Energy and Sustainability Statement

253-255 London Road, Headington, Oxford, OX3 9EH

PR8346
Date: 31/03/2022

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Notice

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Contents

Executive summary

ERS Consultants Ltd has been appointed to prepare an Energy & Sustainability Statement for the site located to the 253-255 London Road, Headington, Oxford, OX3 9EH.

The proposal is for the development of 1x2-bed dwellings, 2x2-bed dwellings 5x4-bed dwellings and 1x6-bed dwellings, provision of private amenity space, bin and bicycle storage. This report will be focusing on the new build dwellings that are being proposed and managing to implement careful design and sustainable measures; so that the project creates attractive new residential units, which will address current housing need within the Oxford city area.

Proposed schedules of accommodation are as follows:

- 1x2-bed dwelling houses
- 2x3-bed dwelling houses
- 5x4-bed dwelling houses
- 1x6-bed dwelling houses

Total combined floor area for habitable dwellings: 855.67m²
(Drawings can be found in the appendix of this report)

This energy and sustainability report outlines the key measures to be incorporated in the design, in regards to sustainability, carbon emissions, renewable energy and environmental impact of the considered development in accordance and with guidance from the following documents and policies:

- Oxford local plan 2036 (Policy RE1)
- The National Planning Policy Framework (NPPF) July 2019

In line with Oxford's Local plan Policy RE1, the development would need to achieve a 40% reduction in regulated CO_2 emissions against a Building Regulations (Part L 2013) compliant scheme.

In addition to passive design and energy efficiency measures, this energy and sustainability statement will demonstrate that the additional solar panels and a gas boiler system provides an increased carbon emissions reduction compared to energy efficiency and passive measures alone.

A dynamic energy simulation has been undertaken to establish the energy consumption and carbon emissions of the proposed building.

The methodology used to determine the expected operational CO_2 emissions for the development is in accordance with the Oxford Local Plan's three-step Energy Hierarchy and the CO_2 savings achieved for each step are outlined below:

Baseline – (CO2 emissions Part L 2013 of the Building Regulation)

Initially in the energy assessment must be established that the regulated CO_2 emissions of the development comply with the Part L 2013 of the Building Regulations using the approved compliance software SAP. Baseline regulated CO2 emissions 15,437kgCO_2/year for the proposed dwelling houses.

Be Lean – Use less energy

The second step addresses reduction in energy demand, through the adoption of passive and active design measures with emphasis on a fabric first approach.

Emphasis will be put on the buildings fabric performance in order to reduce energy consumption, as less heating and cooling will be lost through the high performance fabric hence reducing the demand. Fabric first measures include levels of insulation beyond Building Regulation 2013 requirements which will help in achieving low air tightness levels.

With the addition of the lean fabric improvements the energy regulated CO_2 emissions are shown to reduce by 1.11% (15,266kgCO_2/year) for the proposed flats.

Be Clean – Supply energy efficiently

The space conditioning and hot water system network at the proposed development site will consist of high efficiency ultra low NOx mains gas Boiler to serve as the main heating system will be providing heating throughout each dwelling via radiators or underfloor heating.

A suitable analysis will be taken into account to see if this development can fit in with local heat networks, and provide guidance on this, during this stage of the report.

The hot water for the dwelling will be powered and provided by the proposed heating system.

Additional measures to reduce energy will include low energy lighting without comprising the luminance as well as energy saving controls for heating and hot water.

With the addition of the clean energy regulated CO_2 emissions are shown to reduce by 1.90% (15,144kgCO_2/year) for the dwelling houses.

Be Green – Use renewable energy

The renewable technologies and feasibility studies carried out for the development identified Photovoltaic Panels (16.50kWp), as a suitable technology for the development. The incorporation of renewable technologies will further reduce CO_2 emissions on site by a further 44.70% (8,537kgCO_2/year) for the dwelling houses.

Solar photovoltaic panels are only to be installed facing an orientation that is as close to south as possible.

The proposed dwellings individually each achieve a reduction of over 40%, thus meaning this proposed development using the proposed specification in this report completes the required **40% Carbon Emissions Reduction** against Part L1A, 2013 Building Regulations, in accordance with the Oxford Local Plan's Policy RE1.

Energy & carbon demand summary

Table 1 Energy and Carbon Reductions for Houses

	Energy Consumption (kWh/Year)	Energy Consumption Savings (%)	CO_2 Emissions (kg CO_2/Year)	CO_2 Emissions Savings (%)
Baseline	65,898		15,437	
Be Lean	65,105	1.20%	15,266	1.11%
Be Clean	64,541	2.06%	15,144	1.90%
Be Green	51,810	21.38%	8,537	44.70%
Total Reduction		**21.38%**		**44.70%**

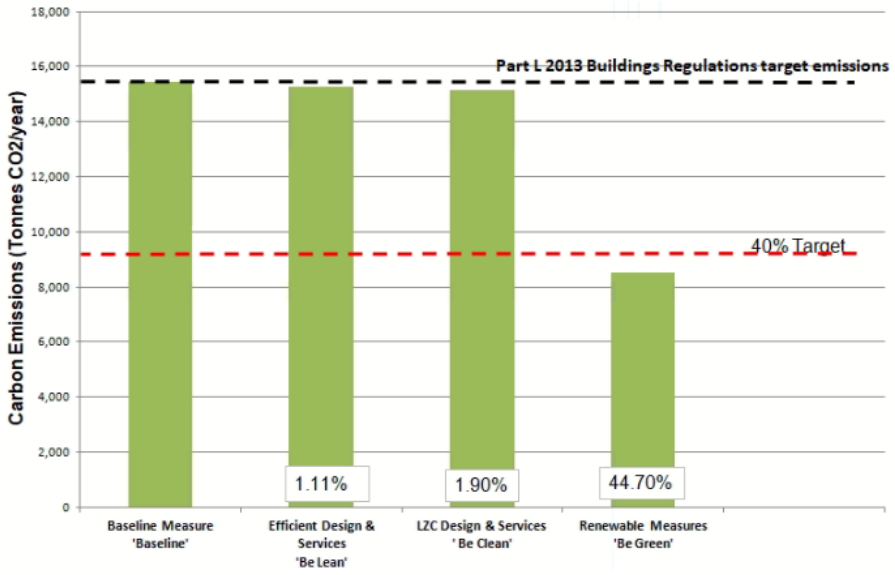


Fig.1 CO_2 Reduction

Table 1, the provisional baseline annual energy consumption of the houses has been estimated to be 65,898KWh/year and the resulting annual carbon dioxide emissions are 15,437kg CO_2/year.

The incorporation of energy saving measures and renewable energy sources, following the Oxford local plan guidance, in the site would reduce the energy requirement and CO_2 emissions to 51,810kWh/year and 8,537kgCO_2/year, respectively.

The total reduction with "Be Clean" and "Be Green" measures would result in a total of 44.70% reduction that is in comparison to the Part L 2013 Building regulations baseline as shown in Figure 1, achieving the required target.

Table 2. Proposed Specifications

Proposed Specifications			
Fabric	U-Value (W/m2K)	Walls	0.18 (External Wall) 0.22 (Dormer Wall) 0.22 (Sheltered-Wall)
		Floors	0.10 (Ground floor) 0.22 (Exposed floor/soffits)
		Roof	0.09(Roof insulated at ceiling) 0.16(Pitched Roofs)
		Windows/ Glazed Openings	1.40 Double glazed units, Low-E Soft Coat; Thermally broken lintels
		Doors	1.40
Air permeability	Q (m3/m2h)	4.00	
Space Heating-Houses	Mains Gas Combination Boiler	Efficiency	Worcester Greenstar 30Si Compact ErP; Efficiency 89.8% SEDBUK2009
Controls	Time and Temperature Zone Control; Delayed start thermostat;		
Water Heating	From Main Heating; As per M&E specification to be designed in on large units;		
Lighting Systems	Lighting type	LED Lighting, throughout the dwelling;	
Renewables	Photovoltaic Panels	Total 16.50kWp 44x375 watt panels installed recommended; Either on a Eastern or Western orientation.	
This specification is a recommendation but may change during the construction stage, to meet site constraints, any worsening of the u-values must ensure the required 40% reduction in Carbon is met before completion;			

Introduction

Site & proposal

The site is located at 253-255 London Road; this is a site that is located in the Headington area of Oxford.

The total development measures internally, approximately 855.67m^2 in area and will consist of 1x2-bed dwellings, 2x2-bed dwellings 5x4-bed dwellings and 1x6-bed dwellings, this application will be focusing on the new build units.

The approximate site location of the proposed development is shown in the site plan Fig.3 and is highlighted in red.

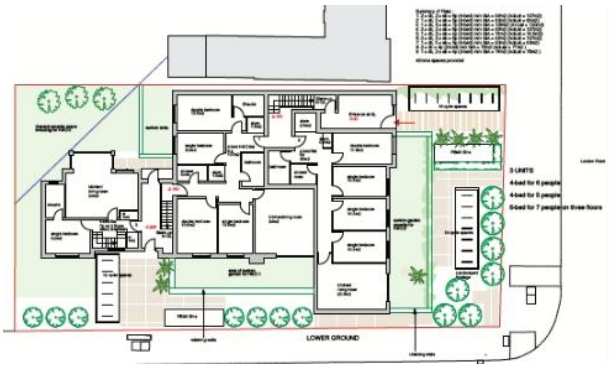


Fig.3 Site Plan

Policy context

This energy and sustainability statement will seek to respond to the energy policies that apply to this development. The most relevant applicable energy policies in the context of the proposed development are presented below.

- Oxford local plan 2036 (Policy RE1)
- The National Planning Policy Framework (NPPF) July 2019

All the aforementioned polices focus on zero carbon targets for residential developments with a minimum 40 per cent on site reduction beyond Part L 2013.

Calculation methodology

The sections below present the methodology followed in determining carbon emissions reduction savings for the proposed scheme.

The methodology employed by the energy and sustainability statement is in line with the GLA's Guidance on preparing energy assessments.

The baseline CO_2 emissions are first established, i.e. the emissions of a scheme that is compliant with Part L 2013 of the Building Regulations.

The approved software used to model and calculate the energy performance and carbon emissions is Design SAP 2012 version 4.14r16 by Elmhurst Energy Systems Ltd.

The TER which is used as the baseline figure for the carbon reductions for each non-domestic element is multiplied by its floor area to establish the total emissions. Similarly, the DER is calculated in the same method to determine the energy performance and CO_2 emissions of the proposed scheme for each of the steps of the Energy Hierarchy.

Baseline:

The dwelling's baseline uses the similar fabric specification and the heating system in the baseline model uses a gas boiler.

Be Lean: use less energy

The demand for energy is reduced through a range of passive and active energy efficiency measures; as part of this step the dwelling fabric u-values, thermal bridging, air tightness and glazing have been improved to a high standard;

Be Clean: supply energy efficiently

As much of the remaining energy demand is supplied as efficiently as possible a highly efficient ultra low NOx mains gas combination/system boiler is the recommended improvement, with suitable heating controls.

Be Green: use renewable energy

Renewable technologies are incorporated to offset part of the carbon emissions of the development. The uptake of renewable technologies is based on feasibility and viability considerations, including their compatibility with the energy system determined in the previous step.

The implementation of the Energy Hierarchy determines the total regulated carbon savings that can be feasibly and viably achieved on site.

The 44.70% improvement for the flats against the baseline emissions is compared to the relevant targets for each element and in case of a shortfall; savings through off-site measures should be achieved.

The Conclusions section summarizes the energy strategy and associated carbon savings for the proposed development.

The carbon emissions factors used in all calculations in this document are those used for Part L of the Building Regulations. The relevant factors are reproduced in Table 3 below.

Table 3 Carbon Emission Factors for selected fuel type

Fuel	CO_2 emission factor ($kgCO_2/kWh$)
Mains Gas	0.216 kgCo2/kWh
Bulk LPG	0.241 kgCo2/kWh
Heating Oil	0.298 kgCo2/kWh
Wood Pellets	0.039 kgCo2/kWh
Grid Electricity	0.519 kgCo2/kWh

* Table extracted from the document SAP 2012 version 9.92 (October 2013), Table 12: Fuel prices, emission factors and primary energy factors, Page 225. This can be found in the appendix of the report.

The emission factors and primary energy factors in Table 12 are for a 3-year projection 2013-2015. Factors for a 15-year projection, which may be relevant to consideration of long-term impacts, are given on www.bre.co.uk/sap2012

Be Lean – Use less energy

The proposals incorporate a range of passive and active design measures that will reduce the energy demand for space conditioning, hot water, and lighting.

Measures will also be put in place to reduce the risk of overheating, the regulated carbon saving achieved in this step of the Energy Hierarchy is 1.11% when compared against the baseline level for the development.

Passive design measures

Building materials

The key issues to be addressed in the selection of materials and equipment are:

- Use of materials and equipment from sustainable sources
- Minimization of in-use environmental impacts
- Minimization of embodied environmental impacts
- Use of materials and equipment with high recycled content

Enhanced U-values

The heat loss of different building fabric elements is dependent upon their U-value. A building with low U-Values provide better levels of insulation and reduced heating demand during the cooler months.

The proposed development will incorporate high levels of insulation and high-performance glazing beyond Part L 2013 targets and notional building specifications, to reduce the demand for space conditioning (heating and/or cooling).
Table 4 demonstrates the improved performance of the proposed building fabric beyond the Building Regulations requirements.

Table 4 Proposed fabric U-Values

Domestic (U-Values in W/m²k)		
Element	**Part L 2013 Building Regulation**	**Proposed**
Wall	0.30	0.18 (External Wall) 0.22 (Dormer Wall) 0.22 (Sheltered-Wall)
Floor	0.25	0.10 (Ground Floor) 0.22 (Exposed floor/soffit)
Roof	0.20	0.09(Roof insulated at ceiling) 0.16(Pitched Roofs)
Windows	1.60	1.40 (Double-glazed)
Doors	1.80	1.40
These u-values are recommended but may change during the construction stage, to meet site constraints, any worsening of the u-values must ensure the required 40% reduction in Carbon is met before completion;		

Air tightness improvement

Heat loss may also occur due to air infiltration. Although this cannot be eliminated altogether, good construction detailing and the use of best practice construction techniques can minimise the amount of air infiltration.

The proposed development will aim to improve upon the Part L 2013 minimum standards for air tightness by targeting air permeability rates of **4.00m³/m².h at 50Pa**.

Reducing the need for artificial lighting

The development has been designed to maximise daylight in all habitable spaces as a way of improving the health and wellbeing of its occupants.

All of the habitable areas will benefit from large areas of glazing to increase the amount of daylight within the internal spaces where possible. This is expected to reduce the need for artificial lighting whilst delivering pleasant, healthy spaces for occupants.

Waste

A site waste management plan that provides details of waste minimisation, sorting, reuse and recycling procedures is required for all levels in the planning guidance. Sustainable waste management should follow the hierarchy described in *BS 5906: Waste management in buildings. Code of practice*. This outlines the following principles in decreasing order of desirability:

- Reduce waste
- Re-use materials and equipment (and facilitate future reuse)
- Recycle waste (and facilitate recycling)
- Compost biodegradable waste
- Recover energy from waste (and facilitate energy recovery from waste)
- Disposal

Active design measures

High efficacy & low energy lighting

Where artificial lighting will be needed it will low energy lighting without compensating for luminance, and will accommodate LED.

Water

Proposals for new residential development are to meet the higher water efficiency standard within Building Regulations Part G2 of water consumption target of 110 litres per person per day. The Building Regulations regulation requirement, 110 litres/ person is recommended for a new development within the Oxford area. This can be achieved by applying various water efficiency and reclamation / recycling measures.

Appendix G of this report shows a model water calculation has been provided as a guide on how this dwelling should achieve this standard.

Water Efficiency Measures

The following measures can be used to reduce the quantity of water demand to satisfy end users:

- Dual or low flush WCs
- Spray or aerating taps
- Water efficient appliances
- Low flow showers
- Smaller size bath

Water Reclamation / Recycling Measures

- Rainwater collection

Water collected from roofs or hard surfaces such as car parks can be harvested for storage and use for non-potable uses such as watering gardens and WC flushing.

Controls and Monitoring

Advanced lighting and space conditioning controls will be incorporated, specifically:

- For areas of infrequent use, occupant sensors will be fitted for lighting, whereas day lit areas will incorporate daylight sensors where appropriate;
- Heating and cooling systems controls will comprise time and temperature controls, both centrally for the whole building, and locally for each space;
- Smart metering to be installed on all new dwellings for adequate monitoring;

Overheating Risk analysis

The potential risk of overheating was assessed via the Part L Building Regulation compliance tool SAP. All domestic areas have been found to pass Criterion 3 'Limiting Solar Gains' of Part L. The SAP output(s) for all domestic areas can be found in Appendix F – SAP Results.

Be Lean CO_2 emissions & savings

Table 1 Breakdown of energy consumption and CO_2 emissions for the baseline and the proposed schemes after 'Lean' measures are implemented.

By means of energy efficiency measures alone, regulated CO_2 emissions are shown to reduce by 1.11% (15,266kgCO_2/year) compared to the baseline for the development.

Be Clean – Supply energy efficiently

By means of installing a high efficiency ultra low NOx gas boiler, and improving the heating controls, the regulated CO_2 emissions are shown to reduce by 1.90% (15,144kgCO_2/year) for the dwelling houses compared to the baseline.

Low Carbon Energy Sources (CHP/District Heating Schemes)

District Heating Scheme

Policy RE1 the City Council will encourage the development of city wide heat networks. If a heat network exists in close proximity to a scheme it is expected to connect to it and this will count towards the development's carbon reduction requirements.

A district heating option has been considered as one of the first LZC technologies options as an opportunity of using waste heat which would be otherwise rejected into the atmosphere, this option is usually applied for large scale developments. Investigation was carried out to identify existing district heating schemes in local area of the development.

A study has been completed into the availability of existing heat networks in the vicinity of the development, using the "Final Report for Heat Networks for Oxford" by BRE. This document looks at the feasibility of heat network. This report has been referenced as there are currently no existing heat networks in the proximity of this proposed development, despite being Headington being a viable location for a proposed heat network.

Fig.3 Overview of project areas for heat network

The proposed development site, is not in a close proximity of an existing heat network making this an unviable solution to improve the heating system in the dwelling at time of this application.

Considering the size of the development, this is not an economically viable solution, however, since there may be potential extensions of the network in the future, we advise measures to be taken for the future connection to the district heating network. Should it become realistic and feasible to do so.

Combined Heat and Power (CHP)

The presence of a year-round base hot water generation heat load in residential units is favourable to CHP. To date, there are readily available micro gas fired CHP units (such as EC power) on the market. At this stage gas fired CHP will be provisionally incorporated into the development's LZC strategy, however, the carbon reductions due to CHP are extremely sensitive to the system design, unit selection and running time.
CHP (Combined Heat & Power) is a great technology to use, however the system itself needs to run on a 24 hour basis. The heat generated would be exceeding the demand and needs for this site, and would require to have an outlet area which can profit from this excess, however this development does not have a space that benefit from this, therefore this option has considered not feasible for this development.

Be Green – Use renewable energy

Renewable technologies feasibility study

Methods of generating on-site renewable energy (Green) were assessed, once Lean and Clean measures were considered.

This section provides an overview of the technologies considered, a brief assessment of their feasibility, a proposed mixture of suitable technologies.

The proposed development will benefit from an energy efficient building fabric which will reduce the energy consumption of the proposed development in the first instance.

A range of renewable technologies were subsequently considered including:

- Biomass;
- Ground/water source heat pumps;
- Wind energy;
- Photovoltaic panels, and,
- Solar thermal panels.

In determining the appropriate renewable technology for the site, the following factors were considered:

- CO_2 savings achieved;
- Site constraints;
- Financial benefit
- Any potential visual impacts

Demand profiles

The balance of technologies chosen will depend on the development's energy demand patterns.

Keeping in mind that the space heating energy demand changes according to the season. While hot water energy demand will provide a significant base load throughout the year.

Electrical demand is likely to be moderate throughout the year. Lighting loads will be highest during the evening but will continue at reduced levels throughout the night and during the day.

Feasibility

At this early stage in the design, it is possible only to outline the likely feasibility of specific technologies. Further descriptions of the LZC technologies below are included in Appendix A.

Table 5. Renewable and Low Zero Carbon Technologies

Renewable Technology	Comments	Lifetime (Years)	Maintenance	Impact on External Appearance	Site Feasibility	Adopted for Site
BIOMASS 	Burning of wood pellets releases high NOx emissions and there are limitations for their storage and delivery within an urban location.	20	High	High	3	☐
PV 	PV panels would generate significant carbon savings, whilst having minimal impact on the appearance of the building and no adverse impact on the amenity of neighboring buildings.	25	Low	Med	9	☑
Solar Thermal 	Solar thermal array mounted on the roof would conflict with the savings made from the CHP unit	25	Low	Med	4	☐
GSHP 	The installation of ground loops requires significant space, additional time at the beginning of the construction process and very high capital costs.	20	Med	Low	5	☐
Wind 	Due to insufficient open area for installation of a stand-alone wind turbine and planning issues this option has not considered in this development.	25	Med	High	3	☐

Detailed assessment of Photovoltaic Panels

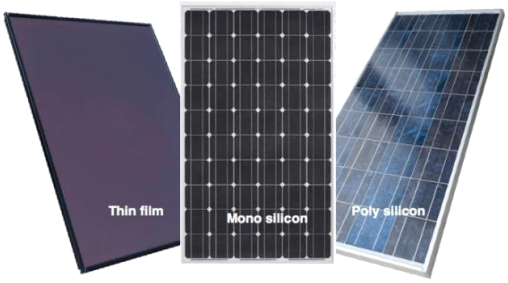


Fig 4. Photovoltaic Panels

Four types of solar cells are available on the market at present and these are mono-crystalline, polycrystalline, thin film and hybrid panels as seen in figure 4. Although mono-crystalline and hybrid cells are the most expensive, they are also the most efficient with an efficiency rate of 12-20%. Poly-crystalline cells are cheaper but they are less efficient (9-15%). Thin film cells are only 5-8% efficient but can be produced as thin and flexible sheets.

1.00 kWp (Kilo Watt Peak) of PV panels can produce approximately 850 kWh/ year of electricity in this region, reducing the grid energy requirement and CO_2 emissions.

Photovoltaic Panel is considered a suitable technology for this development as the development provides an extent of roof space for the installation of PV panels. In addition to this the PV arrays are relatively easy to install when compared to other renewable systems and provide a significant amount of CO_2 savings.

The PV shall comprise 16.50kWp of pitched roof mounted arrays; Table 6 summarizes the technical data for the proposed PV array. In total, the PV installation would produce a further regulated CO_2 savings of 42.80% for the dwelling houses houses.

