6009	521.6587	498.7417	(84)

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	64.8133	65.0191	65.2220	66.1925	66.3773	67.2512	67.2512	67.4156	66.9119	66.3773	66.0045	65.6192	
alpha	5.3209	5.3346	5.3481	5.4128	5.4252	5.4834	5.4834	5.4944	5.4608	5.4252	5.4003	5.3746	
util living area													
	0.9980	0.9950	0.9858	0.9523	0.8569	0.6770	0.5071	0.5620	0.8192	0.9712	0.9954	0.9985	(86)
MIT	19.8677	20.0279	20.2751	20.5919	20.8429	20.9679	20.9944	20.9906	20.9101	20.5805	20.1670	19.8435	(87)
Th 2	20.0242	20.0270	20.0297	20.0426	20.0450	20.0562	20.0562	20.0583	20.0519	20.0450	20.0401	20.0350	(88)
util rest of house													
	0.9973	0.9933	0.9809	0.9353	0.8096	0.5917	0.4019	0.4530	0.7465	0.9576	0.9936	0.9980	(89)
MIT 2	18.5112	18.7466	19.1069	19.5644	19.8924	20.0351	20.0542	20.0544	19.9809	19.5579	18.9600	18.4836	(90)
Living area fraction									fLA = Living area / (4) =			0.2502	(91)
MIT	18.8505	19.0672	19.3991	19.8215	20.1302	20.2685	20.2894	20.2886	20.2134	19.8137	19.2619	18.8238	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8505	19.0672	19.3991	19.8215	20.1302	20.2685	20.2894	20.2886	20.2134	19.8137	19.2619	18.8238	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9961	0.9909	0.9766	0.9305	0.8143	0.6118	0.4283	0.4804	0.7603	0.9533	0.9914	0.9971	(94)
Useful gains	526.7674	612.1906	682.0754	723.2236	675.0494	497.9904	332.6818	348.3423	507.2690	560.1781	517.1939	497.2962	(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													
	1369.1342	1328.8421	1206.1381	1006.2435	774.5489	514.0425	334.5695	351.7768	557.1956	846.5394	1123.7250	1359.1292	(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													
	626.7209	481.5898	389.9026	203.7743	74.0276	0.0000	0.0000	0.0000	0.0000	213.0528	436.7024	641.2037	(98)
Space heating												3066.9742	(98)
Space heating per m2											(98) / (4) =	34.9234	(99)

8c. Space cooling requirement

Not applicable

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

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	93.4000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3283.6983	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	626.7209	481.5898	389.9026	203.7743	74.0276	0.0000	0.0000	0.0000	0.0000	213.0528	436.7024	641.2037	(98)
Space heating efficiency (main heating system 1)	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)	671.0074	515.6208	417.4546	218.1738	79.2587	0.0000	0.0000	0.0000	0.0000	228.1079	467.5614	686.5136	(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	207.2734	182.7410	190.8836	169.3042	163.9163	144.3683	138.3159	154.1898	155.8926	177.5148	188.7177	202.3411	(64)
Efficiency of water heater												80.3000	(216)
(217)m	87.6598	87.3769	86.8113	85.5187	83.1917	80.3000	80.3000	80.3000	80.3000	85.5116	87.0945	87.7525	(217)
Fuel for water heating, kWh/month	236.4521	209.1411	219.8833	197.9732	197.0345	179.7862	172.2489	192.0171	194.1378	207.5916	216.6815	230.5817	(219)
Water heating fuel used												2453.5290	(219)

Annual totals kWh/year		
Space heating fuel - main system	3283.6983	(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)	382.7918	(232)
Total delivered energy for all uses	6195.0191	(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	3283.6983	0.2160	709.2788	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2453.5290	0.2160	529.9623	(264)
Space and water heating			1239.2411	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	382.7918	0.5190	198.6690	(268)
Total CO2, kg/m2/year			1476.8351	(272)
Emissions per m2 for space and water heating			14.1111	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.2622	(272b)
Emissions per m2 for pumps and fans			0.4432	(272c)
Target Carbon Dioxide Emission Rate (TER) = (14.1111 * 1.00) + 2.2622 + 0.4432, rounded to 2 d.p.			16.8200	(273)

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

Design SAP
elmhurst energy

Property Reference	Plot 17	**Issued on Date**	13/02/2020
Assessment Reference	001	**Prop Type Ref**	TF
Property	Epping College Site B, Plot 17		

SAP Rating	83 B	**DER**	19.27	**TER**	19.45
Environmental	86 B	**% DER<TER**	0.90		
CO_2 Emissions (t/year)	1.12	**DFEE**	50.83	**TFEE**	54.54
General Requirements Compliance	Pass	**% DFEE<TFEE**	6.82		

Assessor Details	Miss Georgia Dimitriou, Georgia Dimitriou, Tel: 07599467602, erieta.dimitriou@lowenergyconsultancy.co.uk	**Assessor ID**	P864-0001
Client			

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DWELLING AS DESIGNED

Top-floor flat, total floor area 71 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) 19.45 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 19.27 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)54.5 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)50.8 kWh/m²/yrOK

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2 Fabric U-values

Element	Average	Highest	
External wall	0.22 (max. 0.30)	0.22 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	(no floor)		
Roof	0.16 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

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

---

3 Air permeability
Air permeability at 50 pascals: 4.00 (design value)
Maximum 10.0 OK

---

4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Vaillant ecoFIT sustain 835 VUW 356/6-3 (H-GB)
Combi boiler
Efficiency: 89.3% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

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5 Cylinder insulation
Hot water storage No cylinder

---

6 Controls
Space heating controls: Programmer, room thermostat and TRVs OK

Hot water controls: No cylinder

Boiler interlock Yes OK

---

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

---

8 Mechanical ventilation
Continuous extract system
Specific fan power: 0.16
Maximum 0.7 OK

---

9 Summertime temperature
Overheating risk (Thames Valley): Slight OK
Based on:
Overshading: Average
Windows facing North East: 2.30 m², No overhang
Windows facing North West: 11.48 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

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	70.5400 (1b)	x	2.5000 (2b)	=	176.3500	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	70.5400					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	176.3500	(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		4.0000	
Infiltration rate		0.2000	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1700	(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	0.2168	0.2125	0.2083	0.1870	0.1828	0.1615	0.1615	0.1573	0.1700	0.1828	0.1913	0.1998	(22b)

Mechanical extract ventilation - centralised

If mechanical ventilation:		0.5000	(23a)
Effective ac	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	
Opening Type 2 (Uw = 1.30)			13.7800	1.2357	17.0285			(27)
External Wall 1	43.2500	13.7800	29.4700	0.2200	6.4834			(29a)
External Roof 1	70.5400		70.5400	0.1600	11.2864			(30)
Total net area of external elements Aum(A, m2)			113.7900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		34.7983			(33)
Party Wall 1			43.2500	0.0000	0.0000			(32)
Party Floor 1			70.5400					(32d)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	14.7418	(36)
Total fabric heat loss (33) + (36) =	49.5401	(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	29.0978	29.0978	29.0978	29.0978	29.0978	29.0978	29.0978	29.0978	29.0978	29.0978	29.0978	29.0978	(38)
Heat transfer coeff	78.6379	78.6379	78.6379	78.6379	78.6379	78.6379	78.6379	78.6379	78.6379	78.6379	78.6379	78.6379	(39)
Average = Sum(39)m / 12 =												78.6379	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1148	1.1148	1.1148	1.1148	1.1148	1.1148	1.1148	1.1148	1.1148	1.1148	1.1148	1.1148	(40)
HLP (average)												1.1148	(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	2.2592	(42)
Average daily hot water use (litres/day)	87.8551	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	96.6406	93.1264	89.6122	86.0980	82.5838	79.0696	79.0696	82.5838	86.0980	89.6122	93.1264	96.6406	(44)
Energy conte	143.3153	125.3445	129.3442	112.7655	108.2011	93.3694	86.5204	99.2835	100.4692	117.0872	127.8098	138.7932	(45)
Energy content (annual)										Total = Sum(45)m =		1382.3032	(45)
Distribution loss (46)m = 0.15 x (45)m	21.4973	18.8017	19.4016	16.9148	16.2302	14.0054	12.9781	14.8925	15.0704	17.5631	19.1715	20.8190	(46)
Water storage loss:													
Total storage loss													

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	26.3855	23.7944	26.2838	25.3681	26.1643	25.2634	26.0701	26.1312	25.3205	26.2344	25.4668	26.3658	(61)
Total heat required for water heating calculated for each month													
	169.7008	149.1389	155.6281	138.1336	134.3655	118.6328	112.5905	125.4147	125.7897	143.3216	153.2766	165.1590	(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													
	169.7008	149.1389	155.6281	138.1336	134.3655	118.6328	112.5905	125.4147	125.7897	143.3216	153.2766	165.1590	(64)
								Total per year (kWh/year) = Sum(64)m =				1691.1516	(64)
Heat gains from water heating, kWh/month													
	54.2487	47.6256	49.5779	43.8365	42.5180	37.3612	35.2856	39.5446	39.7361	45.4901	48.8635	52.7402	(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	112.9582	112.9582	112.9582	112.9582	112.9582	112.9582	112.9582	112.9582	112.9582	112.9582	112.9582	112.9582	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	17.8728	15.8745	12.9100	9.7737	7.3059	6.1680	6.6647	8.6631	11.6276	14.7638	17.2316	18.3695	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	198.5541	200.6145	195.4224	184.3691	170.4163	157.3026	148.5419	146.4815	151.6736	162.7269	176.6797	189.7934	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	34.2958	34.2958	34.2958	34.2958	34.2958	34.2958	34.2958	34.2958	34.2958	34.2958	34.2958	34.2958	(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)													
	-90.3665	-90.3665	-90.3665	-90.3665	-90.3665	-90.3665	-90.3665	-90.3665	-90.3665	-90.3665	-90.3665	-90.3665	(71)
Water heating gains (Table 5)													
	72.9149	70.8715	66.6370	60.8841	57.1478	51.8905	47.4268	53.1513	55.1891	61.1426	67.8659	70.8874	(72)
Total internal gains													
	349.2293	347.2479	334.8568	314.9143	294.7575	275.2486	262.5209	268.1833	278.3777	298.5208	321.6647	338.9377	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	2.3000	11.2829	0.5000	0.7000	0.7700	6.2944	(75)
Northwest	11.4800	11.2829	0.5000	0.7000	0.7700	31.4171	(81)

Solar gains	37.7114	76.7627	138.3019	227.1315	305.3093	325.4920	304.4911	242.7438	168.5231	93.8101	47.4507	30.7970	(83)
Total gains	386.9407	424.0105	473.1587	542.0458	600.0668	600.7406	567.0120	510.9272	446.9007	392.3309	369.1154	369.7348	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	62.2933	62.2933	62.2933	62.2933	62.2933	62.2933	62.2933	62.2933	62.2933	62.2933	62.2933	62.2933	
alpha	5.1529	5.1529	5.1529	5.1529	5.1529	5.1529	5.1529	5.1529	5.1529	5.1529	5.1529	5.1529	
util living area													
	0.9987	0.9976	0.9937	0.9755	0.9080	0.7555	0.5906	0.6684	0.9069	0.9881	0.9975	0.9990	(86)
MIT	19.7581	19.8703	20.1021	20.4336	20.7501	20.9338	20.9851	20.9729	20.8160	20.4236	20.0287	19.7247	(87)
Th 2	19.9888	19.9888	19.9888	19.9888	19.9888	19.9888	19.9888	19.9888	19.9888	19.9888	19.9888	19.9888	(88)
util rest of house													
	0.9983	0.9968	0.9913	0.9655	0.8700	0.6664	0.4648	0.5404	0.8520	0.9816	0.9965	0.9986	(89)
MIT 2	18.8532	18.9652	19.1959	19.5216	19.8149	19.9574	19.9849	19.9806	19.8785	19.5155	19.1235	18.8198	(90)
Living area fraction									fLA = Living area / (4) =			0.3720	(91)
MIT	19.1898	19.3019	19.5330	19.8608	20.1628	20.3206	20.3569	20.3497	20.2272	19.8533	19.4602	19.1564	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.1898	19.3019	19.5330	19.8608	20.1628	20.3206	20.3569	20.3497	20.2272	19.8533	19.4602	19.1564	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9978	0.9960	0.9899	0.9639	0.8775	0.6979	0.5122	0.5887	0.8673	0.9805	0.9958	0.9982	(94)
Useful gains	386.0777	422.3274	468.3709	522.4869	526.5819	419.2361	290.4285	300.7679	387.5871	384.6639	367.5519	369.0821	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1170.9017	1132.5320	1024.8879	861.9355	665.4977	449.8557	295.4378	310.5974	481.8309	727.6579	971.9824	1176.1401	(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													
	583.9091	477.2575	414.0487	244.4030	103.3533	0.0000	0.0000	0.0000	0.0000	255.1875	435.1899	600.4511	(98)
Space heating												3113.8000	(98)
Space heating per m2											(98) / (4) =	44.1423	(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 %)	93.2000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3340.9871	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	583.9091	477.2575	414.0487	244.4030	103.3533	0.0000	0.0000	0.0000	0.0000	255.1875	435.1899	600.4511	(98)
Space heating efficiency (main heating system 1)	93.2000	93.2000	93.2000	93.2000	93.2000	0.0000	0.0000	0.0000	0.0000	93.2000	93.2000	93.2000	(210)
Space heating fuel (main heating system)	626.5119	512.0788	444.2582	262.2349	110.8941	0.0000	0.0000	0.0000	0.0000	273.8063	466.9420	644.2608	(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	169.7008	149.1389	155.6281	138.1336	134.3655	118.6328	112.5905	125.4147	125.7897	143.3216	153.2766	165.1590	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.5303	89.4922	89.3888	89.1309	88.5376	87.3000	87.3000	87.3000	87.3000	89.1351	89.4262	89.5582	(217)
Fuel for water heating, kWh/month	189.5457	166.6501	174.1024	154.9784	151.7609	135.8909	128.9697	143.6594	144.0890	160.7914	171.4001	184.4152	(219)
Water heating fuel used												1906.2532	(219)