Table 6. Proposed PV Specifications

Photovoltaic Panels	
Module Efficiency	15%
Panel Orientation	East-West;
Tilt	50°
Array Area (approximately)	88m2
Total power to be installed	16.50 KWp
Energy Generation	11259.996 KWh/yr
Total CO_2 savings	**5843.937 KgCO_2/yr**

Be Green CO_2 emissions & savings

The incorporation of renewable technologies will further reduce CO_2 emissions by a further 44.70% (8,537kgCO_2/year for the flats compared to the baseline).

Flood zone risk assessment for planning

The Environment Agency has developed a flood risk map for planning to identify the relative risk of flooding for proposed development planning locations. Flood zones assume that no defenses are present and so where these do exist, they are only indicative of the potential for flooding.

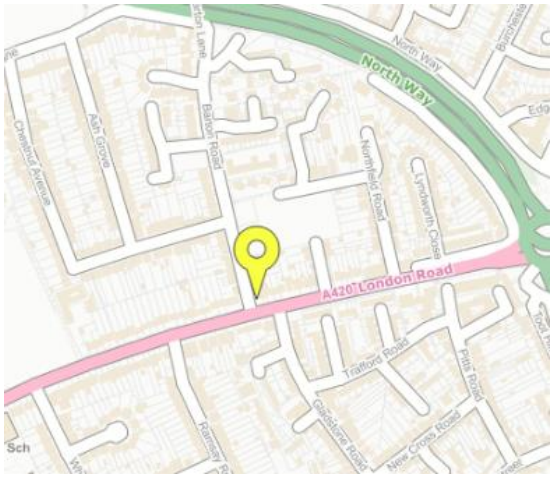


Fig.5 Environment Agency Flood Zone Interactive Map

The whole of the development lies within flood zone 1 of the Environment Agency's flood risk map as seen in figure. 5, the land located within flood zone 1 is at low risk of flooding having an associated annual probability of flooding of less than 1 in 1000 (0.1%).

Study approach

In accordance with Planning Practice Guidance for Flood Risk document, land within flood zone 1 is suitable for all uses. Assessment of this site has been based upon the Environment Agency's flood interactive map, the topographical site survey and the architect's proposed development layout.

Flood vulnerability

Based on the Environment Agencies flood map, the development site is located within Flood Zone 1 and in accordance with Planning Practice Guidance for Flood Risk neither a sequential or exception test is required.

Conclusion

Following the implementation of the three-step Energy Hierarchy, the regulated CO_2 savings for the site are estimated at 44.70% for the houses, against a Part L 2013 compliant scheme.

Overall, the proposed development has been designed to meet energy policies set out by the Oxford plan requirements, which demonstrates the client and the design team's commitment to enhancing sustainability of the scheme.

Table 7. Summarises the implementation of the Energy Hierarchy for the proposed scheme and detail the CO_2 emissions and savings against the baseline scheme for each step of the hierarchy; as well as the savings achieved through carbon offset, in addition to this a total site average is calculated, this average meets the 40% Carbon reduction over a Part L1A 2013 baseline, requirements as set by Oxford's Local Plan RE1

Table 7. CO_2 emissions after each step of the Energy Hierarchy for the proposed development

	CO_2 Emissions (tonnes/yr)	**CO_2 Emissions Savings per Step (%)**
Baseline	15,437	
Be Lean	15,266	1.11%
Be Clean	15,144	1.90%
Be Green	8,537	44.70%
Total Site Reduction achieved		**44.70%**

Based on the results and outline figures, the proposed development, will satisfy the relevant policies for sustainable design and construction requirements of energy consumption and carbon emissions.

The energy demand and carbon emissions, could be reduced by introducing a combination of energy efficiency measures and on-site renewable. Based on the calculations and results achieved when those measures were applied, the development achieved a total site reduction of 44.70% in CO2 emissions based on the 2013 Regulations (Figure 1).

The new dwellings will be designed with a high level of insulation and low air permeability to reduce heat loss as much as is practically possible, also the use of low energy lighting and A – Rated White goods are essential for the reduction of energy consumption.

The control strategy throughout must be carefully designed to ensure the most economical operation of all equipment throughout the development.

To achieve the required reduction of carbon emissions, several options were considered, however the best option in regards to site location and the development size, was the combination of a highly efficient ultra low NOX gas boiler has been selected for the provision of heating in the dwelling houses, with 16.50kWp of Photovoltaic panels installed for the complete site and proposed to be laid across the Roof of the dwellings that need this technology (approximate total of 44 panels).

The fabric specification and u-values in this report are recommended but may change during the construction stage, to meet site constraints, any worsening of the u-values must ensure the required 40% reduction in Carbon is met before completion;

The proposed development site is not in a close proximity of an existing heat network making this an unviable solution to improve the heating system in the dwelling at time of this application. CHP (Combined Heat & Power) is a great system to use for a new development, however due to the low energy demands of the development and the lack of additional space required for this technology, it will not be a preferable solution, as the site does not have the demand and space to accommodate this technology.

The baseline annual energy consumption of the dwelling houses on this development has been calculated to be 64,541kWh/yr and 15,144KgCO_2/yr of CO2 emissions.
By incorporating on-site renewable/ LZC technologies the total CO2 emissions will be reduced to 8,537KgCO_2/yr, equivalent to 44.70% reduction over Part L 2013 requirements, the overall site reduction achieves reduction required as per the required local plan.

Different possible renewable energy options have been identified; bearing in mind that selection is a complex process which requires a more detailed estimation of energy demand patterns, therefore, further analysis will be undertaken as the design progresses.

As the dwelling will be focusing on satisfying a 40% reduction of it already satisfies the standard for Code for Sustainable Homes Level 4 which is a 19% reduction and should it be deemed feasible the developer may look to achieve home quality mark on each dwelling.
Post construction each dwelling is to have suitable post construction testing provided to ensure the dwellings satisfy the requirements of this document and building regulation standards at the time of completion, this is to be provided as As-Built SAP worksheets, EPC and Air and Acoustic testing, in addition to this to enhance post construction monitoring is to be provided and the dwellings are to all be installed with smart

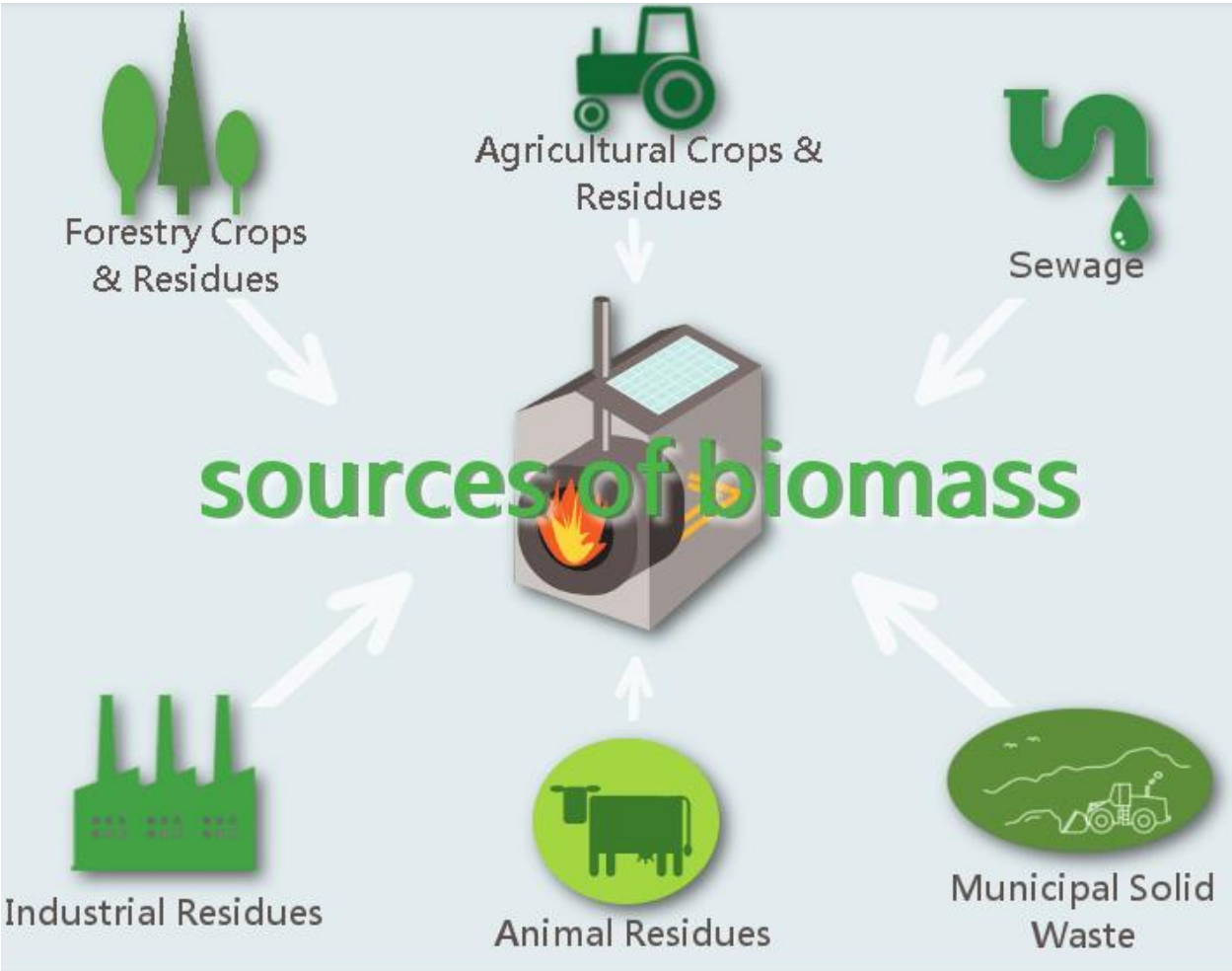
metering.

Appendix A - Low or Zero Carbon Energy Sources

Biomass As a fuel

Biomass is a renewable energy source, generated from burning wood, plants and other organic matter, such as manure or household waste. It releases CO2 when burned, but considerably less than fossil fuels. We consider biomass a renewable energy source, if the plants or other organic materials being burned are replaced.

Biomass is known for its versatility, given it can be used to generate heat, electricity, be used in combined heat and power units and be used as liquid fuel. In domestic settings, it tends to be found in the form of wood-fuelled heating systems.



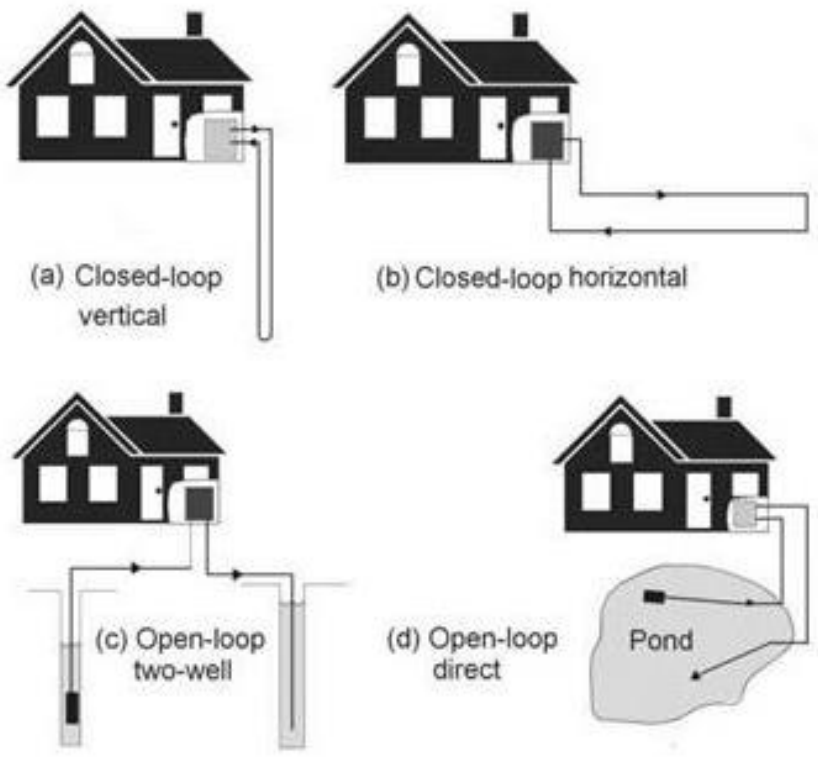
Geothermal Energy:

Geothermal energy technologies use the heat energy stored in ground; either for direct-use applications: such as using the grounds' heat to defrost a driveway or the indirect use with additional equipment such as a geothermal heat pump. Most commercial installations couple a heat pump with the ground to upgrade the low-grade heat from the ground or ground water to a higher-grade heat, where it can be used for heating purposes.

The suitability of a ground source system depends heavily on the type of earth coupling heat exchange system used:

Ground source earth coupling options

The right choice of appropriate heat exchanger depends on several factors such as: size of space heating/hot water system, available site area for the heat exchangers, and local ground conditions. Due to the specialist nature of this technology we recommend that a specialist is employed to size the heat exchangers based on a desk-top study of the site's geological conditions – this normally being required in advance of any other contractor appointment.



Vertical Closed Loop System

A frequently used and simple ground source heat exchanger, for a small to medium size project, is a closed loop vertical system. The system comprises of vertically drilled boreholes, usually up to 100 m deep, into which are inserted two polyethylene pipes with a U-shape connector at the base of the hole – effectively providing a flow down to the bottom of the hole and return back up to the surface. All the flow and return loops are connected together across the site - completing the entire heat exchange loop. Water is pumped around the loop and is then circulated around the heat pump to achieve the required heat exchange. The distance between boreholes is dependent on ground conditions but is typically a minimum of a 6mx6m grid, to prevent overlapping of the heat exchange process between loops.

Horizontal Closed Loop System

Horizontal closed loop heat exchangers are usually applied to small projects such as individual houses, which usually require a relatively low heat output. Consisting of horizontal trenches 1.5-2m deep, with either straight pipes or 'slinky' coiled pipes, these require significant excavation work and significant site area to achieve appreciable outputs as such are not normally suited to medium to large projects.

Vertical Open Boreholes System

A further option is a vertical open borehole system. The system involves the abstraction and discharge of natural ground water using boreholes; into which pumps are inserted, connected to collapsible pipework. Each borehole pump abstracts ground water, circulates it around the heat pump and then discharges the water back to the ground via an absorbing well, some distance from the original abstraction borehole. The system is capable of providing very high rates of heat exchange for a relatively small number of boreholes, which makes it very efficient in terms of site area required. However, this depends greatly on the availability of ground water, which in turn varies according to location. A major downside of this system is that the extraction of water from deep boreholes via pumps consumes a lot of energy, as the water has to be physically lifted to the surface by the pump – this in effect reduces the carbon emissions saved by this system as a whole.

Ground source heat exchange options in summary:

Vertical loop system - closed boreholes

- moderate heat capacity
- relatively low installation cost

Vertical open system - open boreholes

- high heat capacity
- high running energy

- high installation cost

Horizontal loop system – straight pipes

- low capacity,
- high installation cost
- extensive ground excavation work

Horizontal coiled loop system – 'slinky' pipes

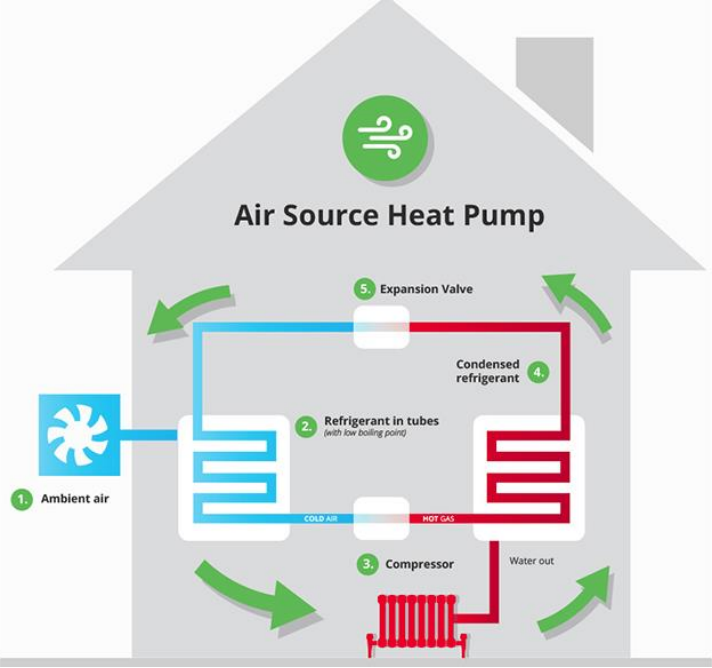
- good capacity
- low installation cost
- extensive ground excavation work

Air Source Heat Pumps

Heat pumps are basically refrigeration units which work in reverse – instead of cooling being produced and heat rejected, the unit produces heat and rejects cooling. Conventional heat pumps use air as the medium to reject this 'coolth' to atmosphere. Ground source units use the ground as a means of improving the unit efficiency because the ground is at a constant temperature of 11-13 °C at depths of 50m– this suits the heat pump much better during the coldest weather than the extremes of air temperature. Reversible heat pumps can also be used for cooling; however this is not being considered further for this project.

A heat pump consumes electrical power to drive the compressor and other ancillary elements. The ratio between total energy input and heat energy output of the heat pump is a measure of its efficiency – usually referred to as 'Coefficient of Performance' - COP. A ground source heat pump has a higher COP than an air cooled heat pump – this additional energy effectively being the grounds' natural contribution to the system.

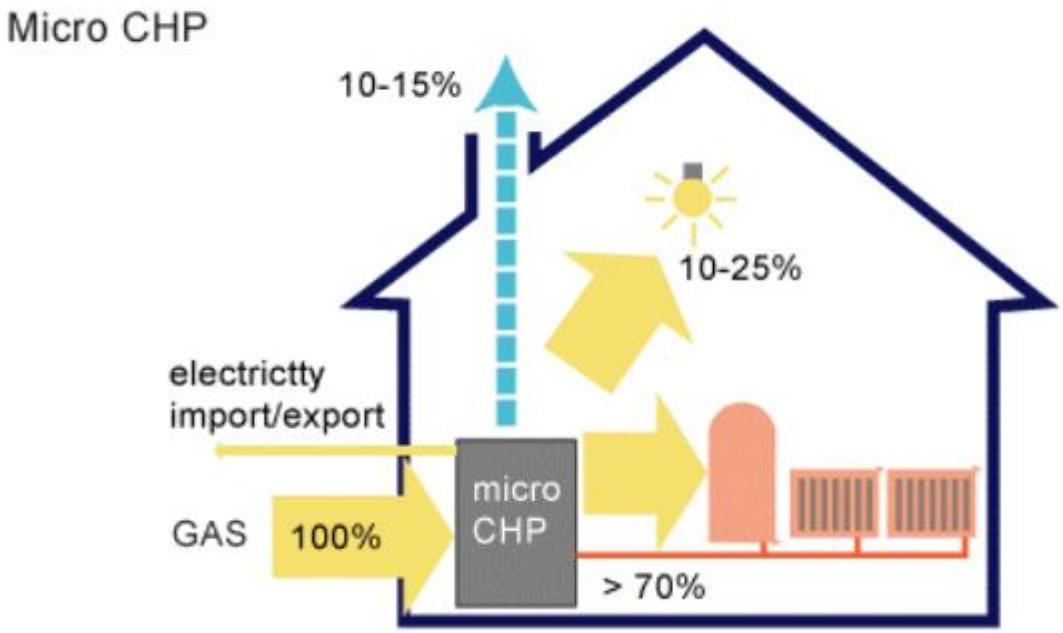
The heat produced by a heat pump is usually used to either provide space heating say to underfloor heating or radiators or the heat is used to generate domestic hot water via a storage vessel.


Air Source Heat Pump
5. Expansion Valve
Condensed refrigerant
4.
2. Refrigerant in tubes
(with low boiling point)
1. Ambient air
COLD AIR
HOT GAS
3. Compressor
Water out

CHP

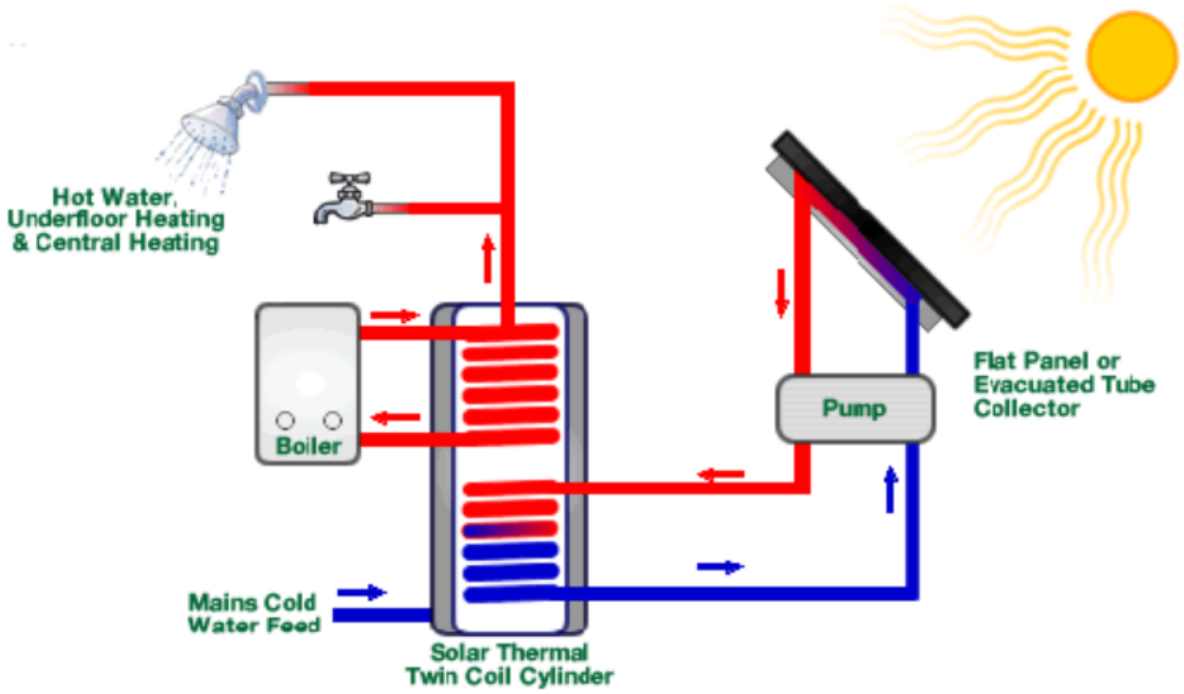
Combined heat and power (CHP) is a process involving simultaneous generation of heat and electricity, where the heat generated in the process in harnessed via heat recovery equipment. CHP at the large commercial size is now fairly common in premises which have a simultaneous demand for heating and electricity for long periods, such as hospitals, recreational centres and hotels. In addition, small CHP systems are now becoming available for individual houses, group residential units and small non-domestic premises. Compared with using centrally generated electricity supplied via the grid, CHP can offer a more efficient and economic method of supplying energy demand, if installed and operated appropriately, owing to the utilization of heat which is normally rejected to the atmosphere from central generating stations, and by reducing network distribution losses due to local generation and use.

Heat generated will be used for space and water heating, and additional heat storage may be used to lengthen use periods, to assist in warm-up and to improve overall energy efficiency. For overall good energy efficiency, as with all CHP, usage must be heat demand led. Thus, a sophisticated control system is required and users should be made aware of efficient operating practices.



Solar thermal collectors

Solar thermal collectors (flat plate or evacuated tubes) convert solar thermal energy into heat for hot water generation. These are usually located on a roof oriented south facing in an ideal slope of 45 degree. Solar collectors properly sized and designed provide approx 50% of annual hot water demand.



Photovoltaic

Photovoltaic modules convert sunlight directly into DC electricity and can be integrated into buildings. Photovoltaics (PVs) are distinct from other renewable energy technologies since they have no moving parts to be maintained and are silent. PV systems can be incorporated into buildings in various ways: on sloped roofs and fl at roofs, in façades, atria and shading devices. Modules can be mounted using

frames or they can be fully incorporated into the actual building fabric; for example, PV roof tiles are now available which can be fitted in place of standard tiles.

Currently, a PV system will cost between £1500 and £2500 per kWp, and frequently part of this cost can be offset owing to the displacement of a conventional cladding material. Costs have fallen significantly since the first systems were installed (1980s) and are predicted to fall further still.

While single crystal silicon remains the most efficient flat plate technology (15–16% conversion efficiency); it also has the least potential for cost reduction. PV cells made from poly-crystalline silicon have become popular as they are less expensive to produce, although they have a slightly lower efficiency.

Thin film modules are constructed by depositing extremely thin layers of photosensitive materials on a low-cost backing such as glass, stainless steel or plastic. As much less semiconductor material is required as for crystalline silicon cells, material costs are potentially much lower. Efficiencies are much lower, around 4–5%, although this can be boosted to 8–10% by depositing two or three layers of thin film material. Thin film production also requires less handling as the films are produced as large, complete modules and not as individual cells that have to be mounted in frames and wired together. Hence, there is the potential for significant cost reductions with volume production.

Since PVs generate DC output, an inverter and other equipment is needed to deliver the power to a building or the grid in an acceptable AC form. The cost of the inverter and these 'Balance Of System' (BOS) components can approach 30% of the total cost of a PV system. Hence, simplification and cost reductions in these components over the coming years will also be necessary to make PV systems affordable.

Wind energy

Wind power is the most successful and fastest spreading renewable energy technology in the UK with a number of individual and group installations of varying size, capacity and location. Traditionally, turbines are installed in non-urban areas with a strong trend for large offshore wind farms. In parallel with the design and development of ever-bigger machines, which are deemed to be more efficient and cost-effective, it is being increasingly recognized that smaller devices installed at the point of use, i.e. urban

settings, can play an important role in reducing carbon emissions if they become mainstream.

At present there is a wide range of available off-the-shelf wind products, many manufactured in the UK and EU with proven good performance and durability. The dominant type is horizontal axis wind turbines (HAWT), which are typically ground mounted. Vertical axis wind turbines (VAWT) have limited market presence and there is a trade-off between lower efficiency and potentially higher resistance to extreme conditions. Capacity ranges from 500W to more than 1.5MW, but, for practical purposes and in built-up areas in particular, machines of more than 1kW and below 500kW are likely to be considered.
Wind technology is also currently one of the most cost-effective renewable energy technologies, which is attributable to the large scale of installations reducing the unit output cost. Individual building or community wind projects, although smaller, have the advantage of feeding electricity directly into the building's electricity circuit, thus sparing costly distribution network development and avoiding distribution losses. The downside is the still high capital cost per kW installed for smaller turbines, plus location constraints, such as visual intrusion and noise. The wind regime in urban areas is also a concern owing to higher wind turbulence which reduces the potential electricity output.

In most cases, wind turbines are connected to the electricity grid and all generated energy is used regardless of the building demand fluctuations. The output largely depends on the wind speed and the correlation between the two is a cube function. This means that in short periods of above-average wind speeds the generation increases exponentially. As a result, it is difficult to make precise calculations of the annual output of a turbine, but average figures can provide useful guidance to designers and architects. In reasonably windy areas (average wind speed of 6m/s) the expected output from 1kW installed is about 2500kWh annually.

The cost per kW installed varies considerably by manufacturer and size of machine with an indicative bracket of £2,500–£5,000. With a lifespan of more than 20 years, wind turbines can save money if design and planning are carried out in a robust way.

Building-integrated wind turbines are starting to be a reality in the UK, but potential projects may face difficulties with obtaining planning permission. There are a few examples now of permitted development rights for certain rooftop turbines in some local councils. A number of horizontal axis devices specifically designed for building integration are now available commercially, having design and reliability parameters relevant to the urban context. Building-mounted vertical axis devices are under development. At present, turbines installed near buildings, as well as community installations for groups of buildings, should be regarded as the larger wind energy

source related to buildings, when they contribute to the carbon emissions from these premises using 'private wire' networks. However, the contribution of several building-integrated turbines in a development is likely to become significant in the next few years.

Appendix B-Fuel prices and emission factors

Table 12: Fuel prices, emission factors and primary energy factors

Fuel	Standing charge, £ [a]	Unit price p/kWh	Emissions kg CO_2 per kWh [b]	Primary energy factor	Fuel code
Gas:					
mains gas	120	3.48	0.216	1.22	1
bulk LPG	70	7.60	0.241	1.09	2
bottled LPG		10.30	0.241	1.09	3
LPG subject to Special Condition 18 [c]	120	3.48	0.241	1.09	9
biogas (including anaerobic digestion)	70	7.60	0.098	1.10	7
Oil:					
heating oil		5.44	0.298	1.10	4
biodiesel from any biomass source [d]		7.64	0.123	1.06	71
biodiesel from vegetable oil only [e]		7.64	0.083	1.01	73
appliances able to use mineral oil or biodiesel		5.44	0.298	1.10	74
B30K [f]		6.10	0.245	1.09	75
bioethanol from any biomass source		47.0	0.140	1.08	76
Solid fuel: [g]					
house coal		3.67	0.394	1.00	11
anthracite		3.64	0.394	1.00	15
manufactured smokeless fuel		4.61	0.433	1.21	12
wood logs		4.23	0.019	1.04	20
wood pellets (in bags for secondary heating)		5.81	0.039	1.26	22
wood pellets (bulk supply for main heating)		5.26	0.039	1.26	23
wood chips		3.07	0.016	1.12	21
dual fuel appliance (mineral and wood)		3.99	0.226	1.02	10
Electricity: [a]					
standard tariff	54	13.19	0.519	3.07	30
7-hour tariff (high rate) [h]	24	15.29	0.519	3.07	32
7-hour tariff (low rate) [h]		5.50	0.519	3.07	31
10-hour tariff (high rate) [h]	23	14.68	0.519	3.07	34
10-hour tariff (low rate) [h]		7.50	0.519	3.07	33
18-hour tariff (high rate) [h]	40	13.67	0.519	3.07	38
18-hour tariff (low rate) [h]		7.41	0.519	3.07	40
24-hour heating tariff	70	6.61	0.519	3.07	35
electricity sold to grid		13.19 [i]	0.519	3.07	36
electricity displaced from grid			0.519 [i]	3.07 [i]	37
electricity, any tariff [j]					39
Community heating schemes: [k]	120 [l]				
heat from boilers – mains gas		4.24	0.216	1.22	51
heat from boilers – LPG		4.24	0.241	1.09	52
heat from boilers – oil		4.24	0.331 [m]	1.10	53
heat from boilers that can use mineral oil or biodiesel		4.24	0.331	1.10	56
heat from boilers using biodiesel from any biomass source		4.24	0.123	1.06	57
heat from boilers using biodiesel from vegetable oil only		4.24	0.083	1.01	58
heat from boilers – B30D [f]		4.24	0.269	1.09	55
heat from boilers – coal		4.24	0.380 [n]	1.00	54
heat from electric heat pump		4.24	0.519	3.07	41
heat from boilers – waste combustion		4.24	0.047	1.23	42
heat from boilers – biomass		4.24	0.031 [o]	1.01	43
heat from boilers – biogas (landfill or sewage gas)		4.24	0.098	1.10	44
waste heat from power station		2.97	0.058 [p]	1.34	45
geothermal heat source		2.97	0.041	1.24	46
heat from CHP		2.97	as above [q]	as above [q]	48
electricity generated by CHP			0.519 [i]	3.07 [i]	49
electricity for pumping in distribution network			0.519	3.07	50

Appendix C, D, E, F and G

This appendix contains the following reports used in producing the content of this Energy and Sustainability Statement.

*Appendix C-*Flood risk map for planning to show the location of the site with regards to the relevant flood zone areas.

Appendix D- Floor plan and elevations used to produce SAP Calculation for this development.

Appendix E- SAP calculation reports for the selected units that were used to base the calculations on for this report. The reports are for the final stage of the energy hierarchy (Be Green). The reports demonstrate how reduction has been achieved over the baseline figures.

Appendix F- Sample water efficiency calculations to demonstrate how the required target suggested could be achieved.

Flood map for planning

Your reference	Location (easting/northing)	Created
<Unspecified>	**455129/207361**	**31 March 2022 10:03**

Your selected location is in flood zone 1, an area with a low probability of flooding.

This means:

- you don't need to do a flood risk assessment if your development is smaller than 1 hectare and not affected by other sources of flooding
- you may need to do a flood risk assessment if your development is larger than 1 hectare or affected by other sources of flooding or in an area with critical drainage problems

Notes

The flood map for planning shows river and sea flooding data only. It doesn't include other sources of flooding. It is for use in development planning and flood risk assessments.

This information relates to the selected location and is not specific to any property within it. The map is updated regularly and is correct at the time of printing.

Environment Agency

Flood map for planning

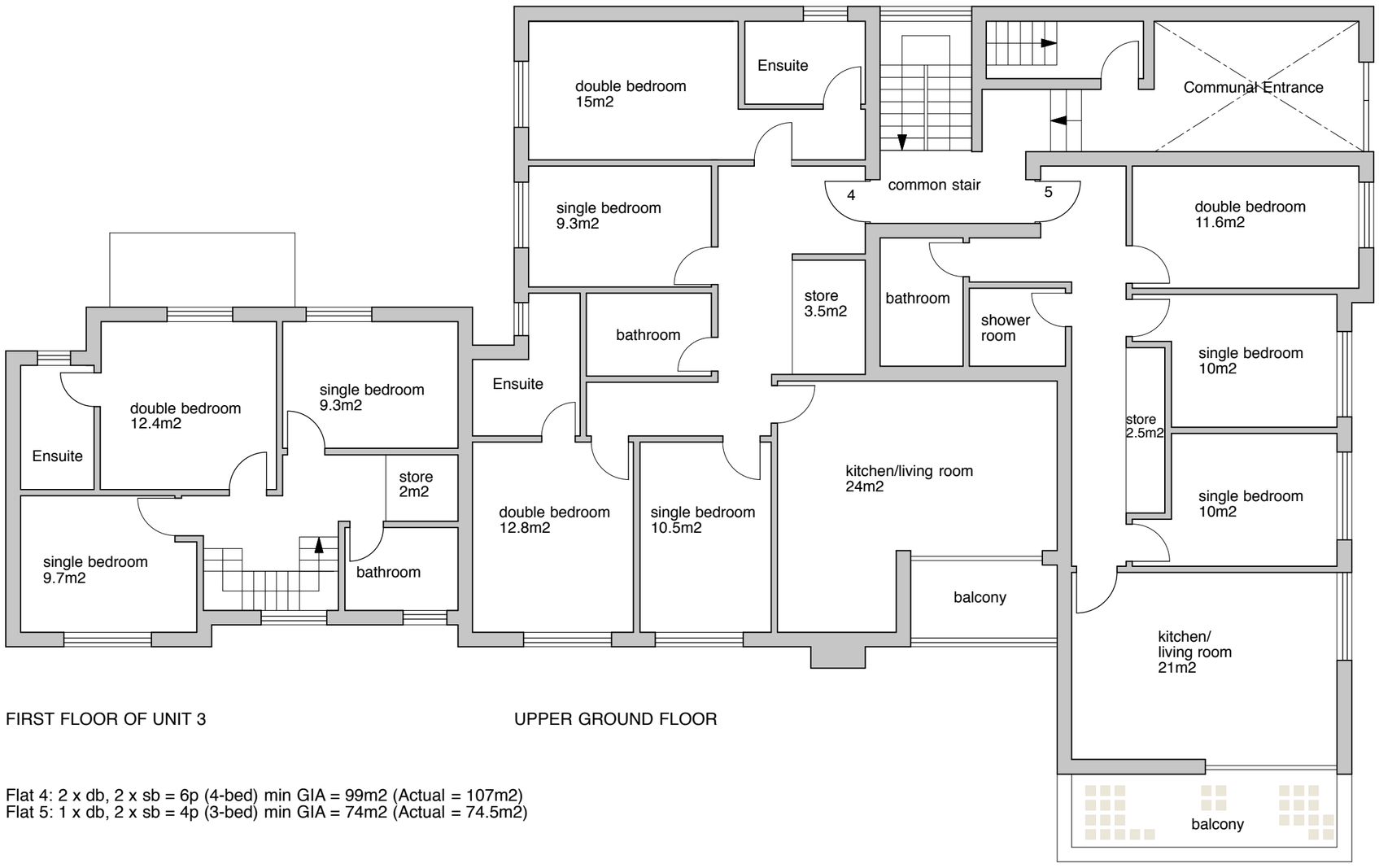
Your reference
<Unspecified>

Location (easting/northing)
455129/207361

Scale
1:2500

- Selected point
- Flood zone 3
- Flood zone 3: areas benefitting from flood defences
- Flood zone 2
- Flood zone 1
- Flood defence
- Main river
- Flood storage area

0 20 40 60m

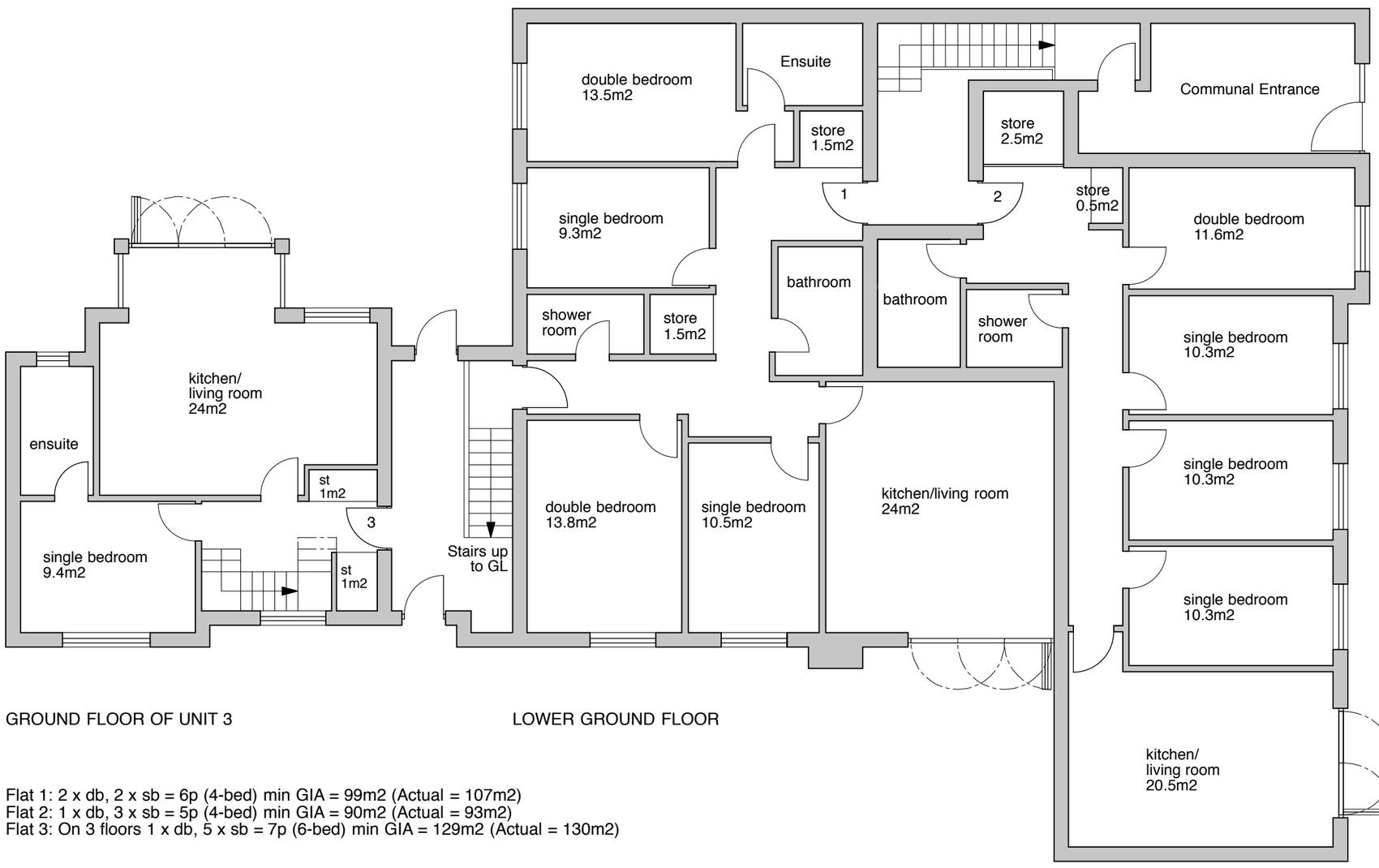


260 GIA

FIRST FLOOR OF UNIT 3

UPPER GROUND FLOOR

Flat 4: 2 x db, 2 x sb = 6p (4-bed) min GIA = 99m2 (Actual = 107m2)
Flat 5: 1 x db, 2 x sb = 4p (3-bed) min GIA = 74m2 (Actual = 74.5m2)



299 GIA

GROUND FLOOR OF UNIT 3

LOWER GROUND FLOOR

Flat 1: 2 x db, 2 x sb = 6p (4-bed) min GIA = 99m2 (Actual = 107m2)
Flat 2: 1 x db, 3 x sb = 5p (4-bed) min GIA = 90m2 (Actual = 93m2)
Flat 3: On 3 floors 1 x db, 5 x sb = 7p (6-bed) min GIA = 129m2 (Actual = 130m2)

0.0 1.0 2.0 3.0 4.0 5.0

Scale = 1 : 100

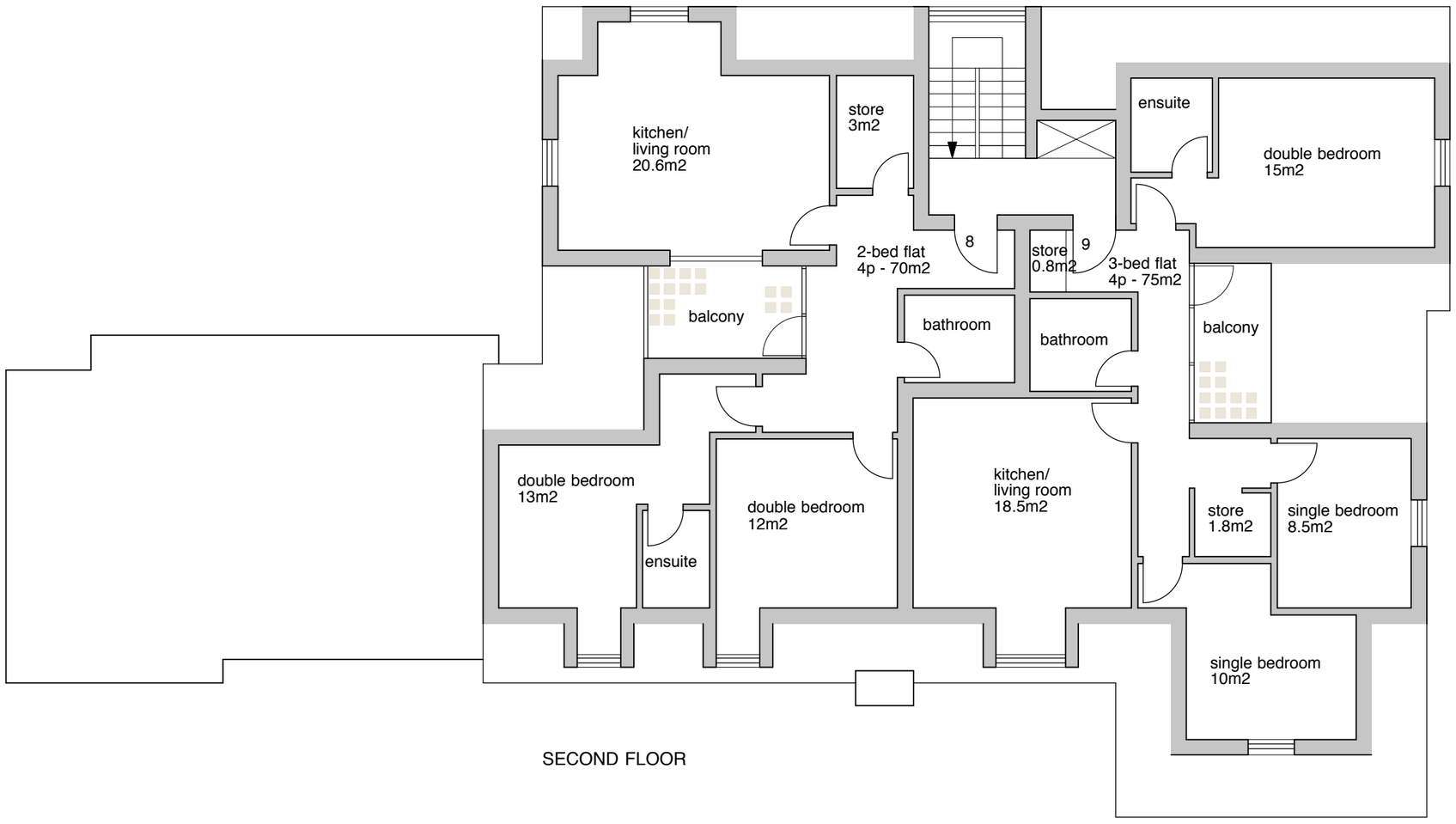
N

LesleyCotton
architect
Unit 12 Standingford House
26 Cave Street
Oxford OX4 1BA
01865 722550