Annual totals kWh/year		
Space heating fuel - main system	3340.9871	(211)
Space heating fuel - secondary	0.0000	(215)

Electricity for pumps and fans:
(MEVCentralised, Database: in-use factor = 1.3000, SFP = 0.2080)

mechanical ventilation fans (SFP = 0.2080)	44.7506	(230a)
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	119.7506	(231)
Electricity for lighting (calculated in Appendix L)	315.6394	(232)
Total delivered energy for all uses	5682.6302	(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	3340.9871	0.2160	721.6532	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1906.2532	0.2160	411.7507	(264)
Space and water heating			1133.4039	(265)
Pumps and fans	119.7506	0.5190	62.1505	(267)
Energy for lighting	315.6394	0.5190	163.8168	(268)
Total CO2, kg/year			1359.3713	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			19.2700	(273)

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

DER		19.2700	ZC1
Total Floor Area	TFA	70.5400	
Assumed number of occupants	N	2.2592	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		16.6798	ZC2
CO2 emissions from cooking, equation (L16)		2.4556	ZC3
Total CO2 emissions		38.4054	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		38.4054	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	70.5400 (1b)	x	2.5000 (2b)	=	176.3500	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	70.5400					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	176.3500	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1701	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4201	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3571	(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	0.4553	0.4464	0.4374	0.3928	0.3839	0.3392	0.3392	0.3303	0.3571	0.3839	0.4017	0.4196	(22b)
Effective ac	0.6036	0.5996	0.5957	0.5771	0.5737	0.5575	0.5575	0.5546	0.5638	0.5737	0.5807	0.5880	(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 Opening Type (Uw = 1.40)			13.7800	1.3258	18.2689			(27)
External Wall 1	43.2500	13.7800	29.4700	0.1800	5.3046			(29a)
External Roof 1	70.5400		70.5400	0.1300	9.1702			(30)
Total net area of external elements Aum(A, m2)			113.7900					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	32.7437			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							13.1135	(36)
Total fabric heat loss						(33) + (36) =	45.8572	(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	35.1297	34.8955	34.6659	33.5875	33.3857	32.4465	32.4465	32.2726	32.8083	33.3857	33.7939	34.2206	(38)
Heat transfer coeff	80.9869	80.7527	80.5231	79.4447	79.2430	78.3037	78.3037	78.1298	78.6655	79.2430	79.6511	80.0778	(39)
Average = Sum(39)m / 12 =												79.4438	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1481	1.1448	1.1415	1.1262	1.1234	1.1101	1.1101	1.1076	1.1152	1.1234	1.1292	1.1352	(40)
HLP (average)												1.1262	(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	2.2592	(42)
Average daily hot water use (litres/day)	87.8551	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	96.6406	93.1264	89.6122	86.0980	82.5838	79.0696	79.0696	82.5838	86.0980	89.6122	93.1264	96.6406	(44)
Energy conte	143.3153	125.3445	129.3442	112.7655	108.2011	93.3694	86.5204	99.2835	100.4692	117.0872	127.8098	138.7932	(45)
Energy content (annual)										Total = Sum(45)m =		1382.3032	(45)
Distribution loss (46)m = 0.15 x (45)m	21.4973	18.8017	19.4016	16.9148	16.2302	14.0054	12.9781	14.8925	15.0704	17.5631	19.1715	20.8190	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	49.2470	42.8637	45.6654	42.4593	42.0838	38.9932	40.2930	42.0838	42.4593	45.6654	45.9254	49.2470	(61)
Total heat required for water heating calculated for each month													

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	192.5623	168.2081	175.0097	155.2247	150.2849	132.3626	126.8134	141.3673	142.9285	162.7526	173.7352	188.0402	(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													
	192.5623	168.2081	175.0097	155.2247	150.2849	132.3626	126.8134	141.3673	142.9285	162.7526	173.7352	188.0402	(64)
								Total per year (kWh/year) = Sum(64)m =				1909.2896	(64)
Heat gains from water heating, kWh/month													
	59.9641	52.3929	54.4233	48.1093	46.4978	40.7936	38.8413	43.5327	44.0208	50.3478	53.9781	58.4605	(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	112.9582	112.9582	112.9582	112.9582	112.9582	112.9582	112.9582	112.9582	112.9582	112.9582	112.9582	112.9582	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	17.8728	15.8745	12.9100	9.7737	7.3059	6.1680	6.6647	8.6631	11.6276	14.7638	17.2316	18.3695	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	198.5541	200.6145	195.4224	184.3691	170.4163	157.3026	148.5419	146.4815	151.6736	162.7269	176.6797	189.7934	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	34.2958	34.2958	34.2958	34.2958	34.2958	34.2958	34.2958	34.2958	34.2958	34.2958	34.2958	34.2958	(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)													
	-90.3665	-90.3665	-90.3665	-90.3665	-90.3665	-90.3665	-90.3665	-90.3665	-90.3665	-90.3665	-90.3665	-90.3665	(71)
Water heating gains (Table 5)													
	80.5969	77.9657	73.1496	66.8185	62.4971	56.6578	52.2060	58.5117	61.1401	67.6718	74.9696	78.5759	(72)
Total internal gains													
	356.9112	354.3421	341.3694	320.8488	300.1068	280.0159	267.3001	273.5437	284.3287	305.0500	328.7683	346.6263	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	2.3000	11.2829	0.6300	0.7000	0.7700	7.9309	(75)
Northwest	11.4800	11.2829	0.6300	0.7000	0.7700	39.5855	(81)

Solar gains	47.5164	96.7210	174.2604	286.1857	384.6897	410.1199	383.6588	305.8572	212.3391	118.2007	59.7879	38.8043	(83)
Total gains	404.4276	451.0631	515.6299	607.0344	684.7965	690.1358	650.9589	579.4010	496.6677	423.2507	388.5562	385.4306	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	60.4864	60.6619	60.8348	61.6606	61.8176	62.5591	62.5591	62.6984	62.2714	61.8176	61.5008	61.1731	
alpha	5.0324	5.0441	5.0557	5.1107	5.1212	5.1706	5.1706	5.1799	5.1514	5.1212	5.1001	5.0782	
util living area													
	0.9984	0.9969	0.9910	0.9626	0.8657	0.6820	0.5198	0.5993	0.8722	0.9837	0.9969	0.9988	(86)
MIT	19.7365	19.8666	20.1244	20.4959	20.8072	20.9591	20.9917	20.9837	20.8532	20.4544	20.0380	19.7179	(87)
Th 2	19.9617	19.9644	19.9671	19.9795	19.9818	19.9926	19.9926	19.9946	19.9884	19.9818	19.9771	19.9722	(88)
util rest of house													
	0.9978	0.9958	0.9876	0.9482	0.8183	0.5922	0.4057	0.4788	0.8069	0.9752	0.9956	0.9983	(89)
MIT 2	18.2747	18.4667	18.8438	19.3829	19.7939	19.9659	19.9896	19.9879	19.8659	19.3338	18.7266	18.2550	(90)
Living area fraction									fLA = Living area / (4) =			0.3720	(91)
MIT	18.8185	18.9874	19.3202	19.7969	20.1708	20.3354	20.3624	20.3583	20.2331	19.7506	19.2144	18.7992	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8185	18.9874	19.3202	19.7969	20.1708	20.3354	20.3624	20.3583	20.2331	19.7506	19.2144	18.7992	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9969	0.9943	0.9848	0.9450	0.8282	0.6242	0.4484	0.5239	0.8250	0.9726	0.9942	0.9976	(94)
Useful gains	403.1918	448.4924	507.7932	573.6570	567.1239	430.8017	291.9141	303.5650	409.7757	411.6362	386.3039	384.5068	(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													
	1175.8056	1137.5990	1032.3194	865.7020	671.2542	449.1037	294.6091	309.2627	482.4665	725.1241	964.9286	1169.0730	(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													
	574.8247	463.0797	390.2475	210.2724	77.4730	0.0000	0.0000	0.0000	0.0000	233.2350	416.6097	583.7173	(98)
Space heating												2949.4593	(98)
Space heating per m2											(98) / (4) =	41.8126	(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)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Efficiency of main space heating system 1 (in %)	93.4000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3157.8793	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	574.8247	463.0797	390.2475	210.2724	77.4730	0.0000	0.0000	0.0000	0.0000	233.2350	416.6097	583.7173	(98)
Space heating efficiency (main heating system 1)	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)	615.4440	495.8027	417.8239	225.1311	82.9475	0.0000	0.0000	0.0000	0.0000	249.7163	446.0489	624.9650	(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	192.5623	168.2081	175.0097	155.2247	150.2849	132.3626	126.8134	141.3673	142.9285	162.7526	173.7352	188.0402	(64)
Efficiency of water heater												80.3000	(216)
(217)m	87.6341	87.4686	87.0116	85.8159	83.4723	80.3000	80.3000	80.3000	80.3000	85.9564	87.1732	87.7120	(217)
Fuel for water heating, kWh/month	219.7344	192.3069	201.1338	180.8810	180.0417	164.8351	157.9246	176.0489	177.9932	189.3431	199.2988	214.3837	(219)
Water heating fuel used												2253.9253	(219)

Annual totals kWh/year		
Space heating fuel - main system	3157.8793	(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)	315.6394	(232)
Total delivered energy for all uses	5802.4440	(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	3157.8793	0.2160	682.1019	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2253.9253	0.2160	486.8479	(264)
Space and water heating			1168.9498	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	315.6394	0.5190	163.8168	(268)
Total CO2, kg/m2/year			1371.6916	(272)
Emissions per m2 for space and water heating			16.5714	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.3223	(272b)
Emissions per m2 for pumps and fans			0.5518	(272c)
Target Carbon Dioxide Emission Rate (TER) = (16.5714 * 1.00) + 2.3223 + 0.5518, rounded to 2 d.p.			19.4500	(273)

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

Design SAP
elmhurst energy

Property Reference	Plot 41	**Issued on Date**	13/02/2020
Assessment Reference	001	**Prop Type Ref**	GF
Property	Epping College Site B, Plot 41		

SAP Rating	82 B	**DER**	20.72	**TER**	19.43
Environmental	85 B	**% DER<TER**	-6.62		
CO_2 Emissions (t/year)	1.14	**DFEE**	55.23	**TFEE**	52.98
General Requirements Compliance	Fail	**% DFEE<TFEE**	-4.26		

Assessor Details	Miss Georgia Dimitriou, Georgia Dimitriou, Tel: 07599467602, erieta.dimitriou@lowenergyconsultancy.co.uk	**Assessor ID**	P864-0001
Client			

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

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

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DWELLING AS DESIGNED

Ground-floor flat, total floor area 66 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) 19.43 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 20.72 kgCO□/m²Fail
Excess emissions =1.29 kgCO□/m² (6.6%)

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)53.0 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)55.2 kWh/m²/yrFail
Excess energy =2.2 kWh/m²/yr (4.2%)

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2 Fabric U-values

Element	Average	Highest	
External wall	0.22 (max. 0.30)	0.22 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.20 (max. 0.25)	0.20 (max. 0.70)	OK
Roof	(no roof)		
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

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

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3 Air permeability
Air permeability at 50 pascals: 4.00 (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 database
Vaillant ecoFIT sustain 835 VUW 356/6-3 (H-GB)
Combi boiler
Efficiency: 89.3% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

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5 Cylinder insulation
Hot water storage No cylinder

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6 Controls
Space heating controls: Programmer, room thermostat and TRVs OK

Hot water controls: No cylinder

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
Specific fan power: 0.17
Maximum 0.7 OK

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9 Summertime temperature
Overheating risk (Thames Valley): Medium OK
Based on:
Overshading: Average
Windows facing South West: 12.17 m², No overhang
Air change rate: 2.00 ach
Blinds/curtains: None