253 London Road, OX3 9EH

Proposed Lower Floor Plans

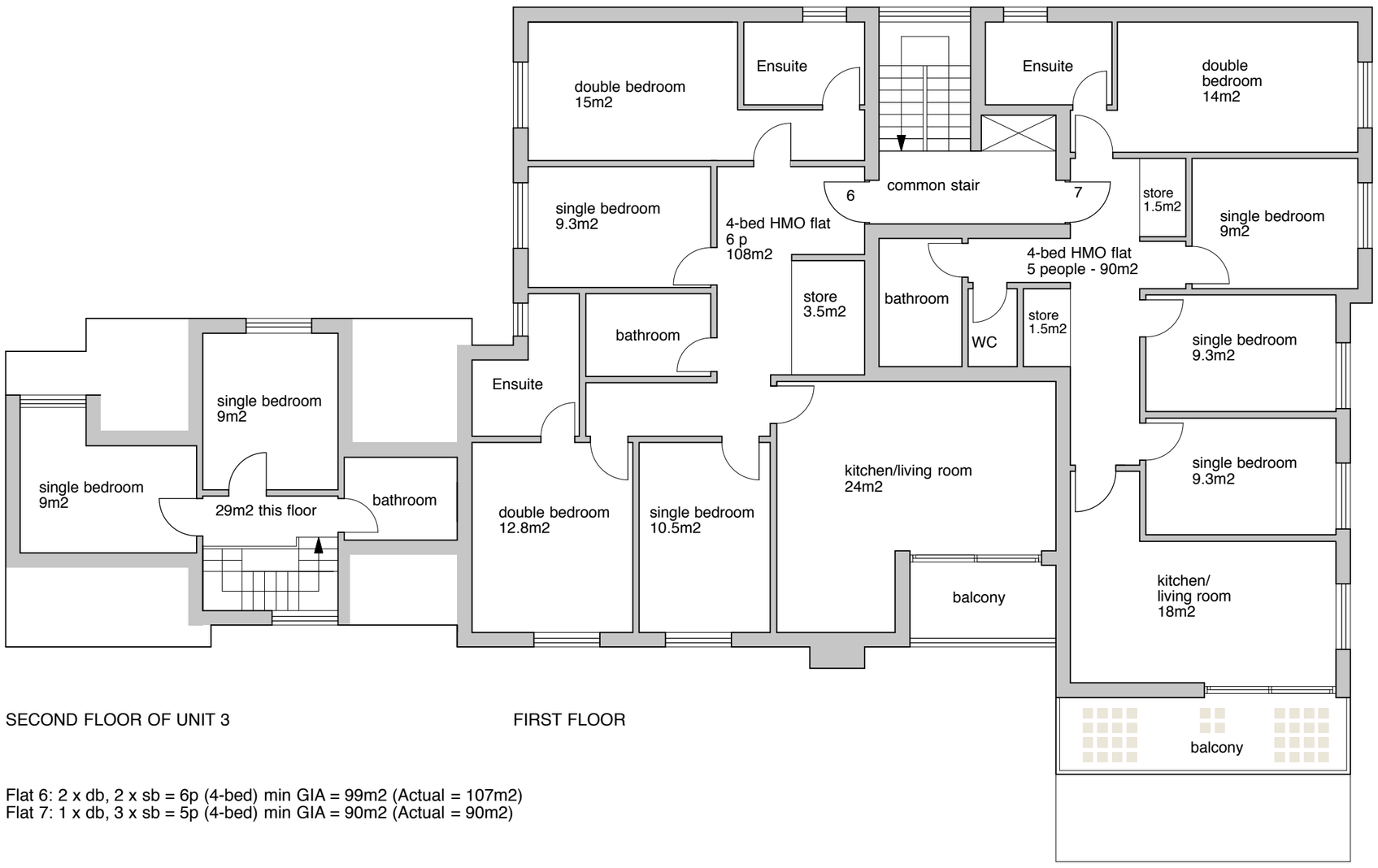
scale	drawing number
1:100 @ A2	245/PL 06



SECOND FLOOR

159 GIA

Flat 8: 2 x db = 4p (2-bed) min GIA = 70m2 (Actual = 70m2)
Flat 9: 1 x db, 2 x sb = 4p (3-bed) min GIA = 74m2 (Actual = 75m2)



SECOND FLOOR OF UNIT 3

FIRST FLOOR

246 GIA

Flat 6: 2 x db, 2 x sb = 6p (4-bed) min GIA = 99m2 (Actual = 107m2)
Flat 7: 1 x db, 3 x sb = 5p (4-bed) min GIA = 90m2 (Actual = 90m2)

0.0 1.0 2.0 3.0 4.0 5.0

Scale = 1 : 100

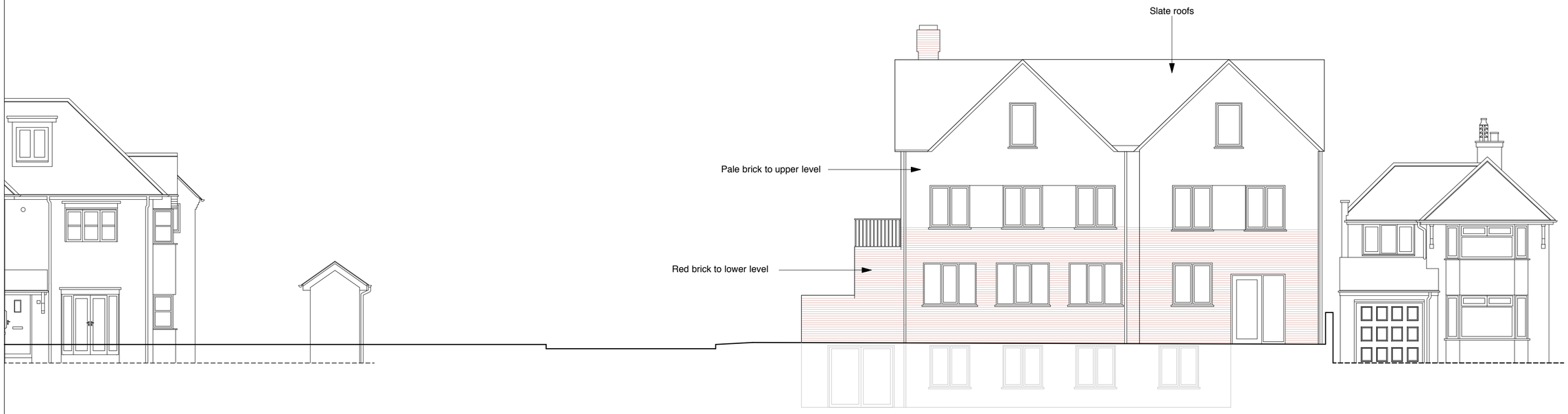
N

LesleyCotton
architect
Unit 12 Standingford House
26 Cave Street
Oxford OX4 1BA
01865 722550

253 London Road, OX3 9EH

Proposed Upper Floor Plans

scale	drawing number
1:100 @ A2	245/PL 07



LONDON ROAD ELEVATION

BARTON ROAD ELEVATION

0.0 1.0 2.0 3.0 4.0 5.0

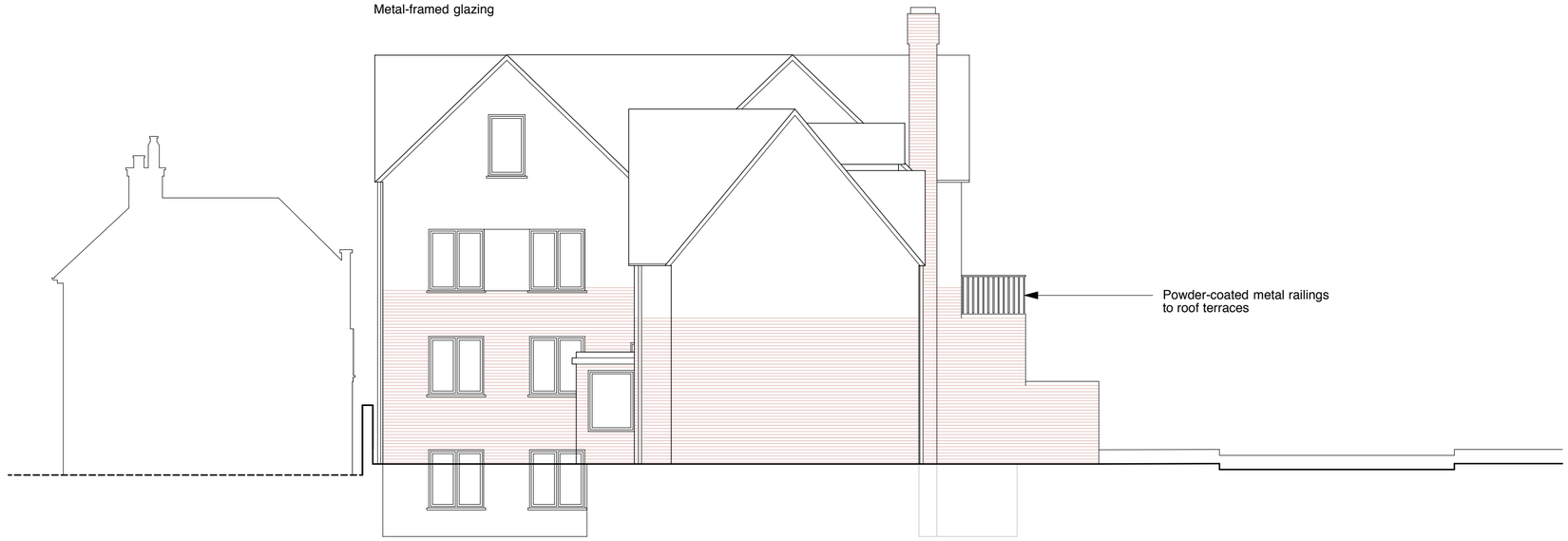
Scale = 1 : 100

LesleyCotton architect
Unit 12 Standingford House
26 Cave Street
Oxford OX4 1BA
01865 722550

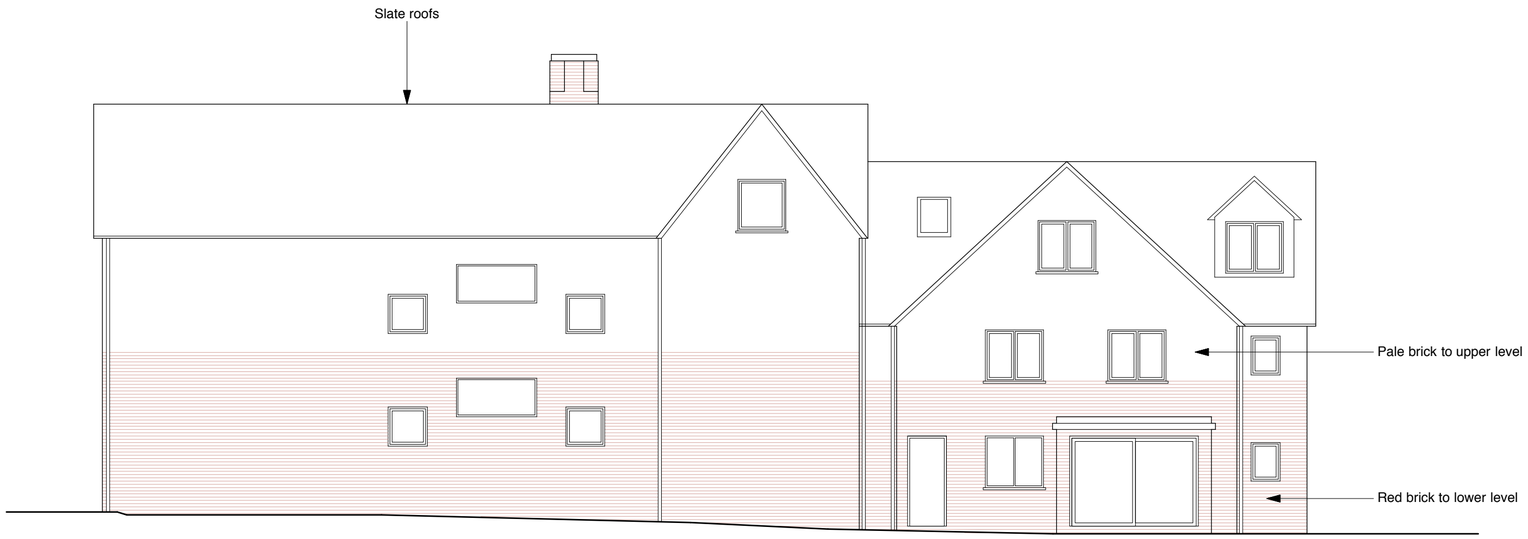
253 London Road, OX3 9EH

Proposed Front and Side Elevations

scale	drawing number
1:100 @ A2	245/PL 08



REAR ELEVATION



SIDE ELEVATION

0.0 1.0 2.0 3.0 4.0 5.0

Scale = 1 : 100

LesleyCotton
architect
Unit 12 Standingford House
26 Cave Street
Oxford OX4 1BA
01865 722550

253 London Road, OX3 9EH

Proposed Rear and Side Elevations

scale	drawing number
1:100 @ A2	245/PL 09

BASIC COMPLIANCE REPORT
Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

Property Reference	Flat 03 - 253-255 London Road	**Issued on Date**	31/03/2022
Assessment Reference	003-BE GREEN	**Prop Type Ref**	PR8346
Property	Flat 03, 253-255, London Road, Headington, Oxford, OX3 9EH		

SAP Rating	92 A	**DER**	10.47	**TER**	18.75
Environmental	91 B	**% DER<TER**	44.17		
CO_2 Emissions (t/year)	0.88	**DFEE**	61.16	**TFEE**	66.90
General Requirements Compliance	Pass	**% DFEE<TFEE**	8.57		

Assessor Details	Mr. Iraj Maghounaki, ERS Consultants Ltd, Tel: 01865 378 885, info@erscltd.co.uk	**Assessor ID**	v571-0001
Client			

SUMARY FOR INPUT DATA FOR New Build (As Designed)

Criterion 1 – Achieving the TER and TFEE rate

1a TER and DER

Fuel for main heating	Mains gas		
Fuel factor	1.00 (mains gas)		
Target Carbon Dioxide Emission Rate (TER)	18.75	$kgCO_2/m^2$	
Dwelling Carbon Dioxide Emission Rate (DER)	10.47	$kgCO_2/m^2$	Pass
	-8.28 (-44.2%)	$kgCO_2/m^2$	

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	66.90	$kWh/m^2/yr$	
Dwelling Fabric Energy Efficiency (DFEE)	61.16	$kWh/m^2/yr$	
	-5.7 (-8.5%)	$kWh/m^2/yr$	Pass

Criterion 2 – Limits on design flexibility

Limiting Fabric Standards

2 Fabric U-values

Element	Average	Highest	
External wall	0.19 (max. 0.30)	0.22 (max. 0.70)	Pass
Party wall	0.00 (max. 0.20)	-	Pass
Floor	0.12 (max. 0.25)	0.22 (max. 0.70)	Pass
Roof	0.12 (max. 0.20)	0.16 (max. 0.35)	Pass
Openings	1.40 (max. 2.00)	1.40 (max. 3.30)	Pass

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	Pass

Limiting System Efficiencies

4 Heating efficiency

Main heating system	Boiler system with radiators or underfloor - Mains gas Data from database Worcester Greenstar 32CDi Compact ErP Combi boiler Efficiency: 89.8% SEDBUK2009 Minimum: 88.0%		Pass
Secondary heating system	None		

5 Cylinder insulation

Hot water storage	No cylinder		

6 Controls

Space heating controls	Time and temperature zone control		Pass
Hot water controls	No cylinder		
Boiler interlock	Yes		Pass

7 Low energy lights

Percentage of fixed lights with low-energy fittings	100	%	
Minimum	75	%	Pass

8 Mechanical ventilation

Not applicable

Criterion 3 – Limiting the effects of heat gains in summer

9 Summertime temperature

Overheating risk (Thames Valley)	Slight		Pass

Based on:

Overshading	Average		
Windows facing North	1.68 m², No overhang		
Windows facing East	7.05 m², No overhang		
Windows facing South	1.68 m², No overhang		
Windows facing West	9.95 m², No overhang		
Air change rate	4.00 ach		
Blinds/curtains	None		

Criterion 4 – Building performance consistent with DER and DFEE rate

Party Walls

Type	U-value		
Filled Cavity with Edge Sealing	0.00	W/m²K	Pass

Air permeability and pressure testing

3 Air permeability

Air permeability at 50 pascals	4.00 (design value)		
Maximum	10.0		Pass

10 Key features

Party wall U-value	0.00	W/m²K	
Roof U-value	0.09	W/m²K	
Roof U-value	0.09	W/m²K	
Floor U-value	0.10	W/m²K	
Photovoltaic array	3.00	kW	

This report has not been submitted through the Elmhurst Energy members' portal, therefore results are subject to change when the dwelling is completed.

BASIC COMPLIANCE REPORT
Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

Property Reference	Flat 07- 253-255 London Road	**Issued on Date**	31/03/2022
Assessment Reference	003-BE GREEN	**Prop Type Ref**	PR8346
Property	Flat 07, 253-255 , London Road, Headington, Oxford, OX3 9EH		

SAP Rating	92 A	**DER**	9.26	**TER**	17.01
Environmental	93 A	**% DER<TER**	45.55		
CO_2 Emissions (t/year)	0.52	**DFEE**	43.18	**TFEE**	48.08
General Requirements Compliance	Pass	**% DFEE<TFEE**	10.20		

Assessor Details	Mr. Iraj Maghounaki, ERS Consultants Ltd, Tel: 01865 378 885, info@erscltd.co.uk	**Assessor ID**	v571-0001
Client			

SUMARY FOR INPUT DATA FOR New Build (As Designed)

Criterion 1 – Achieving the TER and TFEE rate

1a TER and DER

Fuel for main heating	Mains gas		
Fuel factor	1.00 (mains gas)		
Target Carbon Dioxide Emission Rate (TER)	17.01	$kgCO_2/m^2$	
Dwelling Carbon Dioxide Emission Rate (DER)	9.26	$kgCO_2/m^2$	Pass
	-7.75 (-45.6%)	$kgCO_2/m^2$	

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	48.08	$kWh/m^2/yr$	
Dwelling Fabric Energy Efficiency (DFEE)	43.18	$kWh/m^2/yr$	
	-4.9 (-10.2%)	$kWh/m^2/yr$	Pass

Criterion 2 – Limits on design flexibility

Limiting Fabric Standards

2 Fabric U-values

Element	Average	Highest	
External wall	0.19 (max. 0.30)	0.20 (max. 0.70)	Pass
Party wall	0.00 (max. 0.20)	-	Pass
Floor	0.22 (max. 0.25)	0.22 (max. 0.70)	Pass
Roof	0.09 (max. 0.20)	0.09 (max. 0.35)	Pass
Openings	1.40 (max. 2.00)	1.40 (max. 3.30)	Pass

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	Pass

Limiting System Efficiencies

4 Heating efficiency

Main heating system	Boiler system with radiators or underfloor - Mains gas Data from database Worcester Greenstar 32CDi Compact ErP Combi boiler Efficiency: 89.8% SEDBUK2009 Minimum: 88.0%		Pass
Secondary heating system	None		

5 Cylinder insulation

Hot water storage	No cylinder		

6 Controls

Space heating controls	Time and temperature zone control		Pass
Hot water controls	No cylinder		
Boiler interlock	Yes		Pass

7 Low energy lights

Percentage of fixed lights with low-energy fittings	100	%	
Minimum	75	%	Pass

8 Mechanical ventilation

Not applicable

Criterion 3 – Limiting the effects of heat gains in summer

9 Summertime temperature

Overheating risk (Thames Valley)	Medium		Pass

Based on:

Overshading	Average		
Windows facing East	0.83 m², No overhang		
Windows facing South	9.80 m², No overhang		
Windows facing West	5.59 m², No overhang		
Air change rate	3.00 ach		
Blinds/curtains	None		

Criterion 4 – Building performance consistent with DER and DFEE rate

Party Walls

Type	U-value		
Filled Cavity with Edge Sealing	0.00	W/m²K	Pass

Air permeability and pressure testing

3 Air permeability

Air permeability at 50 pascals	4.00 (design value)		
Maximum	10.0		Pass

10 Key features

Party wall U-value	0.00	W/m²K
Roof U-value	0.09	W/m²K
Photovoltaic array	1.80	kW

This report has not been submitted through the Elmhurst Energy members' portal, therefore results are subject to change when the dwelling is completed.