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10 Key features
Party wall U-value 0.00 W/m²K

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	65.9200 (1b)	x	2.5000 (2b)	=	164.8000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	65.9200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		164.8000	(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		4.0000	
Infiltration rate		0.2000	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1850	(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	0.2359	0.2313	0.2266	0.2035	0.1989	0.1758	0.1758	0.1711	0.1850	0.1989	0.2081	0.2174	(22b)

Mechanical extract ventilation - centralised

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	
Opening Type 2 (Uw = 1.30)			12.1700	1.2357	15.0390			(27)
Heat Loss Floor 1			65.9200	0.2000	13.1840			(28a)
External Wall 1	92.6300	12.1700	80.4600	0.2200	17.7012			(29a)
Total net area of external elements Aum(A, m2)			158.5500					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		45.9242			(33)
Party Wall 1			9.7800	0.0000	0.0000			(32)
Party Ceilings 1			65.9200					(32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	13.1423	(36)
Total fabric heat loss (33) + (36) =	59.0665	(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	27.1920	27.1920	27.1920	27.1920	27.1920	27.1920	27.1920	27.1920	27.1920	27.1920	27.1920	27.1920	(38)
Heat transfer coeff	86.2585	86.2585	86.2585	86.2585	86.2585	86.2585	86.2585	86.2585	86.2585	86.2585	86.2585	86.2585	(39)
Average = Sum(39)m / 12 =												86.2585	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3085	1.3085	1.3085	1.3085	1.3085	1.3085	1.3085	1.3085	1.3085	1.3085	1.3085	1.3085	(40)
HLP (average)												1.3085	(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	2.1432	(42)
Average daily hot water use (litres/day)	85.0999	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	93.6099	90.2059	86.8019	83.3979	79.9939	76.5899	76.5899	79.9939	83.3979	86.8019	90.2059	93.6099	(44)
Energy conte	138.8208	121.4136	125.2879	109.2290	104.8079	90.4412	83.8071	96.1699	97.3184	113.4152	123.8016	134.4405	(45)
Energy content (annual)										Total = Sum(45)m =		1338.9531	(45)
Distribution loss (46)m = 0.15 x (45)m	20.8231	18.2120	18.7932	16.3844	15.7212	13.5662	12.5711	14.4255	14.5978	17.0123	18.5702	20.1661	(46)
Water storage loss:													
Total storage loss													

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	26.3470	23.7620	26.2516	25.3411	26.1395	25.2429	26.0511	26.1084	25.2964	26.2052	25.4337	26.3286	(61)
Total heat required for water heating calculated for each month													
	165.1678	145.1755	151.5395	134.5702	130.9474	115.6841	109.8582	122.2783	122.6149	139.6205	149.2353	160.7691	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	165.1678	145.1755	151.5395	134.5702	130.9474	115.6841	109.8582	122.2783	122.6149	139.6205	149.2353	160.7691	(64)
								Total per year (kWh/year) = Sum(64)m =				1647.4608	(64)
Heat gains from water heating, kWh/month													
	52.7447	46.3105	48.2211	42.6539	41.3835	36.3824	34.3786	38.5036	38.6825	44.2619	47.5225	51.2836	(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	107.1577	107.1577	107.1577	107.1577	107.1577	107.1577	107.1577	107.1577	107.1577	107.1577	107.1577	107.1577	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	17.0147	15.1123	12.2902	9.3045	6.9552	5.8719	6.3448	8.2472	11.0693	14.0550	16.4043	17.4876	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	187.5939	189.5406	184.6351	174.1920	161.0093	148.6196	140.3424	138.3958	143.3012	153.7444	166.9270	179.3168	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	33.7158	33.7158	33.7158	33.7158	33.7158	33.7158	33.7158	33.7158	33.7158	33.7158	33.7158	33.7158	(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)													
	-85.7262	-85.7262	-85.7262	-85.7262	-85.7262	-85.7262	-85.7262	-85.7262	-85.7262	-85.7262	-85.7262	-85.7262	(71)
Water heating gains (Table 5)													
	70.8934	68.9144	64.8134	59.2416	55.6230	50.5312	46.2078	51.7521	53.7257	59.4918	66.0034	68.9296	(72)
Total internal gains													
	333.6493	331.7147	319.8860	300.8853	281.7348	263.1699	251.0423	256.5424	266.2435	285.4385	307.4820	323.8813	(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	
Southwest	12.1700	36.7938	0.5000	0.7000	0.7700	108.6093	(79)

Solar gains	108.6093	185.0018	253.1275	313.6372	351.2998	348.7594	336.2413	308.1433	274.0835	204.4664	130.0889	92.9469	(83)
Total gains	442.2586	516.7164	573.0134	614.5225	633.0347	611.9293	587.2836	564.6857	540.3271	489.9049	437.5709	416.8282	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	53.0705	53.0705	53.0705	53.0705	53.0705	53.0705	53.0705	53.0705	53.0705	53.0705	53.0705	53.0705	
alpha	4.5380	4.5380	4.5380	4.5380	4.5380	4.5380	4.5380	4.5380	4.5380	4.5380	4.5380	4.5380	
util living area													
	0.9967	0.9929	0.9841	0.9607	0.9015	0.7749	0.6116	0.6536	0.8567	0.9698	0.9934	0.9975	(86)
MIT	19.6157	19.7874	20.0489	20.3723	20.6794	20.8921	20.9719	20.9616	20.8168	20.4157	19.9417	19.5691	(87)
Th 2	19.8342	19.8342	19.8342	19.8342	19.8342	19.8342	19.8342	19.8342	19.8342	19.8342	19.8342	19.8342	(88)
util rest of house													
	0.9956	0.9905	0.9783	0.9450	0.8589	0.6780	0.4664	0.5109	0.7814	0.9545	0.9907	0.9966	(89)
MIT 2	18.5884	18.7590	19.0177	19.3323	19.6155	19.7835	19.8271	19.8234	19.7339	19.3787	18.9134	18.5420	(90)
Living area fraction										fLA = Living area / (4) =		0.3985	(91)
MIT	18.9978	19.1689	19.4287	19.7467	20.0394	20.2253	20.2833	20.2770	20.1655	19.7920	19.3232	18.9513	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9978	19.1689	19.4287	19.7467	20.0394	20.2253	20.2833	20.2770	20.1655	19.7920	19.3232	18.9513	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9945	0.9886	0.9757	0.9436	0.8676	0.7137	0.5252	0.5685	0.8060	0.9538	0.9891	0.9957	(94)
Useful gains	439.8318	510.8304	559.0942	579.8369	549.2081	436.7594	308.4319	321.0335	435.4961	467.2737	432.8034	415.0539	(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													
	1267.8101	1230.8096	1115.2069	935.6226	719.3477	485.2311	317.7169	334.4248	523.1977	792.8840	1054.3541	1272.4263	(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													
	616.0159	483.8260	413.7479	256.1657	126.5839	0.0000	0.0000	0.0000	0.0000	242.2541	447.5165	637.8850	(98)
Space heating												3223.9951	(98)
Space heating per m2											(98) / (4) =	48.9077	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	93.2000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3459.2222	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	616.0159	483.8260	413.7479	256.1657	126.5839	0.0000	0.0000	0.0000	0.0000	242.2541	447.5165	637.8850	(98)
Space heating efficiency (main heating system 1)	93.2000	93.2000	93.2000	93.2000	93.2000	0.0000	0.0000	0.0000	0.0000	93.2000	93.2000	93.2000	(210)
Space heating fuel (main heating system)	660.9613	519.1267	443.9355	274.8559	135.8196	0.0000	0.0000	0.0000	0.0000	259.9293	480.1679	684.4260	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)

Water heating													
Water heating requirement	165.1678	145.1755	151.5395	134.5702	130.9474	115.6841	109.8582	122.2783	122.6149	139.6205	149.2353	160.7691	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.5709	89.5137	89.4038	89.1797	88.7018	87.3000	87.3000	87.3000	87.3000	89.1176	89.4569	89.6008	(217)
Fuel for water heating, kWh/month	184.3990	162.1825	169.5000	150.8977	147.6266	132.5133	125.8398	140.0668	140.4523	156.6699	166.8238	179.4281	(219)

Water heating fuel used	1856.3997	(219)
Annual totals kWh/year		
Space heating fuel - main system	3459.2222	(211)
Space heating fuel - secondary	0.0000	(215)

Electricity for pumps and fans:
(MEVCentralised, Database: in-use factor = 1.3000, SFP = 0.2210)

mechanical ventilation fans (SFP = 0.2210)	44.4334	(230a)
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	119.4334	(231)
Electricity for lighting (calculated in Appendix L)	300.4854	(232)
Total delivered energy for all uses	5735.5407	(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	3459.2222	0.2160	747.1920	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1856.3997	0.2160	400.9823	(264)
Space and water heating			1148.1743	(265)
Pumps and fans	119.4334	0.5190	61.9859	(267)
Energy for lighting	300.4854	0.5190	155.9519	(268)
Total CO2, kg/year			1366.1122	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			20.7200	(273)

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

DER		20.7200	ZC1
Total Floor Area	TFA	65.9200	
Assumed number of occupants	N	2.1432	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		16.8635	ZC2
CO2 emissions from cooking, equation (L16)		2.5855	ZC3
Total CO2 emissions		40.1690	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		40.1690	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	65.9200 (1b)	x	2.5000 (2b)	=	164.8000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	65.9200					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	164.8000	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							2 * 10 =		20.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1214	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3714	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3435	(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	0.4380	0.4294	0.4208	0.3779	0.3693	0.3263	0.3263	0.3177	0.3435	0.3693	0.3864	0.4036	(22b)
Effective ac	0.5959	0.5922	0.5885	0.5714	0.5682	0.5532	0.5532	0.5505	0.5590	0.5682	0.5747	0.5815	(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 Opening Type (Uw = 1.40)			12.1700	1.3258	16.1345			(27)
Heat Loss Floor 1			65.9200	0.1300	8.5696			(28a)
External Wall 1	92.6300	12.1700	80.4600	0.1800	14.4828			(29a)
Total net area of external elements Aum(A, m2)			158.5500					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	39.1869			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							11.1923	(36)
Total fabric heat loss						(33) + (36) =	50.3792	(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	32.4079	32.2054	32.0069	31.0744	30.8999	30.0877	30.0877	29.9373	30.4006	30.8999	31.2529	31.6218	(38)
Heat transfer coeff	82.7871	82.5846	82.3860	81.4536	81.2791	80.4669	80.4669	80.3165	80.7798	81.2791	81.6320	82.0010	(39)
Average = Sum(39)m / 12 =												81.4527	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2559	1.2528	1.2498	1.2356	1.2330	1.2207	1.2207	1.2184	1.2254	1.2330	1.2383	1.2439	(40)
HLP (average)												1.2356	(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	2.1432	(42)
Average daily hot water use (litres/day)	85.0999	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	93.6099	90.2059	86.8019	83.3979	79.9939	76.5899	76.5899	79.9939	83.3979	86.8019	90.2059	93.6099	(44)
Energy conte	138.8208	121.4136	125.2879	109.2290	104.8079	90.4412	83.8071	96.1699	97.3184	113.4152	123.8016	134.4405	(45)
Energy content (annual)										Total = Sum(45)m =		1338.9531	(45)
Distribution loss (46)m = 0.15 x (45)m	20.8231	18.2120	18.7932	16.3844	15.7212	13.5662	12.5711	14.4255	14.5978	17.0123	18.5702	20.1661	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	47.7026	41.5194	44.2333	41.1277	40.7640	37.7704	39.0294	40.7640	41.1277	44.2333	44.4851	47.7026	(61)
Total heat required for water heating calculated for each month													

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	186.5234	162.9330	169.5212	150.3568	145.5719	128.2116	122.8365	136.9339	138.4462	157.6485	168.2867	182.1431	(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													
	186.5234	162.9330	169.5212	150.3568	145.5719	128.2116	122.8365	136.9339	138.4462	157.6485	168.2867	182.1431	(64)
								Total per year (kWh/year) = Sum(64)m =				1849.4127	(64)
Heat gains from water heating, kWh/month													
	58.0836	50.7499	52.7166	46.6006	45.0396	39.5143	37.6232	42.1675	42.6403	48.7689	52.2853	56.6271	(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	107.1577	107.1577	107.1577	107.1577	107.1577	107.1577	107.1577	107.1577	107.1577	107.1577	107.1577	107.1577	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	17.0147	15.1123	12.2902	9.3045	6.9552	5.8719	6.3448	8.2472	11.0693	14.0550	16.4043	17.4876	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	187.5939	189.5406	184.6351	174.1920	161.0093	148.6196	140.3424	138.3958	143.3012	153.7444	166.9270	179.3168	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	33.7158	33.7158	33.7158	33.7158	33.7158	33.7158	33.7158	33.7158	33.7158	33.7158	33.7158	33.7158	(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)													
	-85.7262	-85.7262	-85.7262	-85.7262	-85.7262	-85.7262	-85.7262	-85.7262	-85.7262	-85.7262	-85.7262	-85.7262	(71)
Water heating gains (Table 5)													
	78.0693	75.5206	70.8556	64.7230	60.5371	54.8810	50.5688	56.6767	59.2227	65.5496	72.6185	76.1117	(72)
Total internal gains													
	340.8253	338.3209	325.9282	306.3668	286.6490	267.5197	255.4033	261.4670	271.7405	291.4963	314.0971	331.0635	(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	
Southwest	12.1700	36.7938	0.6300	0.7000	0.7700	136.8477	(79)