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

Design SAP
elmhurst energy

Property Reference	Flat 03 - 253-255 London Road	**Issued on Date**	31/03/2022
Assessment Reference	003-BE GREEN	**Prop Type Ref**	PR8346
Property	Flat 03, 253-255, London Road, Headington, Oxford, OX3 9EH		

SAP Rating	92 A	**DER**	10.47	**TER**	18.75
Environmental	91 B	**% DER<TER**	44.17		
CO_2 Emissions (t/year)	0.88	**DFEE**	61.16	**TFEE**	66.90
General Requirements Compliance	Pass	**% DFEE<TFEE**	8.57		

Assessor Details	Mr. Iraj Maghounaki, ERS Consultants Ltd, Tel: 01865 378 885, info@erscltd.co.uk	**Assessor ID**	v571-0001
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 130 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) 18.75 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 10.47 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)66.9 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)61.2 kWh/m²/yrOK

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2 Fabric U-values

Element	Average	Highest	
External wall	0.19 (max. 0.30)	0.22 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.12 (max. 0.25)	0.22 (max. 0.70)	OK
Roof	0.12 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.40 (max. 2.00)	1.40 (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
Worcester Greenstar 32CDi Compact ErP
Combi boiler
Efficiency: 89.8% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

---
5 Cylinder insulation
Hot water storage: No cylinder

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

Hot water controls: No cylinder

Boiler interlock: Yes OK

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

---
8 Mechanical ventilation
Not applicable

---
9 Summertime temperature
Overheating risk (Thames Valley): Slight OK
Based on:
Overshading: Average
Windows facing North: 1.68 m², No overhang
Windows facing East: 7.05 m², No overhang
Windows facing South: 1.68 m², No overhang
Windows facing West: 9.95 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 0.09 W/m²K
Roof U-value 0.09 W/m²K
Floor U-value 0.10 W/m²K
Photovoltaic array 3.00 kW

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.9300	(1b)	x 2.4000	(2b) =	115.0320	(1b) - (3b)
First floor	53.2800	(1c)	x 2.5500	(2c) =	135.8640	(1c) - (3c)
Second floor	29.2400	(1d)	x 2.5800	(2d) =	75.4392	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	130.4500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		326.3352	(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							5 * 10	=	50.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000 / (5) =	0.1532	(8)
Pressure test		Yes	
Measured/design AP50		4.0000	
Infiltration rate		0.3532	(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) =	0.2737	(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	0.3490	0.3422	0.3353	0.3011	0.2943	0.2601	0.2601	0.2532	0.2737	0.2943	0.3080	0.3216	(22b)
Effective ac	0.5609	0.5585	0.5562	0.5453	0.5433	0.5338	0.5338	0.5321	0.5375	0.5433	0.5474	0.5517	(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	
Door			10.4200	1.4000	14.5880			(26)
Windows (Uw = 1.40)			20.3600	1.3258	26.9924			(27)
Rooflight (Uw = 1.40)			0.7200	1.3258	0.9545			(27a)
GF			47.9300	0.1000	4.7930			(28a)
Sem. Exposed Floor			8.4800	0.2200	1.8656			(28b)
Exposed Floor			1.2500	0.2200	0.2750			(28b)
Ext. Wall (Red Brick)	81.0900	15.6400	65.4500	0.1800	11.7810			(29a)
Ext. Wall (Pale Brick)	47.0000	10.0200	36.9800	0.1800	6.6564			(29a)
Dormer Wall	11.4600	3.2300	8.2300	0.2200	1.8106			(29a)
Perim. Wall	43.3200		43.3200	0.2000	8.6640			(29a)
Sem. Shelt. Wall	12.3600	1.8900	10.4700	0.2010	2.1043			(29a)
Flat Roof	4.3000		4.3000	0.0900	0.3870			(30)
Roof ins.@Joists	34.7800		34.7800	0.0900	3.1302			(30)
Roof ins.@Rafters	28.7900	0.7200	28.0700	0.1600	4.4912			(30)
Total net area of external elements Aum(A, m2)			320.7600					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		88.4933			(33)
Party Wall 1			20.0000	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	31.7522	(36)
Total fabric heat loss (33) + (36) =	120.2455	(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	60.4046	60.1499	59.9002	58.7275	58.5081	57.4868	57.4868	57.2977	57.8802	58.5081	58.9520	59.4160	(38)
Heat transfer coeff	180.6501	180.3954	180.1457	178.9730	178.7536	177.7323	177.7323	177.5432	178.1257	178.7536	179.1975	179.6615	(39)
Average = Sum(39)m / 12 =												178.9720	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3848	1.3829	1.3810	1.3720	1.3703	1.3625	1.3625	1.3610	1.3655	1.3703	1.3737	1.3772	(40)
HLP (average)												1.3720	(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	2.8961 (42)
Average daily hot water use (litres/day)	102.9835 (43)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	113.2818	109.1625	105.0432	100.9238	96.8045	92.6851	92.6851	96.8045	100.9238	105.0432	109.1625	113.2818	(44)
Energy conte	167.9937	146.9284	151.6169	132.1833	126.8330	109.4473	101.4190	116.3797	117.7697	137.2492	149.8183	162.6929	(45)
Energy content (annual)										Total = Sum(45)m =		1620.3313	(45)
Distribution loss (46)m = 0.15 x (45)m	25.1991	22.0393	22.7425	19.8275	19.0250	16.4171	15.2128	17.4570	17.6655	20.5874	22.4727	24.4039	(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	25.3234	22.8731	25.3084	24.4651	25.2453	24.3840	25.1676	25.2180	24.4264	25.2710	24.4878	25.3105	(61)
Total heat required for water heating calculated for each month	193.3171	169.8015	176.9254	156.6484	152.0783	133.8312	126.5865	141.5977	142.1961	162.5203	174.3060	188.0034	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h	193.3171	169.8015	176.9254	156.6484	152.0783	133.8312	126.5865	141.5977	142.1961	162.5203	174.3060	188.0034	(64)
								Total per year (kWh/year) = Sum(64)m =				1917.8118	(64)
Heat gains from water heating, kWh/month	62.1888	54.5720	56.7397	50.0672	48.4833	42.4872	40.0137	45.0008	45.2650	51.9531	55.9365	60.4230	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	144.8074	144.8074	144.8074	144.8074	144.8074	144.8074	144.8074	144.8074	144.8074	144.8074	144.8074	144.8074	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	27.6498	24.5583	19.9721	15.1202	11.3025	9.5421	10.3105	13.4020	17.9882	22.8401	26.6578	28.4182	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	298.2621	301.3571	293.5577	276.9538	255.9943	236.2954	223.1353	220.0402	227.8396	244.4435	265.4030	285.1020	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.4807	37.4807	37.4807	37.4807	37.4807	37.4807	37.4807	37.4807	37.4807	37.4807	37.4807	37.4807	(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)	-115.8459	-115.8459	-115.8459	-115.8459	-115.8459	-115.8459	-115.8459	-115.8459	-115.8459	-115.8459	-115.8459	-115.8459	(71)
Water heating gains (Table 5)	83.5870	81.2083	76.2631	69.5378	65.1657	59.0100	53.7819	60.4849	62.8681	69.8295	77.6896	81.2137	(72)
Total internal gains	478.9411	476.5659	459.2352	431.0540	401.9048	374.2896	356.6698	363.3693	378.1380	406.5553	439.1926	464.1761	(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	1.6800	10.6334	0.6300	0.7000	0.7700	5.4595	(74)
East	7.0500	19.6403	0.6300	0.7000	0.7700	42.3164	(76)
South	1.6800	46.7521	0.6300	0.7000	0.7700	24.0039	(78)
West	9.9500	19.6403	0.6300	0.7000	0.7700	59.7231	(80)
East	0.7200	25.5349	0.6300	0.7000	1.0000	7.2971	(82)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	138.7999	263.9108	421.2220	601.6691	731.4953	747.4668	712.0893	614.6712	485.0386	309.1331	171.5673	115.1744	(83)
Total gains	617.7410	740.4767	880.4572	1032.7231	1133.4001	1121.7565	1068.7592	978.0405	863.1766	715.6884	610.7599	579.3506	(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	50.1468	50.2176	50.2872	50.6167	50.6788	50.9701	50.9701	51.0244	50.8575	50.6788	50.5533	50.4228	
alpha	4.3431	4.3478	4.3525	4.3744	4.3786	4.3980	4.3980	4.4016	4.3905	4.3786	4.3702	4.3615	
util living area	0.9992	0.9980	0.9942	0.9791	0.9318	0.8204	0.6707	0.7349	0.9259	0.9905	0.9984	0.9994	(86)
MIT	19.3433	19.5045	19.8001	20.2012	20.5804	20.8494	20.9548	20.9321	20.7022	20.2039	19.6988	19.3136	(87)
Th 2	19.7750	19.7765	19.7780	19.7849	19.7862	19.7922	19.7922	19.7934	19.7899	19.7862	19.7836	19.7808	(88)
util rest of house	0.9989	0.9973	0.9918	0.9697	0.8980	0.7277	0.5150	0.5858	0.8734	0.9850	0.9977	0.9992	(89)
MIT 2	17.5721	17.8089	18.2412	18.8255	19.3526	19.6841	19.7750	19.7633	19.5265	18.8361	18.0981	17.5326	(90)
Living area fraction									fLA = Living area / (4) =			0.1840	(91)
MIT	17.8979	18.1208	18.5280	19.0786	19.5785	19.8985	19.9921	19.9784	19.7428	19.0878	18.3926	17.8602	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.7479	17.9708	18.3780	18.9286	19.4285	19.7485	19.8421	19.8284	19.5928	18.9378	18.2426	17.7102	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9980	0.9955	0.9876	0.9601	0.8848	0.7237	0.5221	0.5908	0.8617	0.9787	0.9961	0.9985	(94)
Useful gains	616.5363	737.1680	869.5009	991.5340	1002.8152	811.8289	558.0229	577.7944	743.7619	700.4089	608.3621	578.4973	(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	2429.3712	2357.9163	2139.7680	1794.8484	1381.5004	915.0610	576.2178	608.6811	978.4132	1490.4084	1996.7248	2427.2709	(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	1348.7491	1089.1429	945.0787	578.3864	281.7418	0.0000	0.0000	0.0000	0.0000	587.7596	999.6211	1375.4875	(98)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Space heating		7205.9671 (98)
Space heating per m2	(98) / (4) =	55.2393 (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 %)	93.1000 (206)
Efficiency of secondary/supplementary heating system, %	0.0000 (208)
Space heating requirement	7740.0291 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1348.7491	1089.1429	945.0787	578.3864	281.7418	0.0000	0.0000	0.0000	0.0000	587.7596	999.6211	1375.4875	(98)
Space heating efficiency (main heating system 1)													
	93.1000	93.1000	93.1000	93.1000	93.1000	0.0000	0.0000	0.0000	0.0000	93.1000	93.1000	93.1000	(210)
Space heating fuel (main heating system)													
	1448.7101	1169.8635	1015.1221	621.2528	302.6228	0.0000	0.0000	0.0000	0.0000	631.3207	1073.7069	1477.4302	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	193.3171	169.8015	176.9254	156.6484	152.0783	133.8312	126.5865	141.5977	142.1961	162.5203	174.3060	188.0034	(64)
Efficiency of water heater												87.2000	(216)
(217)m	90.2459	90.2116	90.1296	89.9307	89.4415	87.2000	87.2000	87.2000	87.2000	89.9182	90.1627	90.2643	(217)
Fuel for water heating, kWh/month													
	214.2115	188.2257	196.3012	174.1878	170.0310	153.4762	145.1680	162.3827	163.0689	180.7423	193.3239	208.2809	(219)
Water heating fuel used												2149.4001	(219)
Annual totals kWh/year													
Space heating fuel - main system												7740.0291	(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)												488.3035	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 3.00 * 853 * 1.00) =										-2047.2718		-2047.2718	(233)
Total delivered energy for all uses												8405.4610	(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	7740.0291	0.2160	1671.8463	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2149.4001	0.2160	464.2704	(264)
Space and water heating			2136.1167	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	488.3035	0.5190	253.4295	(268)
Energy saving/generation technologies				
PV Unit	-2047.2718	0.5190	-1062.5341	(269)
Total CO2, kg/year			1365.9372	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			10.4700	(273)

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

DER		10.4700	ZC1
Total Floor Area	TFA	130.4500	
Assumed number of occupants	N	2.8961	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		13.5488	ZC2
CO2 emissions from cooking, equation (L16)		1.4451	ZC3
Total CO2 emissions		25.4638	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		25.4638	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	47.9300 (1b)	x	2.4000 (2b)	=	115.0320	(1b) - (3b)
First floor	53.2800 (1c)	x	2.5500 (2c)	=	135.8640	(1c) - (3c)
Second floor	29.2400 (1d)	x	2.5800 (2d)	=	75.4392	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	130.4500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	326.3352	(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) =	0.1226	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3726	(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) =	0.2887	(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	0.3681	0.3609	0.3537	0.3176	0.3104	0.2743	0.2743	0.2671	0.2887	0.3104	0.3248	0.3393	(22b)
Effective ac	0.5678	0.5651	0.5626	0.5504	0.5482	0.5376	0.5376	0.5357	0.5417	0.5482	0.5528	0.5576	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			10.4200	1.0000	10.4200			(26)
TER Opening Type (Uw = 1.40)			20.3600	1.3258	26.9924			(27)
TER Room Window (Uw = 1.70)			0.7200	1.5918	1.1461			(27a)
GF			47.9300	0.1300	6.2309			(28a)
Sem. Exposed Floor			8.4800	0.1300	1.1024			(28b)
Exposed Floor			1.2500	0.1300	0.1625			(28b)
Ext. Wall (Red Brick)	81.0900	15.6400	65.4500	0.1800	11.7810			(29a)
Ext. Wall (Pale Brick)	47.0000	10.0200	36.9800	0.1800	6.6564			(29a)
Dormer Wall	11.4600	3.2300	8.2300	0.1800	1.4814			(29a)
Perim. Wall	43.3200		43.3200	0.1800	7.7976			(29a)
Sem. Shelt. Wall	12.3600	1.8900	10.4700	0.1800	1.8846			(29a)
Flat Roof	4.3000		4.3000	0.1300	0.5590			(30)
Roof ins.@Joists	34.7800		34.7800	0.1300	4.5214			(30)
Roof ins.@Rafters	28.7900	0.7200	28.0700	0.1300	3.6491			(30)
Total net area of external elements Aum(A, m2)			320.7600					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		84.3848			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							27.1383	(36)
Total fabric heat loss					(33) + (36) =		111.5231	(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	61.1432	60.8598	60.5820	59.2773	59.0332	57.8969	57.8969	57.6864	58.3346	59.0332	59.5270	60.0433	(38)
Heat transfer coeff	172.6663	172.3829	172.1051	170.8004	170.5563	169.4200	169.4200	169.2095	169.8577	170.5563	171.0501	171.5664	(39)
Average = Sum(39)m / 12 =												170.7992	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3236	1.3214	1.3193	1.3093	1.3074	1.2987	1.2987	1.2971	1.3021	1.3074	1.3112	1.3152	(40)
HLP (average)												1.3093	(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	2.8961	(42)
Average daily hot water use (litres/day)	102.9835	(43)

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

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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Daily hot water use
                113.2818   109.1625   105.0432   100.9238    96.8045    92.6851    92.6851    96.8045   100.9238   105.0432   109.1625   113.2818 (44)
Energy conte    167.9937   146.9284   151.6169   132.1833   126.8330   109.4473   101.4190   116.3797   117.7697   137.2492   149.8183   162.6929 (45)
Energy content (annual)                                                                                         Total = Sum(45)m =    1620.3313 (45)
Distribution loss  (46)m = 0.15 x (45)m
                 25.1991    22.0393    22.7425    19.8275    19.0250    16.4171    15.2128    17.4570    17.6655    20.5874    22.4727    24.4039 (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    50.9589    49.3151    49.3305    45.7077    47.2313    49.3305    49.3151    50.9589    49.3151    50.9589 (61)
Total heat required for water heating calculated for each month
                218.9526   192.9558   202.5758   181.4984   176.1635   155.1550   148.6503   165.7102   167.0848   188.2081   199.1333   213.6518 (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
                218.9526   192.9558   202.5758   181.4984   176.1635   155.1550   148.6503   165.7102   167.0848   188.2081   199.1333   213.6518 (64)
                                                                                    Total per year (kWh/year) = Sum(64)m =     2209.7396 (64)
Heat gains from water heating, kWh/month
                 68.5976    60.3605    63.1523    56.2797    54.5046    47.8181    45.5296    51.0289    51.4872    58.3751    62.1433    66.8351 (65)


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5. Internal gains (see Table 5 and 5a)
----------------------------------------------------------------------------------------------------
Metabolic gains (Table 5), Watts
                  Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m           144.8074   144.8074   144.8074   144.8074   144.8074   144.8074   144.8074   144.8074   144.8074   144.8074   144.8074   144.8074 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
                 27.6498    24.5583    19.9721    15.1202    11.3025     9.5421    10.3105    13.4020    17.9882    22.8401    26.6578    28.4182 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
                298.2621   301.3571   293.5577   276.9538   255.9943   236.2954   223.1353   220.0402   227.8396   244.4435   265.4030   285.1020 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
                 37.4807    37.4807    37.4807    37.4807    37.4807    37.4807    37.4807    37.4807    37.4807    37.4807    37.4807    37.4807 (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)
               -115.8459  -115.8459  -115.8459  -115.8459  -115.8459  -115.8459  -115.8459  -115.8459  -115.8459  -115.8459  -115.8459  -115.8459 (71)
Water heating gains (Table 5)
                 92.2011    89.8222    84.8822    78.1663    73.2589    66.4141    61.1958    68.5872    71.5100    78.4611    86.3102    89.8322 (72)
Total internal gains
                487.5552   485.1798   467.8543   439.6825   409.9979   381.6937   364.0837   371.4717   386.7800   415.1870   447.8132   472.7946 (73)


----------------------------------------------------------------------------------------------------
6. Solar gains
----------------------------------------------------------------------------------------------------
[Jan]                                        Area        Solar flux            g              FF            Access             Gains
                                               m2         Table 6a    Specific data   Specific data      factor                W
                                                              W/m2     or Table 6b     or Table 6c      Table 6d
----------------------------------------------------------------------------------------------------
North                                        1.6800        10.6334         0.6300          0.7000          0.7700            5.4595 (74)
East                                         7.0500        19.6403         0.6300          0.7000          0.7700           42.3164 (76)
South                                        1.6800        46.7521         0.6300          0.7000          0.7700           24.0039 (78)
West                                         9.9500        19.6403         0.6300          0.7000          0.7700           59.7231 (80)
East                                         0.7200        25.5349         0.6300          0.7000          1.0000            7.2971 (82)
----------------------------------------------------------------------------------------------------

Solar gains     138.7999   263.9108   421.2220   601.6691   731.4953   747.4668   712.0893   614.6712   485.0386   309.1331   171.5673   115.1744 (83)
Total gains     626.3551   749.0906   889.0763  1041.3516  1141.4932  1129.1605  1076.1731   986.1429   871.8185   724.3201   619.3805   587.9690 (84)


----------------------------------------------------------------------------------------------------
7. Mean internal temperature (heating season)
----------------------------------------------------------------------------------------------------
Temperature during heating periods in the living area from Table 9, Th1 (C)                                                  21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                  Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau              52.4655    52.5518    52.6366    53.0387    53.1146    53.4708    53.4708    53.5373    53.3331    53.1146    52.9612    52.8019
alpha             4.4977     4.5035     4.5091     4.5359     4.5410     4.5647     4.5647     4.5692     4.5555     4.5410     4.5307     4.5201
util living area
                  0.9992     0.9980     0.9938     0.9773     0.9249     0.8033     0.6469     0.7123     0.9175     0.9898     0.9983     0.9994 (86)

MIT              19.4244    19.5843    19.8742    20.2661    20.6288    20.8757    20.9655    20.9467    20.7393    20.2603    19.7696    19.3962 (87)
Th 2             19.8224    19.8241    19.8257    19.8335    19.8350    19.8418    19.8418    19.8431    19.8392    19.8350    19.8320    19.8290 (88)
util rest of house
                  0.9989     0.9973     0.9914     0.9674     0.8894     0.7104     0.4985     0.5677     0.8626     0.9839     0.9976     0.9992 (89)
MIT 2            17.7224    17.9573    18.3814    18.9523    19.4535    19.7536    19.8287    19.8197    19.6106    18.9510    18.2341    17.6855 (90)
Living area fraction                                                                                   fLA = Living area / (4) =      0.1840 (91)
MIT              18.0355    18.2567    18.6561    19.1940    19.6697    19.9601    20.0378    20.0271    19.8182    19.1919    18.5166    18.0002 (92)
Temperature adjustment                                                                                                                0.0000
adjusted MIT     18.0355    18.2567    18.6561    19.1940    19.6697    19.9601    20.0378    20.0271    19.8182    19.1919    18.5166    18.0002 (93)