Solar gains	136.8477	233.1022	318.9406	395.1829	442.6378	439.4369	423.6640	388.2606	345.3452	257.6276	163.9120	117.1131	(83)
Total gains	477.6730	571.4231	644.8688	701.5497	729.2868	706.9566	679.0673	649.7275	617.0858	549.1239	478.0091	448.1765	(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	55.2958	55.4314	55.5650	56.2011	56.3217	56.8902	56.8902	56.9967	56.6699	56.3217	56.0782	55.8259	
alpha	4.6864	4.6954	4.7043	4.7467	4.7548	4.7927	4.7927	4.7998	4.7780	4.7548	4.7385	4.7217	
util living area													
	0.9955	0.9891	0.9739	0.9331	0.8407	0.6769	0.5101	0.5517	0.7824	0.9508	0.9903	0.9966	(86)
MIT	19.7322	19.9310	20.2072	20.5357	20.7996	20.9487	20.9892	20.9845	20.8952	20.5464	20.0728	19.6960	(87)
Th 2	19.8756	19.8780	19.8804	19.8916	19.8937	19.9035	19.9035	19.9053	19.8997	19.8937	19.8894	19.8850	(88)
util rest of house													
	0.9940	0.9855	0.9650	0.9098	0.7867	0.5811	0.3888	0.4288	0.6977	0.9287	0.9865	0.9955	(89)
MIT 2	18.2078	18.4978	18.8966	19.3635	19.7041	19.8707	19.8998	19.8993	19.8215	19.3892	18.7138	18.1616	(90)
Living area fraction									fLA = Living area / (4) =			0.3985	(91)
MIT	18.8153	19.0689	19.4189	19.8306	20.1407	20.3003	20.3339	20.3318	20.2494	19.8504	19.2553	18.7731	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8153	19.0689	19.4189	19.8306	20.1407	20.3003	20.3339	20.3318	20.2494	19.8504	19.2553	18.7731	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9920	0.9820	0.9604	0.9083	0.8001	0.6176	0.4375	0.4781	0.7271	0.9276	0.9835	0.9939	(94)
Useful gains	473.8382	561.1489	619.3388	637.1913	583.4716	436.6284	297.0640	310.6219	448.6540	509.3727	470.1099	445.4362	(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													
	1201.6795	1170.1353	1064.3373	890.3379	686.0501	458.6874	300.4580	315.7866	496.7460	751.8617	992.2651	1195.0085	(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													
	541.5140	409.2388	331.0789	182.2655	76.3185	0.0000	0.0000	0.0000	0.0000	180.4118	375.9517	557.6818	(98)
Space heating												2654.4611	(98)
Space heating per m2											(98) / (4) =	40.2679	(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 %)	93.4000	(206)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												2842.0354	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	541.5140	409.2388	331.0789	182.2655	76.3185	0.0000	0.0000	0.0000	0.0000	180.4118	375.9517	557.6818	(98)
Space heating efficiency (main heating system 1)	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)	579.7794	438.1572	354.4742	195.1451	81.7114	0.0000	0.0000	0.0000	0.0000	193.1604	402.5179	597.0897	(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	186.5234	162.9330	169.5212	150.3568	145.5719	128.2116	122.8365	136.9339	138.4462	157.6485	168.2867	182.1431	(64)
Efficiency of water heater												80.3000	(216)
(217)m	87.5779	87.2741	86.7069	85.5367	83.5091	80.3000	80.3000	80.3000	80.3000	85.3914	87.0157	87.6847	(217)
Fuel for water heating, kWh/month	212.9801	186.6911	195.5107	175.7804	174.3187	159.6657	152.9719	170.5279	172.4112	184.6187	193.3980	207.7250	(219)
Water heating fuel used												2186.5994	(219)
Annual totals kWh/year													
Space heating fuel - main system												2842.0354	(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)												300.4854	(232)
Total delivered energy for all uses												5404.1203	(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	2842.0354	0.2160	613.8796	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2186.5994	0.2160	472.3055	(264)
Space and water heating			1086.1851	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	300.4854	0.5190	155.9519	(268)
Total CO2, kg/m2/year			1281.0621	(272)
Emissions per m2 for space and water heating			16.4773	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.3658	(272b)
Emissions per m2 for pumps and fans			0.5905	(272c)
Target Carbon Dioxide Emission Rate (TER) = (16.4773 * 1.00) + 2.3658 + 0.5905, rounded to 2 d.p.			19.4300	(273)

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

Design SAP
elmhurst energy

Property Reference	Plot 43	**Issued on Date**	13/02/2020
Assessment Reference	001	**Prop Type Ref**	MF
Property	Epping College Site B, Plot 43		

SAP Rating	86 B	**DER**	14.36	**TER**	14.70
Environmental	90 B	**% DER<TER**	2.28		
CO_2 Emissions (t/year)	0.84	**DFEE**	30.55	**TFEE**	32.08
General Requirements Compliance	Pass	**% DFEE<TFEE**	4.77		

Assessor Details	Miss Georgia Dimitriou, Georgia Dimitriou, Tel: 07599467602, erieta.dimitriou@lowenergyconsultancy.co.uk	**Assessor ID**	P864-0001
Client			

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DWELLING AS DESIGNED

Mid-floor flat, total floor area 70 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) 14.70 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 14.36 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)32.1 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)30.5 kWh/m²/yrOK

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2 Fabric U-values

Element	Average	Highest	
External wall	0.22 (max. 0.30)	0.22 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	(no floor)		
Roof	(no roof)		
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

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

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3 Air permeability
Air permeability at 50 pascals: 4.00 (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 database
Vaillant ecoFIT sustain 835 VUW 356/6-3 (H-GB)
Combi boiler
Efficiency: 89.3% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

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5 Cylinder insulation
Hot water storage No cylinder

---

6 Controls
Space heating controls: Programmer, room thermostat and TRVs OK

Hot water controls: No cylinder

Boiler interlock Yes OK

---

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

---

8 Mechanical ventilation
Continuous extract system
Specific fan power: 0.16
Maximum 0.7 OK

---

9 Summertime temperature
Overheating risk (Thames Valley): Slight OK
Based on:
Overshading: Average
Windows facing South East: 12.76 m², No overhang
Windows facing South West: 2.30 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

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	70.0400 (1b)	x	2.5000 (2b)	=	175.1000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	70.0400					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	175.1000	(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		4.0000	
Infiltration rate		0.2000	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1700	(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	0.2168	0.2125	0.2083	0.1870	0.1828	0.1615	0.1615	0.1573	0.1700	0.1828	0.1913	0.1998	(22b)

Mechanical extract ventilation - centralised

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	
Opening Type 2 (Uw = 1.30)			15.0600	1.2357	18.6103			(27)
External Wall 1	51.7000	15.0600	36.6400	0.2200	8.0608			(29a)
Total net area of external elements Aum(A, m2)			51.7000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	26.6711			(33)
Party Wall 1			39.3000	0.0000	0.0000			(32)
Party Floor 1			70.0400					(32d)
Party Ceilings 1			70.0400					(32b)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							7.0818	(36)
Total fabric heat loss					(33) + (36) =		33.7529	(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	28.8915	28.8915	28.8915	28.8915	28.8915	28.8915	28.8915	28.8915	28.8915	28.8915	28.8915	28.8915	(38)
Heat transfer coeff	62.6444	62.6444	62.6444	62.6444	62.6444	62.6444	62.6444	62.6444	62.6444	62.6444	62.6444	62.6444	(39)
Average = Sum(39)m / 12 =												62.6444	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.8944	0.8944	0.8944	0.8944	0.8944	0.8944	0.8944	0.8944	0.8944	0.8944	0.8944	0.8944	(40)
HLP (average)												0.8944	(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	2.2471	(42)
Average daily hot water use (litres/day)	87.5685	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	96.3254	92.8226	89.3199	85.8171	82.3144	78.8117	78.8117	82.3144	85.8171	89.3199	92.8226	96.3254	(44)
Energy conte	142.8477	124.9355	128.9223	112.3976	107.8482	93.0648	86.2382	98.9596	100.1415	116.7052	127.3929	138.3404	(45)
Energy content (annual)										Total = Sum(45)m =		1377.7938	(45)
Distribution loss (46)m = 0.15 x (45)m	21.4272	18.7403	19.3383	16.8596	16.1772	13.9597	12.9357	14.8439	15.0212	17.5058	19.1089	20.7511	(46)
Water storage loss:													
Total storage loss													

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	26.3814	23.7910	26.2804	25.3653	26.1617	25.2613	26.0681	26.1288	25.3179	26.2313	25.4633	26.3619	(61)
Total heat required for water heating calculated for each month													
	169.2292	148.7265	155.2027	137.7628	134.0099	118.3260	112.3063	125.0884	125.4594	142.9365	152.8562	164.7023	(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													
	169.2292	148.7265	155.2027	137.7628	134.0099	118.3260	112.3063	125.0884	125.4594	142.9365	152.8562	164.7023	(64)
								Total per year (kWh/year) = Sum(64)m =				1686.6062	(64)
Heat gains from water heating, kWh/month													
	54.0922	47.4888	49.4368	43.7135	42.3999	37.2593	35.1912	39.4363	39.6265	45.3623	48.7240	52.5887	(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	112.3548	112.3548	112.3548	112.3548	112.3548	112.3548	112.3548	112.3548	112.3548	112.3548	112.3548	112.3548	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	17.6204	15.6503	12.7277	9.6357	7.2028	6.0809	6.5706	8.5407	11.4633	14.5553	16.9882	18.1101	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	197.3904	199.4387	194.2771	183.2886	169.4175	156.3807	147.6713	145.6230	150.7847	161.7732	175.6442	188.6810	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	34.2355	34.2355	34.2355	34.2355	34.2355	34.2355	34.2355	34.2355	34.2355	34.2355	34.2355	34.2355	(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)													
	-89.8838	-89.8838	-89.8838	-89.8838	-89.8838	-89.8838	-89.8838	-89.8838	-89.8838	-89.8838	-89.8838	-89.8838	(71)
Water heating gains (Table 5)													
	72.7046	70.6679	66.4473	60.7132	56.9892	51.7491	47.3000	53.0057	55.0368	60.9709	67.6722	70.6837	(72)
Total internal gains													
	347.4218	345.4633	333.1584	313.3438	293.3159	273.9171	261.2484	266.8759	276.9913	297.0058	320.0110	337.1813	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	12.7600	36.7938	0.5000	0.7000	0.7700	113.8746	(77)
Southwest	2.3000	36.7938	0.5000	0.7000	0.7700	20.5260	(79)

Solar gains	134.4006	228.9340	313.2375	388.1164	434.7227	431.5790	416.0882	381.3178	339.1699	253.0208	160.9810	115.0189	(83)
Total gains	481.8225	574.3973	646.3959	701.4602	728.0386	705.4961	677.3366	648.1937	616.1612	550.0266	480.9920	452.2002	(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	77.6429	77.6429	77.6429	77.6429	77.6429	77.6429	77.6429	77.6429	77.6429	77.6429	77.6429	77.6429	
alpha	6.1762	6.1762	6.1762	6.1762	6.1762	6.1762	6.1762	6.1762	6.1762	6.1762	6.1762	6.1762	
util living area													
	0.9955	0.9865	0.9614	0.8917	0.7496	0.5607	0.4060	0.4429	0.6761	0.9222	0.9884	0.9969	(86)
MIT	20.2033	20.3785	20.5965	20.8136	20.9482	20.9924	20.9991	20.9985	20.9780	20.7971	20.4440	20.1539	(87)
Th 2	20.1723	20.1723	20.1723	20.1723	20.1723	20.1723	20.1723	20.1723	20.1723	20.1723	20.1723	20.1723	(88)
util rest of house													
	0.9941	0.9824	0.9503	0.8635	0.6977	0.4915	0.3301	0.3641	0.6050	0.8949	0.9842	0.9959	(89)
MIT 2	19.4475	19.6204	19.8316	20.0310	20.1402	20.1690	20.1720	20.1718	20.1615	20.0212	19.6864	19.3985	(90)
Living area fraction									fLA = Living area / (4) =			0.3444	(91)
MIT	19.7078	19.8814	20.0950	20.3005	20.4185	20.4526	20.4569	20.4565	20.4427	20.2884	19.9473	19.6586	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.7078	19.8814	20.0950	20.3005	20.4185	20.4526	20.4569	20.4565	20.4427	20.2884	19.9473	19.6586	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9931	0.9807	0.9491	0.8683	0.7138	0.5153	0.3563	0.3913	0.6289	0.8992	0.9828	0.9951	(94)
Useful gains	478.4961	563.3284	613.4762	609.0511	519.6785	363.5123	241.3430	253.6418	387.5196	494.6079	472.7323	450.0057	(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													
	965.2107	938.5031	851.6496	714.1788	546.1633	366.6316	241.6102	254.1179	397.3326	606.9232	804.8090	968.3948	(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													
	362.1156	252.1174	177.2010	75.6919	19.7047	0.0000	0.0000	0.0000	0.0000	83.5626	239.0952	385.6815	(98)
Space heating												1595.1700	(98)
Space heating per m2											(98) / (4) =	22.7751	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	93.2000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	1711.5558	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	362.1156	252.1174	177.2010	75.6919	19.7047	0.0000	0.0000	0.0000	0.0000	83.5626	239.0952	385.6815	(98)
Space heating efficiency (main heating system 1)	93.2000	93.2000	93.2000	93.2000	93.2000	0.0000	0.0000	0.0000	0.0000	93.2000	93.2000	93.2000	(210)
Space heating fuel (main heating system)	388.5361	270.5122	190.1299	81.2145	21.1424	0.0000	0.0000	0.0000	0.0000	89.6594	256.5400	413.8214	(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	169.2292	148.7265	155.2027	137.7628	134.0099	118.3260	112.3063	125.0884	125.4594	142.9365	152.8562	164.7023	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.2557	89.1018	88.8223	88.3068	87.6613	87.3000	87.3000	87.3000	87.3000	88.3479	89.0464	89.3122	(217)
Fuel for water heating, kWh/month	189.6005	166.9175	174.7339	156.0048	152.8724	135.5395	128.6441	143.2857	143.7106	161.7882	171.6590	184.4119	(219)
Water heating fuel used												1909.1681	(219)

Annual totals kWh/year

Space heating fuel - main system	1711.5558	(211)
Space heating fuel - secondary	0.0000	(215)

Electricity for pumps and fans:
(MEVCentralised, Database: in-use factor = 1.3000, SFP = 0.2080)

mechanical ventilation fans (SFP = 0.2080)	44.4334	(230a)
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	119.4334	(231)
Electricity for lighting (calculated in Appendix L)	311.1816	(232)
Total delivered energy for all uses	4051.3389	(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	1711.5558	0.2160	369.6960	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1909.1681	0.2160	412.3803	(264)
Space and water heating			782.0764	(265)
Pumps and fans	119.4334	0.5190	61.9859	(267)
Energy for lighting	311.1816	0.5190	161.5033	(268)
Total CO2, kg/year			1005.5655	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			14.3600	(273)

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

DER		14.3600	ZC1
Total Floor Area	TFA	70.0400	
Assumed number of occupants	N	2.2471	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		16.7004	ZC2
CO2 emissions from cooking, equation (L16)		2.4690	ZC3
Total CO2 emissions		33.5294	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		33.5294	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	70.0400 (1b)	x	2.5000 (2b)	=	175.1000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	70.0400					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	175.1000	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							2 * 10 =	20.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1142	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3642	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3096	(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	0.3947	0.3870	0.3792	0.3405	0.3328	0.2941	0.2941	0.2864	0.3096	0.3328	0.3483	0.3638	(22b)
Effective ac	0.5779	0.5749	0.5719	0.5580	0.5554	0.5432	0.5432	0.5410	0.5479	0.5554	0.5607	0.5662	(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 Opening Type (Uw = 1.40)			15.0600	1.3258	19.9659			(27)
External Wall 1	51.7000	15.0600	36.6400	0.1800	6.5952			(29a)
Total net area of external elements Aum(A, m2)			51.7000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	26.5611			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							5.3167	(36)
Total fabric heat loss						(33) + (36) =	31.8778	(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	33.3930	33.2182	33.0469	32.2421	32.0915	31.3906	31.3906	31.2608	31.6606	32.0915	32.3961	32.7146	(38)
Heat transfer coeff	65.2708	65.0960	64.9247	64.1199	63.9693	63.2684	63.2684	63.1386	63.5384	63.9693	64.2739	64.5924	(39)
Average = Sum(39)m / 12 =												64.1192	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9319	0.9294	0.9270	0.9155	0.9133	0.9033	0.9033	0.9015	0.9072	0.9133	0.9177	0.9222	(40)
HLP (average)												0.9155	(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	2.2471	(42)
Average daily hot water use (litres/day)	87.5685	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	96.3254	92.8226	89.3199	85.8171	82.3144	78.8117	78.8117	82.3144	85.8171	89.3199	92.8226	96.3254	(44)
Energy conte	142.8477	124.9355	128.9223	112.3976	107.8482	93.0648	86.2382	98.9596	100.1415	116.7052	127.3929	138.3404	(45)
Energy content (annual)										Total = Sum(45)m =		1377.7938	(45)
Distribution loss (46)m = 0.15 x (45)m	21.4272	18.7403	19.3383	16.8596	16.1772	13.9597	12.9357	14.8439	15.0212	17.5058	19.1089	20.7511	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	49.0864	42.7238	45.5164	42.3208	41.9465	38.8660	40.1616	41.9465	42.3208	45.5164	45.7755	49.0864	(61)
Total heat required for water heating calculated for each month	191.9341	167.6594	174.4387	154.7184	149.7947	131.9308	126.3997	140.9061	142.4622	162.2217	173.1684	187.4268	(62)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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													
	191.9341	167.6594	174.4387	154.7184	149.7947	131.9308	126.3997	140.9061	142.4622	162.2217	173.1684	187.4268	(64)
									Total per year (kWh/year) = Sum(64)m =			1903.0610	(64)
Heat gains from water heating, kWh/month													
	59.7685	52.2220	54.2458	47.9524	46.3461	40.6605	38.7146	43.3907	43.8772	50.1836	53.8020	58.2698	(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	112.3548	112.3548	112.3548	112.3548	112.3548	112.3548	112.3548	112.3548	112.3548	112.3548	112.3548	112.3548	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	17.6204	15.6503	12.7277	9.6357	7.2028	6.0809	6.5706	8.5407	11.4633	14.5553	16.9882	18.1101	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	197.3904	199.4387	194.2771	183.2886	169.4175	156.3807	147.6713	145.6230	150.7847	161.7732	175.6442	188.6810	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	34.2355	34.2355	34.2355	34.2355	34.2355	34.2355	34.2355	34.2355	34.2355	34.2355	34.2355	34.2355	(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)													
	-89.8838	-89.8838	-89.8838	-89.8838	-89.8838	-89.8838	-89.8838	-89.8838	-89.8838	-89.8838	-89.8838	-89.8838	(71)
Water heating gains (Table 5)													
	80.3340	77.7114	72.9110	66.6005	62.2932	56.4730	52.0357	58.3208	60.9406	67.4511	74.7250	78.3196	(72)
Total internal gains													
	355.0512	352.5068	339.6221	319.2312	298.6199	278.6410	265.9841	272.1910	282.8950	303.4860	327.0639	344.8172	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	12.7600	36.7938	0.6300	0.7000	0.7700	143.4820	(77)
Southwest	2.3000	36.7938	0.6300	0.7000	0.7700	25.8627	(79)

Solar gains	169.3448	288.4568	394.6792	489.0267	547.7506	543.7896	524.2712	480.4605	427.3541	318.8062	202.8360	144.9238	(83)
Total gains	524.3960	640.9636	734.3013	808.2578	846.3705	822.4306	790.2553	752.6515	710.2491	622.2923	529.8999	489.7410	(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	74.5186	74.7187	74.9159	75.8561	76.0347	76.8771	76.8771	77.0351	76.5504	76.0347	75.6744	75.3013	
alpha	5.9679	5.9812	5.9944	6.0571	6.0690	6.1251	6.1251	6.1357	6.1034	6.0690	6.0450	6.0201	
util living area													
	0.9934	0.9788	0.9398	0.8401	0.6761	0.4891	0.3519	0.3852	0.6044	0.8855	0.9822	0.9954	(86)
MIT	20.2053	20.4123	20.6487	20.8644	20.9682	20.9962	20.9996	20.9993	20.9872	20.8399	20.4779	20.1639	(87)
Th 2	20.1405	20.1426	20.1446	20.1544	20.1562	20.1647	20.1647	20.1663	20.1614	20.1562	20.1525	20.1487	(88)
util rest of house													
	0.9913	0.9728	0.9240	0.8054	0.6232	0.4267	0.2853	0.3158	0.5362	0.8508	0.9761	0.9940	(89)
MIT 2	19.0891	19.3881	19.7201	20.0094	20.1285	20.1624	20.1645	20.1660	20.1526	19.9882	19.4928	19.0353	(90)
Living area fraction									fLA = Living area / (4) =			0.3444	(91)
MIT	19.4735	19.7408	20.0399	20.3038	20.4177	20.4495	20.4521	20.4529	20.4400	20.2815	19.8321	19.4240	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.4735	19.7408	20.0399	20.3038	20.4177	20.4495	20.4521	20.4529	20.4400	20.2815	19.8321	19.4240	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9893	0.9693	0.9218	0.8119	0.6400	0.4481	0.3082	0.3397	0.5593	0.8565	0.9733	0.9924	(94)
Useful gains	518.7800	621.3017	676.8660	656.2516	541.7064	368.5561	243.5908	255.6714	397.2633	532.9760	515.7351	486.0139	(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													
	990.3876	966.0788	879.0735	731.2120	557.6658	370.0907	243.7160	255.8969	402.8364	619.3184	818.3396	983.3544	(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													
	350.8760	231.6902	150.4424	53.9715	11.8738	0.0000	0.0000	0.0000	0.0000	64.2387	217.8753	370.0213	(98)
Space heating												1450.9893	(98)
Space heating per m2											(98) / (4) =	20.7166	(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 %)	93.4000	(206)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Efficiency of secondary/supplementary heating system, %													0.0000	(208)
Space heating requirement													1553.5217	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Space heating requirement	350.8760	231.6902	150.4424	53.9715	11.8738	0.0000	0.0000	0.0000	0.0000	64.2387	217.8753	370.0213		(98)
Space heating efficiency (main heating system 1)	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000		(210)
Space heating fuel (main heating system)	375.6703	248.0623	161.0733	57.7853	12.7129	0.0000	0.0000	0.0000	0.0000	68.7781	233.2712	396.1684		(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	191.9341	167.6594	174.4387	154.7184	149.7947	131.9308	126.3997	140.9061	142.4622	162.2217	173.1684	187.4268		(64)
Efficiency of water heater												80.3000		(216)
(217)m	86.5507	85.8658	84.6811	82.6893	80.9644	80.3000	80.3000	80.3000	80.3000	82.9282	85.6304	86.7321		(217)
Fuel for water heating, kWh/month	221.7591	195.2575	205.9948	187.1082	185.0131	164.2974	157.4094	175.4746	177.4125	195.6170	202.2276	216.0984		(219)
Water heating fuel used												2283.6695		(219)
Annual totals kWh/year														
Space heating fuel - main system												1553.5217		(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)												311.1816		(232)
Total delivered energy for all uses												4223.3729		(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	1553.5217	0.2160	335.5607	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2283.6695	0.2160	493.2726	(264)
Space and water heating			828.8333	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	311.1816	0.5190	161.5033	(268)
Total CO2, kg/m2/year			1029.2616	(272)
Emissions per m2 for space and water heating			11.8337	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.3059	(272b)
Emissions per m2 for pumps and fans			0.5558	(272c)
Target Carbon Dioxide Emission Rate (TER) = (11.8337 * 1.00) + 2.3059 + 0.5558, rounded to 2 d.p.			14.7000	(273)

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

Design SAP
elmhurst energy

Property Reference	Plot 73	**Issued on Date**	13/02/2020
Assessment Reference	001	**Prop Type Ref**	GF
Property	Epping College Site B, Plot 73		

SAP Rating	83 B	**DER**	18.77	**TER**	17.82
Environmental	85 B	**% DER<TER**	-5.31		
CO_2 Emissions (t/year)	1.52	**DFEE**	53.42	**TFEE**	53.85
General Requirements Compliance	Fail	**% DFEE<TFEE**	0.79		

Assessor Details	Miss Georgia Dimitriou, Georgia Dimitriou, Tel: 07599467602, erieta.dimitriou@lowenergyconsultancy.co.uk	**Assessor ID**	P864-0001
Client			

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

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

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DWELLING AS DESIGNED

Ground-floor flat, total floor area 98 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) 17.82 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 18.77 kgCO□/m²Fail
Excess emissions =0.95 kgCO□/m² (5.3%)

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)53.8 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)53.4 kWh/m²/yrOK

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2 Fabric U-values

Element	Average	Highest	
External wall	0.22 (max. 0.30)	0.22 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.20 (max. 0.25)	0.20 (max. 0.70)	OK
Roof	(no roof)		
Openings	1.33 (max. 2.00)	1.50 (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: 4.00 (design value)
Maximum 10.0 OK