----------------------------------------------------------------------------------------------------
8. Space heating requirement
----------------------------------------------------------------------------------------------------
                  Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation       0.9982     0.9957     0.9878     0.9599     0.8831     0.7213     0.5256     0.5934     0.8613     0.9790     0.9962     0.9986 (94)
Useful gains    625.1984   745.8668   878.1933   999.5932  1008.0049   814.4941   565.6802   585.1525   750.8876   709.0786   617.0495   587.1542 (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
               2371.6602  2302.4604  2092.1185  1758.2183  1359.2820   908.1010   582.4397   613.7364   971.2851  1465.3975  1952.8099  2367.6567 (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
               1299.3676  1046.0309   903.1603   546.2101   261.3502     0.0000     0.0000     0.0000     0.0000   562.7013   961.7474  1324.6939 (98)
Space heating                                                                                                                      6905.2618 (98)
```

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Space heating per m2 (98) / (4) = 52.9342 (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)
Space heating requirement	7393.2139 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1299.3676	1046.0309	903.1603	546.2101	261.3502	0.0000	0.0000	0.0000	0.0000	562.7013	961.7474	1324.6939	(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)	1391.1859	1119.9474	966.9811	584.8074	279.8182	0.0000	0.0000	0.0000	0.0000	602.4639	1029.7082	1418.3018	(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	218.9526	192.9558	202.5758	181.4984	176.1635	155.1550	148.6503	165.7102	167.0848	188.2081	199.1333	213.6518	(64)
Efficiency of water heater												80.3000	(216)
(217)m	88.7895	88.6632	88.3638	87.6504	86.0424	80.3000	80.3000	80.3000	80.3000	87.6372	88.4908	88.8479	(217)
Fuel for water heating, kWh/month	246.5973	217.6277	229.2520	207.0709	204.7403	193.2192	185.1187	206.3639	208.0757	214.7582	225.0329	240.4691	(219)
Water heating fuel used												2578.3257	(219)
Annual totals kWh/year													
Space heating fuel - main system												7393.2139	(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)												488.3035	(232)
Total delivered energy for all uses												10534.8432	(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	7393.2139	0.2160	1596.9342	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2578.3257	0.2160	556.9184	(264)
Space and water heating			2153.8526	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	488.3035	0.5190	253.4295	(268)
Total CO2, kg/m2/year			2446.2071	(272)
Emissions per m2 for space and water heating			16.5109	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			1.9427	(272b)
Emissions per m2 for pumps and fans			0.2984	(272c)
Target Carbon Dioxide Emission Rate (TER) = (16.5109 * 1.00) + 1.9427 + 0.2984, rounded to 2 d.p.			18.7500	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.9300	(1b)	x 2.4000	(2b) =	115.0320	(1b) - (3b)
First floor	53.2800	(1c)	x 2.5500	(2c) =	135.8640	(1c) - (3c)
Second floor	29.2400	(1d)	x 2.5800	(2d) =	75.4392	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	130.4500					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	326.3352	(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) =	0.1226	(8)
Pressure test			Yes	
Measured/design AP50			4.0000	
Infiltration rate			0.3226	(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) =		0.2500	(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	0.3187	0.3125	0.3062	0.2750	0.2687	0.2375	0.2375	0.2312	0.2500	0.2687	0.2812	0.2937	(22b)
Effective ac	0.5508	0.5488	0.5469	0.5378	0.5361	0.5282	0.5282	0.5267	0.5312	0.5361	0.5395	0.5431	(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	
Door			10.4200	1.4000	14.5880			(26)
Windows (Uw = 1.40)			20.3600	1.3258	26.9924			(27)
Rooflight (Uw = 1.40)			0.7200	1.3258	0.9545			(27a)
GF			47.9300	0.1000	4.7930			(28a)
Sem. Exposed Floor			8.4800	0.2200	1.8656			(28b)
Exposed Floor			1.2500	0.2200	0.2750			(28b)
Ext. Wall (Red Brick)	81.0900	15.6400	65.4500	0.1800	11.7810			(29a)
Ext. Wall (Pale Brick)	47.0000	10.0200	36.9800	0.1800	6.6564			(29a)
Dormer Wall	11.4600	3.2300	8.2300	0.2200	1.8106			(29a)
Perim. Wall	43.3200		43.3200	0.2000	8.6640			(29a)
Sem. Shelt. Wall	12.3600	1.8900	10.4700	0.2010	2.1043			(29a)
Flat Roof	4.3000		4.3000	0.0900	0.3870			(30)
Roof ins.@Joists	34.7800		34.7800	0.0900	3.1302			(30)
Roof ins.@Rafters	28.7900	0.7200	28.0700	0.1600	4.4912			(30)
Total net area of external elements Aum(A, m2)			320.7600					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		88.4933			(33)
Party Wall 1			20.0000	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	31.7522	(36)
Total fabric heat loss (33) + (36) =	120.2455	(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	59.3158	59.1034	58.8952	57.9172	57.7342	56.8824	56.8824	56.7246	57.2105	57.7342	58.1044	58.4914	(38)
Heat transfer coeff	179.5613	179.3489	179.1407	178.1627	177.9797	177.1279	177.1279	176.9701	177.4560	177.9797	178.3499	178.7369	(39)
Average = Sum(39)m / 12 =												178.1618	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3765	1.3748	1.3733	1.3658	1.3644	1.3578	1.3578	1.3566	1.3603	1.3644	1.3672	1.3702	(40)
HLP (average)												1.3657	(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	2.8961	(42)
Average daily hot water use (litres/day)	102.9835	(43)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	113.2818	109.1625	105.0432	100.9238	96.8045	92.6851	92.6851	96.8045	100.9238	105.0432	109.1625	113.2818	(44)
Energy conte	167.9937	146.9284	151.6169	132.1833	126.8330	109.4473	101.4190	116.3797	117.7697	137.2492	149.8183	162.6929	(45)
Energy content (annual)										Total = Sum(45)m =		1620.3313	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month	35.6987	31.2223	32.2186	28.0889	26.9520	23.2575	21.5515	24.7307	25.0261	29.1655	31.8364	34.5722	(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	144.8074	144.8074	144.8074	144.8074	144.8074	144.8074	144.8074	144.8074	144.8074	144.8074	144.8074	144.8074	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	27.6498	24.5583	19.9721	15.1202	11.3025	9.5421	10.3105	13.4020	17.9882	22.8401	26.6578	28.4182	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	298.2621	301.3571	293.5577	276.9538	255.9943	236.2954	223.1353	220.0402	227.8396	244.4435	265.4030	285.1020	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.4807	37.4807	37.4807	37.4807	37.4807	37.4807	37.4807	37.4807	37.4807	37.4807	37.4807	37.4807	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-115.8459	-115.8459	-115.8459	-115.8459	-115.8459	-115.8459	-115.8459	-115.8459	-115.8459	-115.8459	-115.8459	-115.8459	(71)
Water heating gains (Table 5)	47.9821	46.4617	43.3046	39.0124	36.2258	32.3021	28.9671	33.2402	34.7584	39.2009	44.2172	46.4681	(72)
Total internal gains	440.3361	438.8193	423.2766	397.5286	369.9649	344.5818	328.8551	333.1246	347.0284	372.9267	402.7202	426.4305	(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	1.6800	10.6334	0.6300	0.7000	0.7700	5.4595	(74)
East	7.0500	19.6403	0.6300	0.7000	0.7700	42.3164	(76)
South	1.6800	46.7521	0.6300	0.7000	0.7700	24.0039	(78)
West	9.9500	19.6403	0.6300	0.7000	0.7700	59.7231	(80)
East	0.7200	25.5349	0.6300	0.7000	1.0000	7.2971	(82)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	138.7999	263.9108	421.2220	601.6691	731.4953	747.4668	712.0893	614.6712	485.0386	309.1331	171.5673	115.1744	(83)
Total gains	579.1360	702.7301	844.4987	999.1977	1101.4602	1092.0486	1040.9444	947.7958	832.0669	682.0599	574.2875	541.6049	(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	50.4509	50.5106	50.5693	50.8469	50.8992	51.1440	51.1440	51.1896	51.0494	50.8992	50.7936	50.6836	
alpha	4.3634	4.3674	4.3713	4.3898	4.3933	4.4096	4.4096	4.4126	4.4033	4.3933	4.3862	4.3789	
util living area	0.9994	0.9984	0.9950	0.9814	0.9371	0.8300	0.6823	0.7485	0.9332	0.9921	0.9987	0.9995	(86)
MIT	19.3268	19.4882	19.7843	20.1859	20.5683	20.8424	20.9521	20.9274	20.6894	20.1863	19.6804	19.2962	(87)
Th 2	19.7814	19.7827	19.7839	19.7897	19.7908	19.7958	19.7958	19.7968	19.7939	19.7908	19.7886	19.7863	(88)
util rest of house	0.9992	0.9978	0.9930	0.9729	0.9052	0.7395	0.5262	0.6002	0.8845	0.9874	0.9982	0.9994	(89)
MIT 2	18.2595	18.4216	18.7178	19.1191	19.4839	19.7176	19.7831	19.7744	19.6036	19.1240	18.6183	18.2326	(90)
Living area fraction									fLA = Living area / (4) =			0.1840	(91)
MIT	18.4558	18.6178	18.9140	19.3154	19.6834	19.9245	19.9982	19.9865	19.8033	19.3194	18.8137	18.4283	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.4558	18.6178	18.9140	19.3154	19.6834	19.9245	19.9982	19.9865	19.8033	19.3194	18.8137	18.4283	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9988	0.9970	0.9909	0.9684	0.9016	0.7510	0.5553	0.6271	0.8850	0.9847	0.9975	0.9991	(94)
Useful gains	578.4318	700.6189	836.8530	967.6169	993.1290	820.0749	578.0032	594.3673	736.3839	671.6122	572.8421	541.1168	(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	2541.8399	2460.2755	2223.8497	1855.6340	1420.8832	943.1261	601.9158	634.7075	1012.0932	1551.8841	2089.1424	2543.1243	(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	1460.7756	1182.4892	1031.9255	639.3723	318.2491	0.0000	0.0000	0.0000	0.0000	654.9223	1091.7362	1489.4936	(98)
Space heating												7868.9639	(98)
Space heating per m2											(98) / (4) =	60.3217	(99)

8c. Space cooling requirement

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1665.0021	1310.7463	1344.9731	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7342	0.8197	0.7736	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1222.4819	1074.4195	1040.4092	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1387.5637	1325.5802	1220.3037	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	118.8589	186.8636	133.8415	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												439.5640	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	29.7147	46.7159	33.4604	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												109.8910	(107)
Space cooling per m2												0.8424	(108)
Energy for space heating												60.3217	(99)
Energy for space cooling												0.8424	(108)
Total												61.1641	(109)
Dwelling Fabric Energy Efficiency (DFEE)												61.2	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.9300 (1b)	x	2.4000 (2b)	=	115.0320	(1b) - (3b)
First floor	53.2800 (1c)	x	2.5500 (2c)	=	135.8640	(1c) - (3c)
Second floor	29.2400 (1d)	x	2.5800 (2d)	=	75.4392	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	130.4500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	326.3352	(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) =	0.1226	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3726	(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) =	0.2887	(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	0.3681	0.3609	0.3537	0.3176	0.3104	0.2743	0.2743	0.2671	0.2887	0.3104	0.3248	0.3393	(22b)
Effective ac	0.5678	0.5651	0.5626	0.5504	0.5482	0.5376	0.5376	0.5357	0.5417	0.5482	0.5528	0.5576	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			10.4200	1.0000	10.4200			(26)
TER Opening Type (Uw = 1.40)			20.3600	1.3258	26.9924			(27)
TER Room Window (Uw = 1.70)			0.7200	1.5918	1.1461			(27a)
GF			47.9300	0.1300	6.2309			(28a)
Sem. Exposed Floor			8.4800	0.1300	1.1024			(28b)
Exposed Floor			1.2500	0.1300	0.1625			(28b)
Ext. Wall (Red Brick)	81.0900	15.6400	65.4500	0.1800	11.7810			(29a)
Ext. Wall (Pale Brick)	47.0000	10.0200	36.9800	0.1800	6.6564			(29a)
Dormer Wall	11.4600	3.2300	8.2300	0.1800	1.4814			(29a)
Perim. Wall	43.3200		43.3200	0.1800	7.7976			(29a)
Sem. Shelt. Wall	12.3600	1.8900	10.4700	0.1800	1.8846			(29a)
Flat Roof	4.3000		4.3000	0.1300	0.5590			(30)
Roof ins.@Joists	34.7800		34.7800	0.1300	4.5214			(30)
Roof ins.@Rafters	28.7900	0.7200	28.0700	0.1300	3.6491			(30)
Total net area of external elements Aum(A, m2)			320.7600					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		84.3848			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							27.1383	(36)
Total fabric heat loss					(33) + (36) =		111.5231	(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	61.1432	60.8598	60.5820	59.2773	59.0332	57.8969	57.8969	57.6864	58.3346	59.0332	59.5270	60.0433	(38)
Heat transfer coeff	172.6663	172.3829	172.1051	170.8004	170.5563	169.4200	169.4200	169.2095	169.8577	170.5563	171.0501	171.5664	(39)
Average = Sum(39)m / 12 =												170.7992	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3236	1.3214	1.3193	1.3093	1.3074	1.2987	1.2987	1.2971	1.3021	1.3074	1.3112	1.3152	(40)
HLP (average)												1.3093	(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	2.8961 (42)
Average daily hot water use (litres/day)	102.9835 (43)

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

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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Daily hot water use
            113.2818   109.1625   105.0432   100.9238    96.8045    92.6851    92.6851    96.8045   100.9238   105.0432   109.1625   113.2818 (44)
Energy conte   167.9937   146.9284   151.6169   132.1833   126.8330   109.4473   101.4190   116.3797   117.7697   137.2492   149.8183   162.6929 (45)
Energy content (annual)                                                                                                Total = Sum(45)m =   1620.3313 (45)
Distribution loss  (46)m = 0.15 x (45)m
                 0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (46)
Water storage loss:
Total storage loss
                 0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (56)
If cylinder contains dedicated solar storage
                 0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (57)
Primary loss     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (59)
Heat gains from water heating, kWh/month
                35.6987    31.2223    32.2186    28.0889    26.9520    23.2575    21.5515    24.7307    25.0261    29.1655    31.8364    34.5722 (65)


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5. Internal gains (see Table 5 and 5a)
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Metabolic gains (Table 5), Watts
                  Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m          144.8074   144.8074   144.8074   144.8074   144.8074   144.8074   144.8074   144.8074   144.8074   144.8074   144.8074   144.8074 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
                27.6498    24.5583    19.9721    15.1202    11.3025     9.5421    10.3105    13.4020    17.9882    22.8401    26.6578    28.4182 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
               298.2621   301.3571   293.5577   276.9538   255.9943   236.2954   223.1353   220.0402   227.8396   244.4435   265.4030   285.1020 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
                37.4807    37.4807    37.4807    37.4807    37.4807    37.4807    37.4807    37.4807    37.4807    37.4807    37.4807    37.4807 (69)
Pumps, fans      0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
              -115.8459  -115.8459  -115.8459  -115.8459  -115.8459  -115.8459  -115.8459  -115.8459  -115.8459  -115.8459  -115.8459  -115.8459 (71)
Water heating gains (Table 5)
                47.9821    46.4617    43.3046    39.0124    36.2258    32.3021    28.9671    33.2402    34.7584    39.2009    44.2172    46.4681 (72)
Total internal gains
               440.3361   438.8193   423.2766   397.5286   369.9649   344.5818   328.8551   333.1246   347.0284   372.9267   402.7202   426.4305 (73)


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6. Solar gains
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[Jan]                                    Area          Solar flux              g              FF          Access          Gains
                                         m2             Table 6a     Specific data  Specific data     factor              W
                                                           W/m2       or Table 6b    or Table 6c    Table 6d
------------------------------------------------------------------------------------------------------------
North                                  1.6800            10.6334            0.6300         0.7000          0.7700          5.4595 (74)
East                                   7.0500            19.6403            0.6300         0.7000          0.7700         42.3164 (76)
South                                  1.6800            46.7521            0.6300         0.7000          0.7700         24.0039 (78)
West                                   9.9500            19.6403            0.6300         0.7000          0.7700         59.7231 (80)
East                                   0.7200            25.5349            0.6300         0.7000          1.0000          7.2971 (82)
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Solar gains    138.7999   263.9108   421.2220   601.6691   731.4953   747.4668   712.0893   614.6712   485.0386   309.1331   171.5673   115.1744 (83)
Total gains    579.1360   702.7301   844.4987   999.1977  1101.4602  1092.0486  1040.9444   947.7958   832.0669   682.0599   574.2875   541.6049 (84)


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7. Mean internal temperature (heating season)
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Temperature during heating periods in the living area from Table 9, Th1 (C)                                21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                  Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau            52.4655    52.5518    52.6366    53.0387    53.1146    53.4708    53.4708    53.5373    53.3331    53.1146    52.9612    52.8019
alpha           4.4977     4.5035     4.5091     4.5359     4.5410     4.5647     4.5647     4.5692     4.5555     4.5410     4.5307     4.5201
util living area
                0.9994     0.9985     0.9950     0.9805     0.9328     0.8174     0.6637     0.7316     0.9284     0.9919     0.9988     0.9996 (86)

MIT            19.3916    19.5523    19.8440    20.2395    20.6089    20.8656    20.9617    20.9404    20.7201    20.2321    19.7383    19.3639 (87)
Th 2           19.8224    19.8241    19.8257    19.8335    19.8350    19.8418    19.8418    19.8431    19.8392    19.8350    19.8320    19.8290 (88)
util rest of house
                0.9992     0.9979     0.9930     0.9719     0.8999     0.7267     0.5138     0.5872     0.8783     0.9872     0.9982     0.9994 (89)
MIT 2          18.3558    18.5176    18.8097    19.2064    19.5576    19.7756    19.8317    19.8248    19.6683    19.2039    18.7098    18.3332 (90)
Living area fraction                                                                        fLA = Living area / (4) =     0.1840 (91)
MIT            18.5464    18.7079    19.0000    19.3965    19.7511    19.9762    20.0396    20.0301    19.8618    19.3931    18.8990    18.5228 (92)
Temperature adjustment                                                                                                 0.0000
adjusted MIT   18.5464    18.7079    19.0000    19.3965    19.7511    19.9762    20.0396    20.0301    19.8618    19.3931    18.8990    18.5228 (93)


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

                  Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation      0.9989     0.9971     0.9910     0.9675     0.8969     0.7390     0.5417     0.6136     0.8796     0.9846     0.9976     0.9992 (94)
Useful gains   578.4735   700.6918   836.8872   966.7220   987.9122   806.9736   563.8342   581.5327   731.8938   671.5382   572.9037   541.1510 (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
              2459.8654  2380.2512  2151.3057  1792.8034  1373.1592   910.8300   582.7388   614.2452   978.6826  1499.7115  2018.2279  2457.3166 (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
              1399.7555  1128.6639   977.9274   594.7786   286.6238     0.0000     0.0000     0.0000     0.0000   616.1609  1040.6334  1425.6272 (98)
Space heating                                                                                                          7470.1707 (98)
Space heating per m2                                                                                      (98) / (4) =    57.2646 (99)


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8c. Space cooling requirement
------------------------------------------------------------------------------------------------------------
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CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	1592.5476	1253.7077	1285.9924	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7596	0.8424	0.7983	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1209.7394	1056.0955	1026.5876	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1387.5637	1325.5802	1220.3037	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	128.0335	200.4966	144.1247	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												472.6549	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	32.0084	50.1242	36.0312	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												118.1637	(107)
Space cooling per m2												0.9058	(108)
Energy for space heating												57.2646	(99)
Energy for space cooling												0.9058	(108)
Total												58.1704	(109)
Target Fabric Energy Efficiency (TFEE)												66.9	(109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.9300	(1b)	x 2.4000	(2b) =	115.0320	(1b) - (3b)
First floor	53.2800	(1c)	x 2.5500	(2c) =	135.8640	(1c) - (3c)
Second floor	29.2400	(1d)	x 2.5800	(2d) =	75.4392	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	130.4500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		326.3352	(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							5 * 10	=	50.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000	/ (5) =	0.1532	(8)
Pressure test			Yes	
Measured/design AP50			4.0000	
Infiltration rate			0.3532	(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) =		0.2737	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.6000	4.1000	4.1000	4.0000	3.8000	3.3000	3.3000	3.2000	3.4000	3.9000	3.8000	3.9000	(22)
Wind factor	1.1500	1.0250	1.0250	1.0000	0.9500	0.8250	0.8250	0.8000	0.8500	0.9750	0.9500	0.9750	(22a)
Adj infilt rate	0.3148	0.2806	0.2806	0.2737	0.2601	0.2258	0.2258	0.2190	0.2327	0.2669	0.2601	0.2669	(22b)
Effective ac	0.5496	0.5394	0.5394	0.5375	0.5338	0.5255	0.5255	0.5240	0.5271	0.5356	0.5338	0.5356	(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	
Door			10.4200	1.4000	14.5880			(26)
Windows (Uw = 1.40)			20.3600	1.3258	26.9924			(27)
Rooflight (Uw = 1.40)			0.7200	1.3258	0.9545			(27a)
GF			47.9300	0.1000	4.7930			(28a)
Sem. Exposed Floor			8.4800	0.2200	1.8656			(28b)
Exposed Floor			1.2500	0.2200	0.2750			(28b)
Ext. Wall (Red Brick)	81.0900	15.6400	65.4500	0.1800	11.7810			(29a)
Ext. Wall (Pale Brick)	47.0000	10.0200	36.9800	0.1800	6.6564			(29a)
Dormer Wall	11.4600	3.2300	8.2300	0.2200	1.8106			(29a)
Perim. Wall	43.3200		43.3200	0.2000	8.6640			(29a)
Sem. Shelt. Wall	12.3600	1.8900	10.4700	0.2010	2.1043			(29a)
Flat Roof	4.3000		4.3000	0.0900	0.3870			(30)
Roof ins.@Joists	34.7800		34.7800	0.0900	3.1302			(30)
Roof ins.@Rafters	28.7900	0.7200	28.0700	0.1600	4.4912			(30)
Total net area of external elements Aum(A, m2)			320.7600					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		88.4933			(33)
Party Wall 1			20.0000	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	31.7522	(36)
Total fabric heat loss (33) + (36) =	120.2455	(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	59.1815	58.0845	58.0845	57.8802	57.4868	56.5916	56.5916	56.4276	56.7605	57.6810	57.4868	57.6810	(38)
Heat transfer coeff	179.4270	178.3300	178.3300	178.1257	177.7323	176.8371	176.8371	176.6731	177.0060	177.9265	177.7323	177.9265	(39)
Average = Sum(39)m / 12 =												177.7403	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3754	1.3670	1.3670	1.3655	1.3625	1.3556	1.3556	1.3543	1.3569	1.3639	1.3625	1.3639	(40)
HLP (average)												1.3625	(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	2.8961 (42)
Average daily hot water use (litres/day)	102.9835 (43)

CALCULATION OF HEAT DEMAND 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	113.2818	109.1625	105.0432	100.9238	96.8045	92.6851	92.6851	96.8045	100.9238	105.0432	109.1625	113.2818	(44)
Energy conte	167.9937	146.9284	151.6169	132.1833	126.8330	109.4473	101.4190	116.3797	117.7697	137.2492	149.8183	162.6929	(45)
Energy content (annual)										Total = Sum(45)m =		1620.3313	(45)
Distribution loss (46)m = 0.15 x (45)m	25.1991	22.0393	22.7425	19.8275	19.0250	16.4171	15.2128	17.4570	17.6655	20.5874	22.4727	24.4039	(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	25.3234	22.8731	25.3084	24.4651	25.2453	24.3840	25.1676	25.2180	24.4264	25.2710	24.4878	25.3105	(61)
Total heat required for water heating calculated for each month	193.3171	169.8015	176.9254	156.6484	152.0783	133.8312	126.5865	141.5977	142.1961	162.5203	174.3060	188.0034	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h	193.3171	169.8015	176.9254	156.6484	152.0783	133.8312	126.5865	141.5977	142.1961	162.5203	174.3060	188.0034	(64)
								Total per year (kWh/year) = Sum(64)m =				1917.8118	(64)
RHI water heating demand												1918	(64)