---

4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Vaillant ecoFIT sustain 835 VUW 356/6-3 (H-GB)
Combi boiler
Efficiency: 89.3% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

---

5 Cylinder insulation
Hot water storage No cylinder

---

6 Controls
Space heating controls: Programmer, room thermostat and TRVs OK

Hot water controls: No cylinder

Boiler interlock Yes OK

---

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

---

8 Mechanical ventilation
Continuous extract system
Specific fan power: 0.17
Maximum 0.7 OK

---

9 Summertime temperature
Overheating risk (Thames Valley): Not significant OK
Based on:
Overshading: Average
Windows facing North: 9.45 m², No overhang
Windows facing South: 5.60 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

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	28.2300 (1b)	x	2.5000 (2b)	=	70.5750	(1b) - (3b)
First floor	70.2000 (1c)	x	2.8000 (2c)	=	196.5600	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	98.4300					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	267.1350	(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		4.0000	
Infiltration rate		0.2000	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1850	(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	0.2359	0.2313	0.2266	0.2035	0.1989	0.1758	0.1758	0.1711	0.1850	0.1989	0.2081	0.2174	(22b)
Mechanical extract ventilation - centralised													
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	
Opening Type 1			2.3000	1.5000	3.4500			(26)
Opening Type 2 (Uw = 1.30)			15.0500	1.2357	18.5979			(27)
Heat Loss Floor 1			41.9700	0.2000	8.3940			(28b)
External Wall 1	118.5700	17.3500	101.2200	0.2200	22.2684			(29a)
Total net area of external elements Aum(A, m2)			160.5400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		52.7103			(33)
Party Wall 1			37.2300	0.0000	0.0000			(32)
Party Floor 1			28.2300					(32d)
Party Ceilings 1			70.2000					(32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	17.9342	(36)
Total fabric heat loss (33) + (36) =	70.6445	(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	44.0773	44.0773	44.0773	44.0773	44.0773	44.0773	44.0773	44.0773	44.0773	44.0773	44.0773	44.0773	(38)
Heat transfer coeff	114.7218	114.7218	114.7218	114.7218	114.7218	114.7218	114.7218	114.7218	114.7218	114.7218	114.7218	114.7218	(39)
Average = Sum(39)m / 12 =												114.7218	(39)
HLP	1.1655	1.1655	1.1655	1.1655	1.1655	1.1655	1.1655	1.1655	1.1655	1.1655	1.1655	1.1655	(40)
HLP (average)												1.1655	(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	2.7245	(42)
Average daily hot water use (litres/day)	98.9071	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.7978	104.8415	100.8852	96.9289	92.9727	89.0164	89.0164	92.9727	96.9289	100.8852	104.8415	108.7978	(44)
Energy conte	161.3440	141.1125	145.6154	126.9511	121.8126	105.1150	97.4045	111.7731	113.1080	131.8165	143.8880	156.2530	(45)
Energy content (annual)										Total = Sum(45)m =		1556.1936	(45)

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

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

	24.2016	21.1669	21.8423	19.0427	18.2719	15.7672	14.6107	16.7660	16.9662	19.7725	21.5832	23.4380	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	26.4883	23.9041	26.4175	25.4849	26.2719	25.3523	26.1524	26.2299	25.4246	26.3554	25.5787	26.4654	(61)
Total heat required for water heating calculated for each month	187.8323	165.0166	172.0329	152.4360	148.0844	130.4673	123.5569	138.0029	138.5326	158.1719	169.4667	182.7184	(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	187.8323	165.0166	172.0329	152.4360	148.0844	130.4673	123.5569	138.0029	138.5326	158.1719	169.4667	182.7184	(64)
								Total per year (kWh/year) = Sum(64)m =				1866.3189	(64)
Heat gains from water heating, kWh/month	60.2689	52.8959	55.0215	48.5825	47.0706	41.2888	38.9251	43.7220	43.9645	50.4178	54.2374	58.5705	(65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	136.2254	136.2254	136.2254	136.2254	136.2254	136.2254	136.2254	136.2254	136.2254	136.2254	136.2254	136.2254	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	23.8199	21.1566	17.2057	13.0258	9.7370	8.2204	8.8824	11.5457	15.4966	19.6764	22.9653	24.4819	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	253.7644	256.3976	249.7619	235.6351	217.8025	201.0425	189.8457	187.2124	193.8482	207.9750	225.8075	242.5676	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.6225	36.6225	36.6225	36.6225	36.6225	36.6225	36.6225	36.6225	36.6225	36.6225	36.6225	36.6225	(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)	-108.9804	-108.9804	-108.9804	-108.9804	-108.9804	-108.9804	-108.9804	-108.9804	-108.9804	-108.9804	-108.9804	-108.9804	(71)
Water heating gains (Table 5)	81.0066	78.7142	73.9536	67.4756	63.2670	57.3456	52.3187	58.7661	61.0619	67.7659	75.3298	78.7238	(72)
Total internal gains	425.4585	423.1361	407.7889	383.0042	357.6741	333.4760	317.9144	324.3919	337.2743	362.2850	390.9702	412.6409	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	9.4500	10.6334	0.5000	0.7000	0.7700	24.3728	(74)
South	5.6000	46.7521	0.5000	0.7000	0.7700	63.5024	(78)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	87.8752	150.5782	211.6250	276.8592	327.2828	333.4892	317.8764	278.2745	233.5492	167.6189	105.3389	75.1903	(83)
Total gains	513.3337	573.7142	619.4139	659.8634	684.9569	666.9652	635.7908	602.6664	570.8235	529.9039	496.3092	487.8312	(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	59.5826	59.5826	59.5826	59.5826	59.5826	59.5826	59.5826	59.5826	59.5826	59.5826	59.5826	59.5826	
alpha	4.9722	4.9722	4.9722	4.9722	4.9722	4.9722	4.9722	4.9722	4.9722	4.9722	4.9722	4.9722	
util living area	0.9990	0.9979	0.9954	0.9868	0.9575	0.8699	0.7245	0.7729	0.9360	0.9901	0.9979	0.9992	(86)
MIT	19.6651	19.7874	20.0039	20.2988	20.6089	20.8534	20.9580	20.9411	20.7552	20.3640	19.9540	19.6300	(87)
Th 2	19.9477	19.9477	19.9477	19.9477	19.9477	19.9477	19.9477	19.9477	19.9477	19.9477	19.9477	19.9477	(88)
util rest of house	0.9986	0.9972	0.9936	0.9809	0.9352	0.7960	0.5835	0.6409	0.8920	0.9846	0.9970	0.9989	(89)
MIT 2	18.7274	18.8495	19.0654	19.3577	19.6569	19.8691	19.9353	19.9279	19.7939	19.4238	19.0161	18.6924	(90)
Living area fraction									fLA = Living area / (4) =			0.1774	(91)
MIT	18.8937	19.0159	19.2319	19.5246	19.8258	20.0437	20.1167	20.1077	19.9644	19.5905	19.1825	18.8587	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8937	19.0159	19.2319	19.5246	19.8258	20.0437	20.1167	20.1077	19.9644	19.5905	19.1825	18.8587	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9981	0.9963	0.9919	0.9777	0.9319	0.8040	0.6087	0.6638	0.8929	0.9819	0.9961	0.9985	(94)
Useful gains	512.3361	571.5818	614.3728	645.1716	638.3090	536.2657	386.9918	400.0635	509.7095	520.3291	494.3756	487.0944	(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	1674.2210	1619.4006	1460.6229	1218.8748	932.2031	624.5095	403.4408	425.3487	672.7745	1031.4118	1386.1272	1681.6777	(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	864.4424	704.1342	629.6101	413.0663	218.6572	0.0000	0.0000	0.0000	0.0000	380.2456	642.0611	888.7700	(98)
Space heating												4740.9869	(98)
Space heating per m2											(98) / (4) =	48.1661	(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 %)	93.2000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	5086.8958	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	864.4424	704.1342	629.6101	413.0663	218.6572	0.0000	0.0000	0.0000	0.0000	380.2456	642.0611	888.7700	(98)
Space heating efficiency (main heating system 1)	93.2000	93.2000	93.2000	93.2000	93.2000	0.0000	0.0000	0.0000	0.0000	93.2000	93.2000	93.2000	(210)
Space heating fuel (main heating system)	927.5133	755.5088	675.5473	443.2042	234.6107	0.0000	0.0000	0.0000	0.0000	407.9888	688.9068	953.6158	(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	187.8323	165.0166	172.0329	152.4360	148.0844	130.4673	123.5569	138.0029	138.5326	158.1719	169.4667	182.7184	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.6683	89.6347	89.5615	89.3995	89.0061	87.3000	87.3000	87.3000	87.3000	89.3283	89.5786	89.6919	(217)
Fuel for water heating, kWh/month	209.4745	184.0991	192.0835	170.5111	166.3755	149.4470	141.5314	158.0790	158.6856	177.0681	189.1821	203.7178	(219)

Water heating fuel used	2100.2548	(219)
Annual totals kWh/year		
Space heating fuel - main system	5086.8958	(211)
Space heating fuel - secondary	0.0000	(215)

Electricity for pumps and fans:
(MEVCentralised, Database: in-use factor = 1.3000, SFP = 0.2210)

mechanical ventilation fans (SFP = 0.2210)	72.0249	(230a)
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	147.0249	(231)
Electricity for lighting (calculated in Appendix L)	420.6667	(232)
Total delivered energy for all uses	7754.8422	(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	5086.8958	0.2160	1098.7695	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2100.2548	0.2160	453.6550	(264)
Space and water heating			1552.4245	(265)
Pumps and fans	147.0249	0.5190	76.3059	(267)
Energy for lighting	420.6667	0.5190	218.3260	(268)
Total CO2, kg/year			1847.0565	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			18.7700	(273)

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

DER		18.7700	ZC1
Total Floor Area	TFA	98.4300	
Assumed number of occupants	N	2.7245	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		15.2774	ZC2
CO2 emissions from cooking, equation (L16)		1.8733	ZC3
Total CO2 emissions		35.9207	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		35.9207	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	28.2300 (1b)	x	2.5000 (2b)	=	70.5750	(1b) - (3b)
First floor	70.2000 (1c)	x	2.8000 (2c)	=	196.5600	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	98.4300					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	267.1350	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1123	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3623	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3351	(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	0.4273	0.4189	0.4105	0.3686	0.3603	0.3184	0.3184	0.3100	0.3351	0.3603	0.3770	0.3938	(22b)
Effective ac	0.5913	0.5877	0.5843	0.5679	0.5649	0.5507	0.5507	0.5480	0.5562	0.5649	0.5711	0.5775	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.3000	1.0000	2.3000			(26)
TER Opening Type (Uw = 1.40)			15.0500	1.3258	19.9527			(27)
Heat Loss Floor 1			41.9700	0.1300	5.4561			(28b)
External Wall 1	118.5700	17.3500	101.2200	0.1800	18.2196			(29a)
Total net area of external elements Aum(A, m2)			160.5400					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	45.9284			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							14.7471	(36)
Total fabric heat loss					(33) + (36) =		60.6755	(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	52.1248	51.8123	51.5060	50.0673	49.7981	48.5450	48.5450	48.3130	49.0277	49.7981	50.3426	50.9119	(38)
Heat transfer coeff	112.8002	112.4877	112.1814	110.7427	110.4735	109.2205	109.2205	108.9884	109.7031	110.4735	111.0181	111.5874	(39)
Average = Sum(39)m / 12 =												110.7414	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1460	1.1428	1.1397	1.1251	1.1224	1.1096	1.1096	1.1073	1.1145	1.1224	1.1279	1.1337	(40)
HLP (average)												1.1251	(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	2.7245	(42)
Average daily hot water use (litres/day)	98.9071	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.7978	104.8415	100.8852	96.9289	92.9727	89.0164	89.0164	92.9727	96.9289	100.8852	104.8415	108.7978	(44)
Energy conte	161.3440	141.1125	145.6154	126.9511	121.8126	105.1150	97.4045	111.7731	113.1080	131.8165	143.8880	156.2530	(45)
Energy content (annual)										Total = Sum(45)m =		1556.1936	(45)
Distribution loss (46)m = 0.15 x (45)m	24.2016	21.1669	21.8423	19.0427	18.2719	15.7672	14.6107	16.7660	16.9662	19.7725	21.5832	23.4380	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Combi loss	50.9589	46.0274	50.9589	47.8006	47.3778	43.8985	45.3618	47.3778	47.8006	50.9589	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month													
	212.3029	187.1399	196.5743	174.7516	169.1904	149.0135	142.7663	159.1509	160.9086	182.7754	193.2031	207.2119	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
Solar input (sum of months) = Sum(63)m =												0.0000	(63)
Output from w/h													
	212.3029	187.1399	196.5743	174.7516	169.1904	149.0135	142.7663	159.1509	160.9086	182.7754	193.2031	207.2119	(64)
Total per year (kWh/year) = Sum(64)m =												2134.9888	(64)
Heat gains from water heating, kWh/month													
	66.3866	58.4267	61.1569	54.1614	52.3471	45.9254	43.7274	49.0090	49.5586	56.5687	60.1715	64.6939	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	136.2254	136.2254	136.2254	136.2254	136.2254	136.2254	136.2254	136.2254	136.2254	136.2254	136.2254	136.2254	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	23.8199	21.1566	17.2057	13.0258	9.7370	8.2204	8.8824	11.5457	15.4966	19.6764	22.9653	24.4819	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	253.7644	256.3976	249.7619	235.6351	217.8025	201.0425	189.8457	187.2124	193.8482	207.9750	225.8075	242.5676	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.6225	36.6225	36.6225	36.6225	36.6225	36.6225	36.6225	36.6225	36.6225	36.6225	36.6225	36.6225	(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)													
	-108.9804	-108.9804	-108.9804	-108.9804	-108.9804	-108.9804	-108.9804	-108.9804	-108.9804	-108.9804	-108.9804	-108.9804	(71)
Water heating gains (Table 5)													
	89.2293	86.9446	82.2001	75.2241	70.3591	63.7852	58.7734	65.8723	68.8313	76.0332	83.5716	86.9541	(72)
Total internal gains													
	433.6812	431.3665	416.0353	390.7527	364.7662	339.9157	324.3692	331.4980	345.0437	370.5523	399.2120	420.8713	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	9.4500	10.6334	0.6300	0.7000	0.7700	30.7097	(74)
South	5.6000	46.7521	0.6300	0.7000	0.7700	80.0130	(78)

Solar gains	110.7227	189.7285	266.6475	348.8426	412.3763	420.1963	400.5243	350.6259	294.2720	211.1998	132.7271	94.7397	(83)
Total gains	544.4039	621.0950	682.6828	739.5952	777.1425	760.1120	724.8935	682.1240	639.3158	581.7521	531.9391	515.6110	(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	60.5975	60.7659	60.9318	61.7234	61.8738	62.5837	62.5837	62.7169	62.3083	61.8738	61.5703	61.2562	
alpha	5.0398	5.0511	5.0621	5.1149	5.1249	5.1722	5.1722	5.1811	5.1539	5.1249	5.1047	5.0837	
util living area													
	0.9986	0.9970	0.9928	0.9780	0.9289	0.8009	0.6340	0.6885	0.8993	0.9847	0.9971	0.9990	(86)
MIT	19.7204	19.8614	20.0930	20.4089	20.7070	20.9133	20.9798	20.9695	20.8252	20.4475	20.0298	19.6989	(87)
Th 2	19.9634	19.9660	19.9685	19.9804	19.9826	19.9930	19.9930	19.9949	19.9890	19.9826	19.9781	19.9734	(88)
util rest of house													
	0.9982	0.9960	0.9901	0.9688	0.8968	0.7161	0.5033	0.5601	0.8419	0.9766	0.9960	0.9986	(89)
MIT 2	18.2525	18.4602	18.7995	19.2636	19.6763	19.9300	19.9849	19.9812	19.8373	19.3247	18.7154	18.2281	(90)
Living area fraction									fLA = Living area / (4) =			0.1774	(91)
MIT	18.5129	18.7087	19.0289	19.4668	19.8592	20.1044	20.1614	20.1565	20.0126	19.5239	18.9486	18.4890	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.5129	18.7087	19.0289	19.4668	19.8592	20.1044	20.1614	20.1565	20.0126	19.5239	18.9486	18.4890	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9971	0.9941	0.9865	0.9625	0.8920	0.7267	0.5264	0.5824	0.8435	0.9714	0.9941	0.9978	(94)
Useful gains	542.8467	617.4451	673.4921	711.8822	693.2079	552.3474	381.6161	397.2735	539.2589	565.1202	528.8101	514.4874	(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													
	1603.2147	1553.3137	1405.5100	1170.1946	901.3708	601.1972	388.9779	409.4147	648.6254	985.8546	1315.4060	1594.4699	(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													
	788.9138	628.9037	544.6213	329.9849	154.8733	0.0000	0.0000	0.0000	0.0000	313.0264	566.3490	803.5069	(98)
Space heating												4130.1794	(98)
Space heating per m2											(98) / (4) =	41.9606	(99)

8c. Space cooling requirement

Not applicable

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

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	93.4000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	4422.0336	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	788.9138	628.9037	544.6213	329.9849	154.8733	0.0000	0.0000	0.0000	0.0000	313.0264	566.3490	803.5069	(98)
Space heating efficiency (main heating system 1)	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)	844.6615	673.3444	583.1063	353.3029	165.8172	0.0000	0.0000	0.0000	0.0000	335.1461	606.3694	860.2858	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)

Water heating													
Water heating requirement	212.3029	187.1399	196.5743	174.7516	169.1904	149.0135	142.7663	159.1509	160.9086	182.7754	193.2031	207.2119	(64)
Efficiency of water heater												80.3000	(216)
(217)m	88.0516	87.8656	87.4818	86.6276	84.8295	80.3000	80.3000	80.3000	80.3000	86.3941	87.5974	88.1275	(217)
Fuel for water heating, kWh/month	241.1119	212.9843	224.7032	201.7275	199.4477	185.5710	177.7911	198.1954	200.3843	211.5600	220.5579	235.1274	(219)
Water heating fuel used												2509.1616	(219)

Annual totals kWh/year		
Space heating fuel - main system	4422.0336	(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)	420.6667	(232)
Total delivered energy for all uses	7426.8619	(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	4422.0336	0.2160	955.1593	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2509.1616	0.2160	541.9789	(264)
Space and water heating			1497.1382	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	420.6667	0.5190	218.3260	(268)
Total CO2, kg/m2/year			1754.3892	(272)
Emissions per m2 for space and water heating			15.2102	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.2181	(272b)
Emissions per m2 for pumps and fans			0.3955	(272c)
Target Carbon Dioxide Emission Rate (TER) = (15.2102 * 1.00) + 2.2181 + 0.3955, rounded to 2 d.p.			17.8200	(273)

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

Design SAP
elmhurst energy

Property Reference	Plot 96	**Issued on Date**	13/02/2020
Assessment Reference	001	**Prop Type Ref**	GF
Property	Epping College Site B, Plot 96		

SAP Rating	83 B	**DER**	19.31	**TER**	18.65
Environmental	89 B	**% DER<TER**	-3.56		
CO_2 Emissions (t/year)	0.65	**DFEE**	38.61	**TFEE**	35.18
General Requirements Compliance	Fail	**% DFEE<TFEE**	-9.74		

Assessor Details	Miss Georgia Dimitriou, Georgia Dimitriou, Tel: 07599467602, erieta.dimitriou@lowenergyconsultancy.co.uk	**Assessor ID**	P864-0001
Client			

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

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

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DWELLING AS DESIGNED

Ground-floor flat, total floor area 39 m²

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

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 18.65 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 19.31 kgCO□/m²Fail
Excess emissions =0.66 kgCO□/m² (3.5%)

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)35.2 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)38.6 kWh/m²/yrFail
Excess energy =3.4 kWh/m²/yr (9.7%)

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2 Fabric U-values

Element	Average	Highest	
External wall	0.22 (max. 0.30)	0.22 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.20 (max. 0.25)	0.20 (max. 0.70)	OK
Roof	(no roof)		
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

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

---

3 Air permeability
Air permeability at 50 pascals: 4.00 (design value)
Maximum 10.0 OK

---

4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Vaillant ecoFIT sustain 835 VUW 356/6-3 (H-GB)
Combi boiler
Efficiency: 89.3% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

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5 Cylinder insulation
Hot water storage No cylinder

---

6 Controls
Space heating controls: Programmer, room thermostat and TRVs OK

Hot water controls: No cylinder

Boiler interlock Yes OK

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

---

8 Mechanical ventilation
Continuous extract system
Specific fan power: 0.17
Maximum 0.7 OK

---

9 Summertime temperature
Overheating risk (Thames Valley): Medium OK
Based on:
Overshading: Average
Windows facing South East: 7.90 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

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	39.2800 (1b)	x	2.5000 (2b)	=	98.2000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	39.2800					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	98.2000	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							0 * 10 =		0.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Measured/design AP50		4.0000	
Infiltration rate		0.2000	(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) =	0.1550	(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	0.1976	0.1938	0.1899	0.1705	0.1666	0.1473	0.1473	0.1434	0.1550	0.1666	0.1744	0.1821	(22b)

Mechanical extract ventilation - centralised

If mechanical ventilation:	0.5000	(23a)
Effective ac	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	
Opening Type 2 (Uw = 1.30)			7.9000	1.2357	9.7624			(27)
Heat Loss Floor 1			39.2800	0.2000	7.8560			(28a)
External Wall 1	14.9300	7.9000	7.0300	0.2200	1.5466			(29a)
Total net area of external elements Aum(A, m2)			54.2100					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		19.1650			(33)
Party Wall 1			47.8300	0.0000	0.0000			(32)
Party Ceilings 1			39.2800					(32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	6.3393	(36)
Total fabric heat loss (33) + (36) =	25.5043	(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	16.2030	16.2030	16.2030	16.2030	16.2030	16.2030	16.2030	16.2030	16.2030	16.2030	16.2030	16.2030	(38)
Heat transfer coeff	41.7073	41.7073	41.7073	41.7073	41.7073	41.7073	41.7073	41.7073	41.7073	41.7073	41.7073	41.7073	(39)
Average = Sum(39)m / 12 =												41.7073	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0618	1.0618	1.0618	1.0618	1.0618	1.0618	1.0618	1.0618	1.0618	1.0618	1.0618	1.0618	(40)
HLP (average)												1.0618	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.3873	(42)
Average daily hot water use (litres/day)	67.1492	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	73.8641	71.1781	68.4922	65.8062	63.1202	60.4343	60.4343	63.1202	65.8062	68.4922	71.1781	73.8641	(44)
Energy conte	109.5383	95.8029	98.8600	86.1886	82.7000	71.3638	66.1290	75.8840	76.7903	89.4917	97.6872	106.0820	(45)
Energy content (annual)										Total = Sum(45)m =		1056.5179	(45)
Distribution loss (46)m = 0.15 x (45)m	16.4307	14.3704	14.8290	12.9283	12.4050	10.7046	9.9194	11.3826	11.5185	13.4238	14.6531	15.9123	(46)
Water storage loss:													
Total storage loss													

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	26.1263	23.5760	26.0669	25.1864	25.9971	25.1253	25.9421	25.9778	25.1586	26.0381	25.2441	26.1148	(61)
Total heat required for water heating calculated for each month													
	135.6646	119.3789	124.9270	111.3750	108.6971	96.4891	92.0711	101.8618	101.9489	115.5298	122.9313	132.1968	(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													
	135.6646	119.3789	124.9270	111.3750	108.6971	96.4891	92.0711	101.8618	101.9489	115.5298	122.9313	132.1968	(64)
								Total per year (kWh/year) = Sum(64)m =				1363.0714	(64)
Heat gains from water heating, kWh/month													
	42.9531	37.7485	39.3877	34.9543	33.9970	30.0098	28.4734	31.7259	31.8224	36.2655	38.7920	41.8010	(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	69.3667	69.3667	69.3667	69.3667	69.3667	69.3667	69.3667	69.3667	69.3667	69.3667	69.3667	69.3667	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	10.7428	9.5416	7.7598	5.8747	4.3914	3.7074	4.0060	5.2071	6.9890	8.8741	10.3574	11.0414	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	119.7270	120.9693	117.8386	111.1735	102.7600	94.8526	89.5699	88.3275	91.4583	98.1234	106.5368	114.4443	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	29.9367	29.9367	29.9367	29.9367	29.9367	29.9367	29.9367	29.9367	29.9367	29.9367	29.9367	29.9367	(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)													
	-55.4933	-55.4933	-55.4933	-55.4933	-55.4933	-55.4933	-55.4933	-55.4933	-55.4933	-55.4933	-55.4933	-55.4933	(71)
Water heating gains (Table 5)													
	57.7326	56.1733	52.9404	48.5476	45.6949	41.6802	38.2707	42.6423	44.1978	48.7440	53.8778	56.1841	(72)
Total internal gains													
	235.0124	233.4943	225.3488	212.4058	199.6563	187.0502	178.6566	182.9869	189.4551	202.5514	217.5820	228.4797	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	7.9000	36.7938	0.5000	0.7000	0.7700	70.5023	(77)