Heat gains from water heating, kWh/month	62.1888	54.5720	56.7397	50.0672	48.4833	42.4872	40.0137	45.0008	45.2650	51.9531	55.9365	60.4230	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	173.7688	173.7688	173.7688	173.7688	173.7688	173.7688	173.7688	173.7688	173.7688	173.7688	173.7688	173.7688	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	69.1244	61.3957	49.9303	37.8005	28.2563	23.8552	25.7763	33.5051	44.9704	57.1003	66.6445	71.0456	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	445.1673	449.7867	438.1459	413.3639	382.0811	352.6797	333.0377	328.4183	340.0591	364.8411	396.1239	425.5253	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.2730	55.2730	55.2730	55.2730	55.2730	55.2730	55.2730	55.2730	55.2730	55.2730	55.2730	55.2730	(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)	-115.8459	-115.8459	-115.8459	-115.8459	-115.8459	-115.8459	-115.8459	-115.8459	-115.8459	-115.8459	-115.8459	-115.8459	(71)
Water heating gains (Table 5)	83.5870	81.2083	76.2631	69.5378	65.1657	59.0100	53.7819	60.4849	62.8681	69.8295	77.6896	81.2137	(72)
Total internal gains	714.0747	708.5867	680.5353	636.8981	591.6991	551.7408	528.7919	538.6042	564.0936	607.9668	656.6539	693.9806	(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	1.6800	12.4105	0.6300	0.7000	0.7700	6.3719	(74)
East	7.0500	23.1112	0.6300	0.7000	0.7700	49.7948	(76)
South	1.6800	52.9996	0.6300	0.7000	0.7700	27.2116	(78)
West	9.9500	23.1112	0.6300	0.7000	0.7700	70.2778	(80)
East	0.7200	30.1684	0.6300	0.7000	1.0000	8.6212	(82)

Solar gains	162.2772	278.4213	436.6602	634.8042	748.3449	820.4365	763.0423	666.9418	532.7657	340.8124	198.9078	134.3980	(83)
Total gains	876.3519	987.0080	1117.1955	1271.7024	1340.0440	1372.1773	1291.8342	1205.5459	1096.8592	948.7792	855.5617	828.3787	(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	50.4887	50.7992	50.7992	50.8575	50.9701	51.2281	51.2281	51.2756	51.1792	50.9144	50.9701	50.9144	
alpha	4.3659	4.3866	4.3866	4.3905	4.3980	4.4152	4.4152	4.4184	4.4119	4.3943	4.3980	4.3943	
util living area	0.9961	0.9930	0.9817	0.9449	0.8472	0.6275	0.4315	0.4865	0.7947	0.9637	0.9924	0.9969	(86)
MIT	19.6184	19.7644	20.0799	20.4504	20.7768	20.9594	20.9942	20.9901	20.8802	20.4623	19.9624	19.5873	(87)
Th 2	19.7822	19.7887	19.7887	19.7899	19.7922	19.7975	19.7975	19.7985	19.7965	19.7911	19.7922	19.7911	(88)
util rest of house	0.9947	0.9904	0.9745	0.9220	0.7828	0.5014	0.2728	0.3207	0.6884	0.9435	0.9891	0.9958	(89)
MIT 2	17.9786	18.1956	18.6521	19.1740	19.5955	19.7784	19.7967	19.7967	19.7191	19.2024	18.4876	17.9393	(90)
Living area fraction									fLA = Living area / (4) =			0.1840	(91)
MIT	18.2803	18.4842	18.9148	19.4089	19.8129	19.9957	20.0170	20.0163	19.9327	19.4342	18.7589	18.2425	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1303	18.3342	18.7648	19.2589	19.6629	19.8457	19.8670	19.8663	19.7827	19.2842	18.6089	18.0925	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9916	0.9856	0.9657	0.9086	0.7745	0.5069	0.2822	0.3304	0.6869	0.9313	0.9840	0.9933	(94)
Useful gains	868.9776	972.8293	1078.8741	1155.5236	1037.8987	695.5313	364.5267	398.3340	753.4712	883.6231	841.8588	822.8443	(95)
Ext temp.	5.0000	5.5000	7.4000	9.8000	12.8000	15.8000	17.8000	17.6000	15.1000	11.5000	7.8000	4.9000	(96)
Heat loss rate W	2355.9339	2288.7224	2026.6769	1684.8645	1219.7510	715.4237	365.5224	400.3909	828.8628	1385.0115	1921.0939	2347.2934	(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													

CALCULATION OF HEAT DEMAND 09 Jan 2014

	1106.2955	884.2802	705.1652	381.1255	135.2981	0.0000	0.0000	0.0000	0.0000	373.0330	777.0493	1134.1901 (98)
Space heating												5496.4368 (98)
RHI space heating demand												5496 (98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.9300	(1b)	x 2.4000	(2b) =	115.0320	(1b) - (3b)
First floor	53.2800	(1c)	x 2.5500	(2c) =	135.8640	(1c) - (3c)
Second floor	29.2400	(1d)	x 2.5800	(2d) =	75.4392	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	130.4500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		326.3352	(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							5 * 10	=	50.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000 / (5) =	0.1532	(8)
Pressure test		Yes	
Measured/design AP50		4.0000	
Infiltration rate		0.3532	(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) =	0.2737	(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	0.3490	0.3422	0.3353	0.3011	0.2943	0.2601	0.2601	0.2532	0.2737	0.2943	0.3080	0.3216	(22b)
Effective ac	0.5609	0.5585	0.5562	0.5453	0.5433	0.5338	0.5338	0.5321	0.5375	0.5433	0.5474	0.5517	(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	
Door			10.4200	1.4000	14.5880			(26)
Windows (Uw = 1.40)			20.3600	1.3258	26.9924			(27)
Rooflight (Uw = 1.40)			0.7200	1.3258	0.9545			(27a)
GF			47.9300	0.1000	4.7930			(28a)
Sem. Exposed Floor			8.4800	0.2200	1.8656			(28b)
Exposed Floor			1.2500	0.2200	0.2750			(28b)
Ext. Wall (Red Brick)	81.0900	15.6400	65.4500	0.1800	11.7810			(29a)
Ext. Wall (Pale Brick)	47.0000	10.0200	36.9800	0.1800	6.6564			(29a)
Dormer Wall	11.4600	3.2300	8.2300	0.2200	1.8106			(29a)
Perim. Wall	43.3200		43.3200	0.2000	8.6640			(29a)
Sem. Shelt. Wall	12.3600	1.8900	10.4700	0.2010	2.1043			(29a)
Flat Roof	4.3000		4.3000	0.0900	0.3870			(30)
Roof ins.@Joists	34.7800		34.7800	0.0900	3.1302			(30)
Roof ins.@Rafters	28.7900	0.7200	28.0700	0.1600	4.4912			(30)
Total net area of external elements Aum(A, m2)			320.7600					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		88.4933			(33)
Party Wall 1			20.0000	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	31.7522	(36)
Total fabric heat loss (33) + (36) =	120.2455	(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	60.4046	60.1499	59.9002	58.7275	58.5081	57.4868	57.4868	57.2977	57.8802	58.5081	58.9520	59.4160	(38)
Heat transfer coeff	180.6501	180.3954	180.1457	178.9730	178.7536	177.7323	177.7323	177.5432	178.1257	178.7536	179.1975	179.6615	(39)
Average = Sum(39)m / 12 =												178.9720	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3848	1.3829	1.3810	1.3720	1.3703	1.3625	1.3625	1.3610	1.3655	1.3703	1.3737	1.3772	(40)
HLP (average)												1.3720	(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	2.8961	(42)
Average daily hot water use (litres/day)	102.9835	(43)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	113.2818	109.1625	105.0432	100.9238	96.8045	92.6851	92.6851	96.8045	100.9238	105.0432	109.1625	113.2818	(44)
Energy conte	167.9937	146.9284	151.6169	132.1833	126.8330	109.4473	101.4190	116.3797	117.7697	137.2492	149.8183	162.6929	(45)
Energy content (annual)										Total = Sum(45)m =		1620.3313	(45)
Distribution loss (46)m = 0.15 x (45)m	25.1991	22.0393	22.7425	19.8275	19.0250	16.4171	15.2128	17.4570	17.6655	20.5874	22.4727	24.4039	(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	25.3234	22.8731	25.3084	24.4651	25.2453	24.3840	25.1676	25.2180	24.4264	25.2710	24.4878	25.3105	(61)
Total heat required for water heating calculated for each month	193.3171	169.8015	176.9254	156.6484	152.0783	133.8312	126.5865	141.5977	142.1961	162.5203	174.3060	188.0034	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h	193.3171	169.8015	176.9254	156.6484	152.0783	133.8312	126.5865	141.5977	142.1961	162.5203	174.3060	188.0034	(64)
								Total per year (kWh/year) = Sum(64)m =				1917.8118	(64)
Heat gains from water heating, kWh/month	62.1888	54.5720	56.7397	50.0672	48.4833	42.4872	40.0137	45.0008	45.2650	51.9531	55.9365	60.4230	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	173.7688	173.7688	173.7688	173.7688	173.7688	173.7688	173.7688	173.7688	173.7688	173.7688	173.7688	173.7688	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	69.1244	61.3957	49.9303	37.8005	28.2563	23.8552	25.7763	33.5051	44.9704	57.1003	66.6445	71.0456	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	445.1673	449.7867	438.1459	413.3639	382.0811	352.6797	333.0377	328.4183	340.0591	364.8411	396.1239	425.5253	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.2730	55.2730	55.2730	55.2730	55.2730	55.2730	55.2730	55.2730	55.2730	55.2730	55.2730	55.2730	(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)	-115.8459	-115.8459	-115.8459	-115.8459	-115.8459	-115.8459	-115.8459	-115.8459	-115.8459	-115.8459	-115.8459	-115.8459	(71)
Water heating gains (Table 5)	83.5870	81.2083	76.2631	69.5378	65.1657	59.0100	53.7819	60.4849	62.8681	69.8295	77.6896	81.2137	(72)
Total internal gains	714.0747	708.5867	680.5353	636.8981	591.6991	551.7408	528.7919	538.6042	564.0936	607.9668	656.6539	693.9806	(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	1.6800	10.6334	0.6300	0.7000	0.7700	5.4595	(74)
East	7.0500	19.6403	0.6300	0.7000	0.7700	42.3164	(76)
South	1.6800	46.7521	0.6300	0.7000	0.7700	24.0039	(78)
West	9.9500	19.6403	0.6300	0.7000	0.7700	59.7231	(80)
East	0.7200	25.5349	0.6300	0.7000	1.0000	7.2971	(82)

Solar gains	138.7999	263.9108	421.2220	601.6691	731.4953	747.4668	712.0893	614.6712	485.0386	309.1331	171.5673	115.1744	(83)
Total gains	852.8746	972.4975	1101.7573	1238.5672	1323.1944	1299.2076	1240.8812	1153.2754	1049.1321	917.0999	828.2212	809.1550	(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	50.1468	50.2176	50.2872	50.6167	50.6788	50.9701	50.9701	51.0244	50.8575	50.6788	50.5533	50.4228	
alpha	4.3431	4.3478	4.3525	4.3744	4.3786	4.3980	4.3980	4.4016	4.3905	4.3786	4.3702	4.3615	
util living area	0.9970	0.9943	0.9864	0.9609	0.8937	0.7569	0.5969	0.6546	0.8727	0.9765	0.9946	0.9976	(86)
MIT	19.5042	19.6619	19.9462	20.3250	20.6679	20.8932	20.9713	20.9572	20.7828	20.3331	19.8468	19.4714	(87)
Th 2	19.7750	19.7765	19.7780	19.7849	19.7862	19.7922	19.7922	19.7934	19.7899	19.7862	19.7836	19.7808	(88)
util rest of house	0.9960	0.9922	0.9812	0.9449	0.8482	0.6560	0.4492	0.5076	0.8002	0.9640	0.9923	0.9968	(89)
MIT 2	17.8071	18.0379	18.4515	18.9967	19.4586	19.7206	19.7821	19.7761	19.6133	19.0177	18.3134	17.7631	(90)
Living area fraction									fLA = Living area / (4) =			0.1840	(91)
MIT	18.1193	18.3367	18.7265	19.2411	19.6811	19.9364	20.0009	19.9934	19.8285	19.2597	18.5955	18.0774	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.9693	18.1867	18.5765	19.0911	19.5311	19.7864	19.8509	19.8434	19.6785	19.1097	18.4455	17.9274	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9935	0.9881	0.9738	0.9325	0.8362	0.6555	0.4569	0.5143	0.7917	0.9536	0.9882	0.9948	(94)
Useful gains	847.3393	960.9608	1072.8569	1155.0081	1106.5134	851.5840	566.9035	593.1781	830.6147	874.5746	818.4486	804.9340	(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	2469.3621	2396.8621	2175.5248	1823.9270	1399.8324	921.7857	577.7854	611.3472	993.6700	1521.1469	2033.0840	2466.2901	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	1206.7850	964.9257	820.3849	481.6216	218.2293	0.0000	0.0000	0.0000	0.0000	481.0498	874.5375	1236.0490	(98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Space heating		6283.5828 (98)
Space heating per m2	(98) / (4) =	48.1685 (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 %)		93.1000 (206)
Efficiency of secondary/supplementary heating system, %		0.0000 (208)
Space heating requirement		6749.2834 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1206.7850	964.9257	820.3849	481.6216	218.2293	0.0000	0.0000	0.0000	0.0000	481.0498	874.5375	1236.0490	(98)
Space heating efficiency (main heating system 1)													
	93.1000	93.1000	93.1000	93.1000	93.1000	0.0000	0.0000	0.0000	0.0000	93.1000	93.1000	93.1000	(210)
Space heating fuel (main heating system)													
	1296.2244	1036.4400	881.1868	517.3165	234.4032	0.0000	0.0000	0.0000	0.0000	516.7023	939.3528	1327.6573	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	193.3171	169.8015	176.9254	156.6484	152.0783	133.8312	126.5865	141.5977	142.1961	162.5203	174.3060	188.0034	(64)
Efficiency of water heater												87.2000	(216)
(217)m	90.2001	90.1585	90.0587	89.8152	89.2292	87.2000	87.2000	87.2000	87.2000	89.7899	90.0990	90.2219	(217)
Fuel for water heating, kWh/month													
	214.3202	188.3367	196.4555	174.4118	170.4356	153.4762	145.1680	162.3827	163.0689	181.0006	193.4605	208.3789	(219)
Water heating fuel used												2150.8956	(219)
Annual totals kWh/year													
Space heating fuel - main system												6749.2834	(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)												488.3035	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 3.00 * 853 * 1.00) =										-2047.2718		-2047.2718	(233)
Total delivered energy for all uses												7416.2108	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	6749.2834	3.4800	234.8751	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2150.8956	3.4800	74.8512	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	488.3035	13.1900	64.4072	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-2047.2718	13.1900	-270.0352	(252)
Total energy cost			233.9908	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200 (256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.5601 (257)
SAP value		92.1861
SAP rating (Section 12)		92 (258)
SAP band		A

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	6749.2834	0.2160	1457.8452	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2150.8956	0.2160	464.5935	(264)
Space and water heating			1922.4387	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	488.3035	0.5190	253.4295	(268)
Energy saving/generation technologies				
PV Unit	-2047.2718	0.5190	-1062.5341	(269)
Total kg/year			1152.2591	(272)
CO2 emissions per m2			8.8300	(273)
EI value			91.1996	
EI rating			91	(274)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

EI band B

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9070 = 3.837, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9070 = 0.2381, stars = 4
Water heating energy efficiency	3.48 / 0.8903 = 3.909, stars = 4
Water heating environmental impact	0.216 / 0.8903 = 0.2426, stars = 4

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

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	47.9300	(1b)	x 2.4000	(2b) =	115.0320	(1b) - (3b)
First floor	53.2800	(1c)	x 2.5500	(2c) =	135.8640	(1c) - (3c)
Second floor	29.2400	(1d)	x 2.5800	(2d) =	75.4392	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	130.4500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		326.3352	(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							5 * 10	=	50.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	50.0000	/ (5) =	0.1532	(8)
Pressure test			Yes	
Measured/design AP50			4.0000	
Infiltration rate			0.3532	(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) =		0.2737	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.6000	4.1000	4.1000	4.0000	3.8000	3.3000	3.3000	3.2000	3.4000	3.9000	3.8000	3.9000	(22)
Wind factor	1.1500	1.0250	1.0250	1.0000	0.9500	0.8250	0.8250	0.8000	0.8500	0.9750	0.9500	0.9750	(22a)
Adj infilt rate	0.3148	0.2806	0.2806	0.2737	0.2601	0.2258	0.2258	0.2190	0.2327	0.2669	0.2601	0.2669	(22b)
Effective ac	0.5496	0.5394	0.5394	0.5375	0.5338	0.5255	0.5255	0.5240	0.5271	0.5356	0.5338	0.5356	(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	
Door			10.4200	1.4000	14.5880			(26)
Windows (Uw = 1.40)			20.3600	1.3258	26.9924			(27)
Rooflight (Uw = 1.40)			0.7200	1.3258	0.9545			(27a)
GF			47.9300	0.1000	4.7930			(28a)
Sem. Exposed Floor			8.4800	0.2200	1.8656			(28b)
Exposed Floor			1.2500	0.2200	0.2750			(28b)
Ext. Wall (Red Brick)	81.0900	15.6400	65.4500	0.1800	11.7810			(29a)
Ext. Wall (Pale Brick)	47.0000	10.0200	36.9800	0.1800	6.6564			(29a)
Dormer Wall	11.4600	3.2300	8.2300	0.2200	1.8106			(29a)
Perim. Wall	43.3200		43.3200	0.2000	8.6640			(29a)
Sem. Shelt. Wall	12.3600	1.8900	10.4700	0.2010	2.1043			(29a)
Flat Roof	4.3000		4.3000	0.0900	0.3870			(30)
Roof ins.@Joists	34.7800		34.7800	0.0900	3.1302			(30)
Roof ins.@Rafters	28.7900	0.7200	28.0700	0.1600	4.4912			(30)
Total net area of external elements Aum(A, m2)			320.7600					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		88.4933			(33)
Party Wall 1			20.0000	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	31.7522	(36)
Total fabric heat loss (33) + (36) =	120.2455	(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	59.1815	58.0845	58.0845	57.8802	57.4868	56.5916	56.5916	56.4276	56.7605	57.6810	57.4868	57.6810	(38)
Heat transfer coeff	179.4270	178.3300	178.3300	178.1257	177.7323	176.8371	176.8371	176.6731	177.0060	177.9265	177.7323	177.9265	(39)
Average = Sum(39)m / 12 =												177.7403	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3754	1.3670	1.3670	1.3655	1.3625	1.3556	1.3556	1.3543	1.3569	1.3639	1.3625	1.3639	(40)
HLP (average)												1.3625	(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	2.8961 (42)
Average daily hot water use (litres/day)	102.9835 (43)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	113.2818	109.1625	105.0432	100.9238	96.8045	92.6851	92.6851	96.8045	100.9238	105.0432	109.1625	113.2818	(44)
Energy conte	167.9937	146.9284	151.6169	132.1833	126.8330	109.4473	101.4190	116.3797	117.7697	137.2492	149.8183	162.6929	(45)
Energy content (annual)										Total = Sum(45)m =		1620.3313	(45)
Distribution loss (46)m = 0.15 x (45)m													
	25.1991	22.0393	22.7425	19.8275	19.0250	16.4171	15.2128	17.4570	17.6655	20.5874	22.4727	24.4039	(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	25.3234	22.8731	25.3084	24.4651	25.2453	24.3840	25.1676	25.2180	24.4264	25.2710	24.4878	25.3105	(61)
Total heat required for water heating calculated for each month													
	193.3171	169.8015	176.9254	156.6484	152.0783	133.8312	126.5865	141.5977	142.1961	162.5203	174.3060	188.0034	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	193.3171	169.8015	176.9254	156.6484	152.0783	133.8312	126.5865	141.5977	142.1961	162.5203	174.3060	188.0034	(64)
									Total per year (kWh/year) = Sum(64)m =			1917.8118	(64)
Heat gains from water heating, kWh/month													
	62.1888	54.5720	56.7397	50.0672	48.4833	42.4872	40.0137	45.0008	45.2650	51.9531	55.9365	60.4230	(65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	173.7688	173.7688	173.7688	173.7688	173.7688	173.7688	173.7688	173.7688	173.7688	173.7688	173.7688	173.7688	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	69.1244	61.3957	49.9303	37.8005	28.2563	23.8552	25.7763	33.5051	44.9704	57.1003	66.6445	71.0456	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	445.1673	449.7867	438.1459	413.3639	382.0811	352.6797	333.0377	328.4183	340.0591	364.8411	396.1239	425.5253	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.2730	55.2730	55.2730	55.2730	55.2730	55.2730	55.2730	55.2730	55.2730	55.2730	55.2730	55.2730	(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)													
	-115.8459	-115.8459	-115.8459	-115.8459	-115.8459	-115.8459	-115.8459	-115.8459	-115.8459	-115.8459	-115.8459	-115.8459	(71)
Water heating gains (Table 5)													
	83.5870	81.2083	76.2631	69.5378	65.1657	59.0100	53.7819	60.4849	62.8681	69.8295	77.6896	81.2137	(72)
Total internal gains													
	714.0747	708.5867	680.5353	636.8981	591.6991	551.7408	528.7919	538.6042	564.0936	607.9668	656.6539	693.9806	(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	1.6800	12.4105	0.6300	0.7000	0.7700	6.3719	(74)
East	7.0500	23.1112	0.6300	0.7000	0.7700	49.7948	(76)
South	1.6800	52.9996	0.6300	0.7000	0.7700	27.2116	(78)
West	9.9500	23.1112	0.6300	0.7000	0.7700	70.2778	(80)
East	0.7200	30.1684	0.6300	0.7000	1.0000	8.6212	(82)

Solar gains	162.2772	278.4213	436.6602	634.8042	748.3449	820.4365	763.0423	666.9418	532.7657	340.8124	198.9078	134.3980	(83)
Total gains	876.3519	987.0080	1117.1955	1271.7024	1340.0440	1372.1773	1291.8342	1205.5459	1096.8592	948.7792	855.5617	828.3787	(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	50.4887	50.7992	50.7992	50.8575	50.9701	51.2281	51.2281	51.2756	51.1792	50.9144	50.9701	50.9144	
alpha	4.3659	4.3866	4.3866	4.3905	4.3980	4.4152	4.4152	4.4184	4.4119	4.3943	4.3980	4.3943	
util living area													
	0.9961	0.9930	0.9817	0.9449	0.8472	0.6275	0.4315	0.4865	0.7947	0.9637	0.9924	0.9969	(86)
MIT	19.6184	19.7644	20.0799	20.4504	20.7768	20.9594	20.9942	20.9901	20.8802	20.4623	19.9624	19.5873	(87)
Th 2	19.7822	19.7887	19.7887	19.7899	19.7922	19.7975	19.7975	19.7985	19.7965	19.7911	19.7922	19.7911	(88)
util rest of house													
	0.9947	0.9904	0.9745	0.9220	0.7828	0.5014	0.2728	0.3207	0.6884	0.9435	0.9891	0.9958	(89)
MIT 2	17.9786	18.1956	18.6521	19.1740	19.5955	19.7784	19.7967	19.7967	19.7191	19.2024	18.4876	17.9393	(90)
Living area fraction									fLA = Living area / (4) =			0.1840	(91)
MIT	18.2803	18.4842	18.9148	19.4089	19.8129	19.9957	20.0170	20.0163	19.9327	19.4342	18.7589	18.2425	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1303	18.3342	18.7648	19.2589	19.6629	19.8457	19.8670	19.8663	19.7827	19.2842	18.6089	18.0925	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9916	0.9856	0.9657	0.9086	0.7745	0.5069	0.2822	0.3304	0.6869	0.9313	0.9840	0.9933	(94)
Useful gains	868.9776	972.8293	1078.8741	1155.5236	1037.8987	695.5313	364.5267	398.3340	753.4712	883.6231	841.8588	822.8443	(95)
Ext temp.	5.0000	5.5000	7.4000	9.8000	12.8000	15.8000	17.8000	17.6000	15.1000	11.5000	7.8000	4.9000	(96)
Heat loss rate W													
	2355.9339	2288.7224	2026.6769	1684.8645	1219.7510	715.4237	365.5224	400.3909	828.8628	1385.0115	1921.0939	2347.2934	(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													
	1106.2955	884.2802	705.1652	381.1255	135.2981	0.0000	0.0000	0.0000	0.0000	373.0330	777.0493	1134.1901	(98)

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

Space heating		5496.4368 (98)
Space heating per m2	(98) / (4) =	42.1344 (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 %)		93.1000 (206)
Efficiency of secondary/supplementary heating system, %		0.0000 (208)
Space heating requirement		5903.7989 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1106.2955	884.2802	705.1652	381.1255	135.2981	0.0000	0.0000	0.0000	0.0000	373.0330	777.0493	1134.1901	(98)
Space heating efficiency (main heating system 1)													
	93.1000	93.1000	93.1000	93.1000	93.1000	0.0000	0.0000	0.0000	0.0000	93.1000	93.1000	93.1000	(210)
Space heating fuel (main heating system)													
	1188.2873	949.8176	757.4278	409.3721	145.3256	0.0000	0.0000	0.0000	0.0000	400.6799	834.6394	1218.2493	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	193.3171	169.8015	176.9254	156.6484	152.0783	133.8312	126.5865	141.5977	142.1961	162.5203	174.3060	188.0034	(64)
Efficiency of water heater												87.2000	(216)
(217)m	90.1617	90.1173	89.9756	89.6518	88.8135	87.2000	87.2000	87.2000	87.2000	89.6085	90.0379	90.1853	(217)
Fuel for water heating, kWh/month													
	214.4116	188.4227	196.6369	174.7297	171.2332	153.4762	145.1680	162.3827	163.0689	181.3669	193.5919	208.4635	(219)
Water heating fuel used												2152.9523	(219)
Annual totals kWh/year													
Space heating fuel - main system												5903.7989	(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)												488.3035	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 3.00 * 923 * 1.00) =										-2216.3904		-2216.3904	(233)
Total delivered energy for all uses												6403.6643	(238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	5903.7989	3.6300	214.3079	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2152.9523	3.6300	78.1522	(247)
Pumps and fans for heating	75.0000	19.4400	14.5800	(249)
Energy for lighting	488.3035	19.4400	94.9262	(250)
Additional standing charges			95.0000	(251)
Energy saving/generation technologies				
PV Unit	-2216.3904	19.4400	-430.8663	(252)
Total energy cost			66.1000	(255)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	5903.7989	0.2160	1275.2206	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2152.9523	0.2160	465.0377	(264)
Space and water heating			1740.2583	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	488.3035	0.5190	253.4295	(268)
Energy saving/generation technologies				
PV Unit	-2216.3904	0.5190	-1150.3066	(269)
Total kg/year			882.3062	(272)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	5903.7989	1.2200	7202.6347	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2152.9523	1.2200	2626.6018	(264)
Space and water heating			9829.2364	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	488.3035	3.0700	1499.0919	(268)

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

Energy saving/generation technologies			
PV Unit	-2216.3904	3.0700	-6804.3185 (269)
Primary energy kWh/year			4754.2598 (272)
Primary energy kWh/m2/year			36.4451 (273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: A 92
Current environmental impact rating: B 91

(For testing purposes):

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

Recommended measures: SAP change Cost change CO2 change
(none)

Recommended measures	Typical annual savings	Energy efficiency	Environmental impact
(none)			
Total Savings	£0	0.00 kg/m²	

Potential energy efficiency rating: A 92
Potential environmental impact rating: B 91

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

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

	Current	Potential	Saving
Electricity	£110	£110	£0
Mains gas	£387	£387	£0
Space heating	£324	£324	£0
Water heating	£78	£78	£0
Lighting	£95	£95	£0
Generated (PV)	-£431	-£431	£0
Total cost of fuels	£66	£66	£0
Total cost of uses	£66	£66	£0
Delivered energy	49 kWh/m²	49 kWh/m²	0 kWh/m²
Carbon dioxide emissions	0.9 tonnes	0.9 tonnes	0.0 tonnes
CO2 emissions per m²	7 kg/m²	7 kg/m²	0 kg/m²
Primary energy	36 kWh/m²	36 kWh/m²	0 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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SAP 2012 WORKSHEET FOR New Build (As Designed)   (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING      09 Jan 2014
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No improvements selected / applicable


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

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SAP 2012 WORKSHEET FOR New Build (As Designed)   (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING      09 Jan 2014
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No improvements selected / applicable
```