Solar gains	70.5023	120.0915	164.3145	203.5936	228.0418	226.3927	218.2667	200.0273	177.9178	132.7267	84.4455	60.3353	(83)
Total gains	305.5147	353.5858	389.6633	415.9994	427.6981	413.4429	396.9233	383.0142	367.3729	335.2781	302.0275	288.8150	(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	65.4030	65.4030	65.4030	65.4030	65.4030	65.4030	65.4030	65.4030	65.4030	65.4030	65.4030	65.4030	
alpha	5.3602	5.3602	5.3602	5.3602	5.3602	5.3602	5.3602	5.3602	5.3602	5.3602	5.3602	5.3602	
util living area													
	0.9932	0.9845	0.9641	0.9118	0.7989	0.6223	0.4583	0.4947	0.7252	0.9291	0.9852	0.9949	(86)
MIT	20.0448	20.2142	20.4433	20.6954	20.8877	20.9765	20.9961	20.9942	20.9481	20.7030	20.3143	19.9956	(87)
Th 2	20.0322	20.0322	20.0322	20.0322	20.0322	20.0322	20.0322	20.0322	20.0322	20.0322	20.0322	20.0322	(88)
util rest of house													
	0.9911	0.9798	0.9531	0.8852	0.7442	0.5379	0.3597	0.3939	0.6447	0.9017	0.9798	0.9933	(89)
MIT 2	19.1735	19.3404	19.5631	19.7987	19.9612	20.0220	20.0312	20.0306	20.0065	19.8109	19.4406	19.1247	(90)
Living area fraction									fLA = Living area / (4) =			0.4908	(91)
MIT	19.6012	19.7693	19.9952	20.2389	20.4160	20.4905	20.5048	20.5036	20.4687	20.2487	19.8695	19.5522	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.6012	19.7693	19.9952	20.2389	20.4160	20.4905	20.5048	20.5036	20.4687	20.2487	19.8695	19.5522	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9899	0.9782	0.9526	0.8915	0.7672	0.5789	0.4083	0.4435	0.6827	0.9087	0.9787	0.9923	(94)
Useful gains	302.4146	345.8903	371.1780	370.8449	328.1100	239.3227	162.0468	169.8796	250.8019	304.6625	295.6014	286.5787	(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													
	638.1700	620.1574	562.8461	472.9124	363.5188	245.6779	162.8598	171.1490	265.6194	402.4228	532.5801	640.2967	(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													
	249.8020	184.3075	142.6010	73.4886	26.3441	0.0000	0.0000	0.0000	0.0000	72.7337	170.6247	263.1662	(98)
Space heating												1183.0679	(98)
Space heating per m2											(98) / (4) =	30.1188	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	93.2000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	1269.3861	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	249.8020	184.3075	142.6010	73.4886	26.3441	0.0000	0.0000	0.0000	0.0000	72.7337	170.6247	263.1662	(98)
Space heating efficiency (main heating system 1)	93.2000	93.2000	93.2000	93.2000	93.2000	0.0000	0.0000	0.0000	0.0000	93.2000	93.2000	93.2000	(210)
Space heating fuel (main heating system)	268.0279	197.7549	153.0054	78.8504	28.2663	0.0000	0.0000	0.0000	0.0000	78.0404	183.0737	282.3672	(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	135.6646	119.3789	124.9270	111.3750	108.6971	96.4891	92.0711	101.8618	101.9489	115.5298	122.9313	132.1968	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.1576	89.0373	88.8222	88.4302	87.8510	87.3000	87.3000	87.3000	87.3000	88.3980	88.9625	89.2091	(217)
Fuel for water heating, kWh/month	152.1627	134.0773	140.6484	125.9467	123.7289	110.5258	105.4652	116.6802	116.7800	130.6928	138.1834	148.1876	(219)

Water heating fuel used	1543.0790	(219)
Annual totals kWh/year		
Space heating fuel - main system	1269.3861	(211)
Space heating fuel - secondary	0.0000	(215)

Electricity for pumps and fans:
(MEVCentralised, Database: in-use factor = 1.3000, SFP = 0.2210)

mechanical ventilation fans (SFP = 0.2210)	26.4767	(230a)
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	101.4767	(231)
Electricity for lighting (calculated in Appendix L)	189.7208	(232)
Total delivered energy for all uses	3103.6627	(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	1269.3861	0.2160	274.1874	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1543.0790	0.2160	333.3051	(264)
Space and water heating			607.4925	(265)
Pumps and fans	101.4767	0.5190	52.6664	(267)
Energy for lighting	189.7208	0.5190	98.4651	(268)
Total CO2, kg/year			758.6240	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			19.3100	(273)

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

DER		19.3100	ZC1
Total Floor Area	TFA	39.2800	
Assumed number of occupants	N	1.3873	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		18.0620	ZC2
CO2 emissions from cooking, equation (L16)		3.8772	ZC3
Total CO2 emissions		41.2492	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		41.2492	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	39.2800 (1b)	x	2.5000 (2b)	=	98.2000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	39.2800					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	98.2000	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							2 * 10 =		20.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.2037	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4537	(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) =	0.3516	(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	0.4483	0.4395	0.4307	0.3868	0.3780	0.3340	0.3340	0.3252	0.3516	0.3780	0.3955	0.4131	(22b)
Effective ac	0.6005	0.5966	0.5928	0.5748	0.5714	0.5558	0.5558	0.5529	0.5618	0.5714	0.5782	0.5853	(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 Opening Type (Uw = 1.40)			7.9000	1.3258	10.4735			(27)
Heat Loss Floor 1			39.2800	0.1300	5.1064			(28a)
External Wall 1	14.9300	7.9000	7.0300	0.1800	1.2654			(29a)
Total net area of external elements Aum(A, m2)			54.2100					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	16.8453			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							3.9570	(36)
Total fabric heat loss						(33) + (36) =	20.8023	(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	19.4591	19.3326	19.2087	18.6266	18.5177	18.0107	18.0107	17.9168	18.2060	18.5177	18.7380	18.9683	(38)
Heat transfer coeff	40.2613	40.1349	40.0110	39.4289	39.3200	38.8130	38.8130	38.7191	39.0082	39.3200	39.5403	39.7706	(39)
Average = Sum(39)m / 12 =												39.4283	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0250	1.0218	1.0186	1.0038	1.0010	0.9881	0.9881	0.9857	0.9931	1.0010	1.0066	1.0125	(40)
HLP (average)												1.0038	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.3873	(42)
Average daily hot water use (litres/day)	67.1492	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	73.8641	71.1781	68.4922	65.8062	63.1202	60.4343	60.4343	63.1202	65.8062	68.4922	71.1781	73.8641	(44)
Energy conte	109.5383	95.8029	98.8600	86.1886	82.7000	71.3638	66.1290	75.8840	76.7903	89.4917	97.6872	106.0820	(45)
Energy content (annual)										Total = Sum(45)m =		1056.5179	(45)
Distribution loss (46)m = 0.15 x (45)m	16.4307	14.3704	14.8290	12.9283	12.4050	10.7046	9.9194	11.3826	11.5185	13.4238	14.6531	15.9123	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	37.6403	32.7614	34.9028	32.4524	32.1654	29.8032	30.7966	32.1654	32.4524	34.9028	35.1015	37.6403	(61)
Total heat required for water heating calculated for each month													

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	147.1786	128.5643	133.7629	118.6409	114.8653	101.1670	96.9257	108.0494	109.2427	124.3946	132.7888	143.7223	(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													
	147.1786	128.5643	133.7629	118.6409	114.8653	101.1670	96.9257	108.0494	109.2427	124.3946	132.7888	143.7223	(64)
								Total per year (kWh/year) = Sum(64)m =				1459.3025	(64)
Heat gains from water heating, kWh/month													
	45.8316	40.0448	41.5967	36.7708	35.5391	31.1793	29.6871	33.2728	33.6459	38.4817	41.2564	44.6823	(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	69.3667	69.3667	69.3667	69.3667	69.3667	69.3667	69.3667	69.3667	69.3667	69.3667	69.3667	69.3667	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	10.7428	9.5416	7.7598	5.8747	4.3914	3.7074	4.0060	5.2071	6.9890	8.8741	10.3574	11.0414	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	119.7270	120.9693	117.8386	111.1735	102.7600	94.8526	89.5699	88.3275	91.4583	98.1234	106.5368	114.4443	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	29.9367	29.9367	29.9367	29.9367	29.9367	29.9367	29.9367	29.9367	29.9367	29.9367	29.9367	29.9367	(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)													
	-55.4933	-55.4933	-55.4933	-55.4933	-55.4933	-55.4933	-55.4933	-55.4933	-55.4933	-55.4933	-55.4933	-55.4933	(71)
Water heating gains (Table 5)													
	61.6016	59.5905	55.9095	51.0705	47.7676	43.3045	39.9020	44.7215	46.7304	51.7227	57.3005	60.0569	(72)
Total internal gains													
	238.8813	236.9115	228.3178	214.9287	201.7290	188.6745	180.2878	185.0661	191.9876	205.5302	221.0047	232.3526	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	7.9000	36.7938	0.6300	0.7000	0.7700	88.8329	(77)

Solar gains	88.8329	151.3153	207.0362	256.5279	287.3327	285.2548	275.0161	252.0344	224.1765	167.2357	106.4014	76.0225	(83)
Total gains	327.7142	388.2268	435.3541	471.4566	489.0617	473.9293	455.3039	437.1005	416.1641	372.7659	327.4061	308.3750	(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	67.7518	67.9652	68.1757	69.1823	69.3739	70.2801	70.2801	70.4505	69.9282	69.3739	68.9873	68.5878	
alpha	5.5168	5.5310	5.5450	5.6122	5.6249	5.6853	5.6853	5.6967	5.6619	5.6249	5.5992	5.5725	
util living area													
	0.9902	0.9753	0.9401	0.8538	0.7047	0.5177	0.3742	0.4060	0.6263	0.8854	0.9770	0.9927	(86)
MIT	20.1489	20.3450	20.5814	20.8168	20.9483	20.9925	20.9990	20.9984	20.9790	20.8062	20.4360	20.1122	(87)
Th 2	20.0626	20.0652	20.0679	20.0802	20.0825	20.0933	20.0933	20.0953	20.0891	20.0825	20.0778	20.0729	(88)
util rest of house													
	0.9872	0.9682	0.9238	0.8188	0.6482	0.4472	0.2976	0.3270	0.5518	0.8492	0.9692	0.9905	(89)
MIT 2	18.9477	19.2306	19.5631	19.8831	20.0371	20.0887	20.0929	20.0947	20.0747	19.8798	19.3736	18.9026	(90)
Living area fraction									fLA = Living area / (4) =			0.4908	(91)
MIT	19.5373	19.7776	20.0629	20.3414	20.4844	20.5323	20.5376	20.5383	20.5186	20.3345	19.8951	19.4963	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.5373	19.7776	20.0629	20.3414	20.4844	20.5323	20.5376	20.5383	20.5186	20.3345	19.8951	19.4963	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9851	0.9656	0.9237	0.8294	0.6737	0.4817	0.3352	0.3658	0.5877	0.8601	0.9673	0.9887	(94)
Useful gains	322.8296	374.8693	402.1258	391.0433	329.4640	228.2816	152.6268	159.8952	244.5641	320.5986	316.6967	304.8856	(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													
	613.4745	597.1107	542.6645	451.1217	345.4005	230.2512	152.8317	160.2295	250.3777	382.7592	505.9211	608.3433	(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													
	216.2398	149.3462	104.5608	43.2565	11.8568	0.0000	0.0000	0.0000	0.0000	46.2475	136.2416	225.7725	(98)
Space heating												933.5216	(98)
Space heating per m2											(98) / (4) =	23.7658	(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 %)	93.4000	(206)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												999.4878	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	216.2398	149.3462	104.5608	43.2565	11.8568	0.0000	0.0000	0.0000	0.0000	46.2475	136.2416	225.7725	(98)
Space heating efficiency (main heating system 1)	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)	231.5202	159.8996	111.9495	46.3131	12.6946	0.0000	0.0000	0.0000	0.0000	49.5155	145.8689	241.7264	(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	147.1786	128.5643	133.7629	118.6409	114.8653	101.1670	96.9257	108.0494	109.2427	124.3946	132.7888	143.7223	(64)
Efficiency of water heater												80.3000	(216)
(217)m	86.0184	85.4292	84.4390	82.7708	81.1483	80.3000	80.3000	80.3000	80.3000	82.8074	85.1158	86.1836	(217)
Fuel for water heating, kWh/month	171.1014	150.4923	158.4136	143.3366	141.5499	125.9863	120.7044	134.5572	136.0432	150.2216	156.0095	166.7630	(219)
Water heating fuel used												1755.1789	(219)
Annual totals kWh/year													
Space heating fuel - main system												999.4878	(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)												189.7208	(232)
Total delivered energy for all uses												3019.3876	(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	999.4878	0.2160	215.8894	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1755.1789	0.2160	379.1186	(264)
Space and water heating			595.0080	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	189.7208	0.5190	98.4651	(268)
Total CO2, kg/m2/year			732.3981	(272)
Emissions per m2 for space and water heating			15.1479	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.5067	(272b)
Emissions per m2 for pumps and fans			0.9910	(272c)
Target Carbon Dioxide Emission Rate (TER) = (15.1479 * 1.00) + 2.5067 + 0.9910, rounded to 2 d.p.			18.6500	(273)