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

Design SAP
elmhurst energy

Property Reference	Flat 07- 253-255 London Road	**Issued on Date**	31/03/2022
Assessment Reference	003-BE GREEN	**Prop Type Ref**	PR8346
Property	Flat 07, 253-255 , London Road, Headington, Oxford, OX3 9EH		

SAP Rating	92 A	**DER**	9.26	**TER**	17.01
Environmental	93 A	**% DER<TER**	45.55		
CO_2 Emissions (t/year)	0.52	**DFEE**	43.18	**TFEE**	48.08
General Requirements Compliance	Pass	**% DFEE<TFEE**	10.20		

Assessor Details	Mr. Iraj Maghounaki, ERS Consultants Ltd, Tel: 01865 378 885, info@erscltd.co.uk	**Assessor ID**	v571-0001
Client			

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

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

Mid-floor flat, total floor area 90 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) 17.01 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 9.26 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)48.1 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)43.2 kWh/m²/yrOK

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2 Fabric U-values

Element	Average	Highest	
External wall	0.19 (max. 0.30)	0.20 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.22 (max. 0.25)	0.22 (max. 0.70)	OK
Roof	0.09 (max. 0.20)	0.09 (max. 0.35)	OK
Openings	1.40 (max. 2.00)	1.40 (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
Worcester Greenstar 32CDi Compact ErP
Combi boiler
Efficiency: 89.8% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

---
5 Cylinder insulation
Hot water storage No cylinder

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

Hot water controls: No cylinder

Boiler interlock Yes OK

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

---
8 Mechanical ventilation
Not applicable

---
9 Summertime temperature
Overheating risk (Thames Valley): Medium OK
Based on:
Overshading: Average
Windows facing East: 0.83 m², No overhang
Windows facing South: 9.80 m², No overhang
Windows facing West: 5.59 m², No overhang
Air change rate: 3.00 ach
Blinds/curtains: None

---
10 Key features
Party wall U-value 0.00 W/m²K
Roof U-value 0.09 W/m²K
Photovoltaic array 1.80 kW

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	89.7200 (1b)	x	2.4000 (2b)	=	215.3280	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	89.7200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	215.3280	(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) =	0.1858	(8)
Pressure test		Yes	
Measured/design AP50		4.0000	
Infiltration rate		0.3858	(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) =	0.3279	(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	0.4181	0.4099	0.4017	0.3607	0.3525	0.3115	0.3115	0.3033	0.3279	0.3525	0.3689	0.3853	(22b)
Effective ac	0.5874	0.5840	0.5807	0.5650	0.5621	0.5485	0.5485	0.5460	0.5538	0.5621	0.5680	0.5742	(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	
Door			1.8900	1.4000	2.6460			(26)
Windows (Uw = 1.40)			16.2200	1.3258	21.5038			(27)
Sem. Exposed Floor			20.5600	0.2200	4.5232			(28b)
External Wall	67.2700	16.2200	51.0500	0.1800	9.1890			(29a)
Semi Exposed Wall	24.3100	1.8900	22.4200	0.2022	4.5335			(29a)
Roof ins.@Joists	29.2300		29.2300	0.0900	2.6307			(30)
Total net area of external elements Aum(A, m2)			141.3700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		45.0261			(33)
Party Wall 1			29.1400	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)	20.9621	(36)
Total fabric heat loss (33) + (36) =	65.9882	(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	41.7390	41.4979	41.2615	40.1513	39.9436	38.9767	38.9767	38.7976	39.3491	39.9436	40.3638	40.8031	(38)
Heat transfer coeff	107.7273	107.4861	107.2498	106.1396	105.9319	104.9649	104.9649	104.7859	105.3374	105.9319	106.3521	106.7914	(39)
Average = Sum(39)m / 12 =												106.1386	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2007	1.1980	1.1954	1.1830	1.1807	1.1699	1.1699	1.1679	1.1741	1.1807	1.1854	1.1903	(40)
HLP (average)												1.1830	(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	2.6219	(42)
Average daily hot water use (litres/day)	96.4694	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	106.1163	102.2575	98.3988	94.5400	90.6812	86.8224	86.8224	90.6812	94.5400	98.3988	102.2575	106.1163	(44)
Energy conte	157.3674	137.6346	142.0265	123.8222	118.8103	102.5243	95.0038	109.0183	110.3203	128.5677	140.3417	152.4020	(45)
Energy content (annual)										Total = Sum(45)m =		1517.8390	(45)
Distribution loss (46)m = 0.15 x (45)m	23.6051	20.6452	21.3040	18.5733	17.8215	15.3786	14.2506	16.3527	16.5480	19.2851	21.0512	22.8603	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	25.3200	22.8687	25.2911	24.4262	25.2047	24.3504	25.1365	25.1807	24.3917	25.2553	24.4832	25.3072 (61)
Total heat required for water heating calculated for each month												
	182.6875	160.5033	167.3176	148.2483	144.0150	126.8747	120.1403	134.1990	134.7120	153.8230	164.8249	177.7092 (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												
	182.6875	160.5033	167.3176	148.2483	144.0150	126.8747	120.1403	134.1990	134.7120	153.8230	164.8249	177.7092 (64)
								Total per year (kWh/year) = Sum(64)m =				1815.0548 (64)
Heat gains from water heating, kWh/month												
	58.6547	51.4807	53.5466	47.2774	45.8056	40.1769	37.8729	42.5437	42.7794	49.0626	52.7844	57.0005 (65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	131.0934	131.0934	131.0934	131.0934	131.0934	131.0934	131.0934	131.0934	131.0934	131.0934	131.0934	131.0934	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	21.7071	19.2801	15.6796	11.8705	8.8733	7.4912	8.0945	10.5216	14.1221	17.9312	20.9284	22.3105	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	238.5617	241.0372	234.7990	221.5185	204.7543	188.9983	178.4723	175.9968	182.2350	195.5155	212.2797	228.0357	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.1093	36.1093	36.1093	36.1093	36.1093	36.1093	36.1093	36.1093	36.1093	36.1093	36.1093	36.1093	(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)													
	-104.8747	-104.8747	-104.8747	-104.8747	-104.8747	-104.8747	-104.8747	-104.8747	-104.8747	-104.8747	-104.8747	-104.8747	(71)
Water heating gains (Table 5)													
	78.8369	76.6081	71.9712	65.6631	61.5667	55.8013	50.9044	57.1825	59.4159	65.9443	73.3117	76.6135	(72)
Total internal gains													
	404.4338	402.2535	387.7778	364.3801	340.5223	317.6188	302.7993	309.0289	321.1010	344.7191	371.8478	392.2877	(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	
East	0.8300	19.6403	0.6300	0.7000	0.7700	4.9819	(76)
South	9.8000	46.7521	0.6300	0.7000	0.7700	140.0228	(78)
West	5.5900	19.6403	0.6300	0.7000	0.7700	33.5530	(80)

Solar gains	178.5577	304.7037	416.2587	511.2097	565.9316	558.2373	539.7486	499.9173	449.5329	336.7921	214.0232	152.6818	(83)
Total gains	582.9915	706.9571	804.0365	875.5898	906.4539	875.8561	842.5479	808.9461	770.6339	681.5111	585.8710	544.9695	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	57.8364	57.9661	58.0939	58.7015	58.8166	59.3585	59.3585	59.4599	59.1486	58.8166	58.5843	58.3433	
alpha	4.8558	4.8644	4.8729	4.9134	4.9211	4.9572	4.9572	4.9640	4.9432	4.9211	4.9056	4.8896	
util living area													
	0.9972	0.9924	0.9802	0.9459	0.8637	0.7066	0.5352	0.5765	0.8065	0.9619	0.9935	0.9979	(86)
MIT	19.7370	19.9322	20.2037	20.5255	20.7895	20.9448	20.9886	20.9837	20.8902	20.5356	20.0679	19.7008	(87)
Th 2	19.9194	19.9216	19.9237	19.9336	19.9355	19.9441	19.9441	19.9457	19.9408	19.9355	19.9317	19.9278	(88)
util rest of house													
	0.9962	0.9898	0.9733	0.9264	0.8148	0.6133	0.4134	0.4540	0.7267	0.9441	0.9909	0.9972	(89)
MIT 2	18.2456	18.5311	18.9245	19.3850	19.7315	19.9077	19.9400	19.9392	19.8565	19.4087	18.7372	18.1986	(90)
Living area fraction									fLA = Living area / (4) =			0.2006	(91)
MIT	18.5448	18.8122	19.1811	19.6138	19.9437	20.1158	20.1504	20.1488	20.0639	19.6348	19.0042	18.5000	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.3948	18.6622	19.0311	19.4638	19.7937	19.9658	20.0004	19.9988	19.9139	19.4848	18.8542	18.3500	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9941	0.9854	0.9654	0.9154	0.8072	0.6153	0.4201	0.4605	0.7244	0.9339	0.9869	0.9956	(94)
Useful gains	579.5382	696.6502	776.2514	801.5108	731.6675	538.9441	353.9951	372.4975	558.2093	636.4529	578.2235	542.5844	(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													
	1518.3928	1479.2482	1343.9607	1121.2367	857.3842	563.2211	356.9244	377.1011	612.4179	941.1792	1250.0827	1511.0982	(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													
	698.5078	525.9058	422.3757	230.2026	93.5332	0.0000	0.0000	0.0000	0.0000	226.7164	483.7387	720.5743	(98)
Space heating												3401.5546	(98)
Space heating per m2											(98) / (4) =	37.9130	(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 %)												93.1000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3653.6569	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	698.5078	525.9058	422.3757	230.2026	93.5332	0.0000	0.0000	0.0000	0.0000	226.7164	483.7387	720.5743	(98)
Space heating efficiency (main heating system 1)													
	93.1000	93.1000	93.1000	93.1000	93.1000	0.0000	0.0000	0.0000	0.0000	93.1000	93.1000	93.1000	(210)
Space heating fuel (main heating system)													
	750.2770	564.8827	453.6796	247.2638	100.4653	0.0000	0.0000	0.0000	0.0000	243.5192	519.5904	773.9788	(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													
	182.6875	160.5033	167.3176	148.2483	144.0150	126.8747	120.1403	134.1990	134.7120	153.8230	164.8249	177.7092	(64)
Efficiency of water heater												87.2000	(216)
(217)m	89.9515	89.8567	89.6787	89.2960	88.5454	87.2000	87.2000	87.2000	87.2000	89.2519	89.7842	89.9855	(217)
Fuel for water heating, kWh/month													
	203.0955	178.6215	186.5746	166.0190	162.6454	145.4985	137.7756	153.8979	154.4862	172.3470	183.5791	197.4865	(219)
Water heating fuel used												2042.0268	(219)
Annual totals kWh/year													
Space heating fuel - main system												3653.6569	(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)												383.3551	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.80 * 853 * 1.00) =										-1228.3631		-1228.3631	(233)
Total delivered energy for all uses												4925.6757	(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	3653.6569	0.2160	789.1899	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2042.0268	0.2160	441.0778	(264)
Space and water heating			1230.2677	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	383.3551	0.5190	198.9613	(268)
Energy saving/generation technologies				
PV Unit	-1228.3631	0.5190	-637.5204	(269)
Total CO2, kg/year			830.6335	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			9.2600	(273)

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

DER		9.2600	ZC1
Total Floor Area	TFA	89.7200	
Assumed number of occupants	N	2.6219	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		15.7564	ZC2
CO2 emissions from cooking, equation (L16)		2.0277	ZC3
Total CO2 emissions		27.0441	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		27.0441	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	89.7200 (1b)	x	2.4000 (2b)	=	215.3280	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	89.7200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	215.3280	(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) =	0.1393	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3893	(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) =	0.3309	(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	0.4219	0.4137	0.4054	0.3640	0.3557	0.3144	0.3144	0.3061	0.3309	0.3557	0.3723	0.3888	(22b)
Effective ac	0.5890	0.5856	0.5822	0.5663	0.5633	0.5494	0.5494	0.5469	0.5548	0.5633	0.5693	0.5756	(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			1.8900	1.0000	1.8900			(26)
TER Opening Type (Uw = 1.40)			16.2200	1.3258	21.5038			(27)
Sem. Exposed Floor			20.5600	0.1300	2.6728			(28b)
External Wall	67.2700	16.2200	51.0500	0.1800	9.1890			(29a)
Semi Exposed Wall	24.3100	1.8900	22.4200	0.1800	4.0356			(29a)
Roof ins.@Joists	29.2300		29.2300	0.1300	3.7999			(30)
Total net area of external elements Aum(A, m2)			141.3700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		43.0911			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	19.3377	(36)
Total fabric heat loss (33) + (36) =	62.4288	(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	41.8541	41.6085	41.3678	40.2370	40.0254	39.0406	39.0406	38.8582	39.4199	40.0254	40.4534	40.9009	(38)
Heat transfer coeff	104.2829	104.0373	103.7966	102.6658	102.4542	101.4694	101.4694	101.2870	101.8487	102.4542	102.8822	103.3297	(39)
Average = Sum(39)m / 12 =												102.6648	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1623	1.1596	1.1569	1.1443	1.1419	1.1310	1.1310	1.1289	1.1352	1.1419	1.1467	1.1517	(40)
HLP (average)												1.1443	(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	2.6219 (42)
Average daily hot water use (litres/day)	96.4694 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	106.1163	102.2575	98.3988	94.5400	90.6812	86.8224	86.8224	90.6812	94.5400	98.3988	102.2575	106.1163	(44)
Energy conte	157.3674	137.6346	142.0265	123.8222	118.8103	102.5243	95.0038	109.0183	110.3203	128.5677	140.3417	152.4020	(45)
Energy content (annual)										Total = Sum(45)m =		1517.8390	(45)
Distribution loss (46)m = 0.15 x (45)m	23.6051	20.6452	21.3040	18.5733	17.8215	15.3786	14.2506	16.3527	16.5480	19.2851	21.0512	22.8603	(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	50.1429	46.6225	46.2102	42.8165	44.2438	46.2102	46.6225	50.1429	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month													
	208.3263	183.6620	192.1695	170.4446	165.0205	145.3408	139.2476	155.2284	156.9428	178.7106	189.6567	203.3609	(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													
	208.3263	183.6620	192.1695	170.4446	165.0205	145.3408	139.2476	155.2284	156.9428	178.7106	189.6567	203.3609	(64)
								Total per year (kWh/year) = Sum(64)m =				2088.1107	(64)
Heat gains from water heating, kWh/month													
	65.0644	57.2703	59.7596	52.8265	51.0570	44.7935	42.6497	47.8011	48.3371	55.2845	58.9924	63.4134	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	131.0934	131.0934	131.0934	131.0934	131.0934	131.0934	131.0934	131.0934	131.0934	131.0934	131.0934	131.0934	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	21.7071	19.2801	15.6796	11.8705	8.8733	7.4912	8.0945	10.5216	14.1221	17.9312	20.9284	22.3105	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	238.5617	241.0372	234.7990	221.5185	204.7543	188.9983	178.4723	175.9968	182.2350	195.5155	212.2797	228.0357	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.1093	36.1093	36.1093	36.1093	36.1093	36.1093	36.1093	36.1093	36.1093	36.1093	36.1093	36.1093	(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)													
	-104.8747	-104.8747	-104.8747	-104.8747	-104.8747	-104.8747	-104.8747	-104.8747	-104.8747	-104.8747	-104.8747	-104.8747	(71)
Water heating gains (Table 5)													
	87.4521	85.2237	80.3220	73.3701	68.6250	62.2131	57.3249	64.2488	67.1349	74.3071	81.9338	85.2330	(72)
Total internal gains													
	413.0490	410.8690	396.1286	372.0871	347.5806	324.0307	309.2198	316.0952	328.8200	353.0818	380.4699	400.9072	(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	0.8300	19.6403	0.6300	0.7000	0.7700	4.9819	(76)
South	9.8000	46.7521	0.6300	0.7000	0.7700	140.0228	(78)
West	5.5900	19.6403	0.6300	0.7000	0.7700	33.5530	(80)

Solar gains	178.5577	304.7037	416.2587	511.2097	565.9316	558.2373	539.7486	499.9173	449.5329	336.7921	214.0232	152.6818	(83)
Total gains	591.6067	715.5727	812.3873	883.2968	913.5122	882.2679	848.9683	816.0125	778.3529	689.8739	594.4932	553.5890	(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	59.7467	59.8877	60.0266	60.6877	60.8131	61.4033	61.4033	61.5139	61.1746	60.8131	60.5601	60.2978	
alpha	4.9831	4.9925	5.0018	5.0458	5.0542	5.0936	5.0936	5.1009	5.0783	5.0542	5.0373	5.0199	
util living area													
	0.9970	0.9917	0.9784	0.9408	0.8519	0.6878	0.5163	0.5564	0.7900	0.9578	0.9929	0.9978	(86)
MIT	19.7971	19.9913	20.2575	20.5690	20.8170	20.9553	20.9914	20.9875	20.9078	20.5757	20.1204	19.7615	(87)
Th 2	19.9503	19.9525	19.9546	19.9648	19.9667	19.9756	19.9756	19.9773	19.9722	19.9667	19.9629	19.9588	(88)
util rest of house													
	0.9959	0.9890	0.9710	0.9200	0.8017	0.5967	0.4011	0.4401	0.7099	0.9387	0.9901	0.9971	(89)
MIT 2	18.3550	18.6389	19.0241	19.4686	19.7908	19.9464	19.9725	19.9723	19.9022	19.4875	18.8358	18.3091	(90)
Living area fraction										fLA = Living area / (4) =		0.2006	(91)
MIT	18.6443	18.9102	19.2716	19.6894	19.9967	20.1488	20.1769	20.1760	20.1040	19.7058	19.0935	18.6005	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6443	18.9102	19.2716	19.6894	19.9967	20.1488	20.1769	20.1760	20.1040	19.7058	19.0935	18.6005	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9940	0.9852	0.9647	0.9133	0.8034	0.6131	0.4243	0.4634	0.7213	0.9325	0.9867	0.9956	(94)
Useful gains	588.0779	704.9801	783.7069	806.7107	733.8884	540.9268	360.1940	378.1596	561.4513	643.2851	586.6149	551.1531	(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													
	1495.8675	1457.5823	1325.6468	1107.7006	850.0300	563.0347	362.9503	382.4593	611.4964	932.9326	1233.9169	1487.9953	(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													
	675.3955	505.7487	403.2033	216.7127	86.4094	0.0000	0.0000	0.0000	0.0000	215.4977	466.0575	697.0106	(98)
Space heating												3266.0353	(98)
Space heating per m2											(98) / (4) =	36.4025	(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												3496.8258	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	675.3955	505.7487	403.2033	216.7127	86.4094	0.0000	0.0000	0.0000	0.0000	215.4977	466.0575	697.0106	(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)													
	723.1215	541.4868	431.6952	232.0264	92.5154	0.0000	0.0000	0.0000	0.0000	230.7256	498.9909	746.2640	(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													
	208.3263	183.6620	192.1695	170.4446	165.0205	145.3408	139.2476	155.2284	156.9428	178.7106	189.6567	203.3609	(64)
Efficiency of water heater												80.3000	(216)
(217)m	87.7968	87.4691	86.8732	85.6569	83.5064	80.3000	80.3000	80.3000	80.3000	85.5234	87.2267	87.9028	(217)
Fuel for water heating, kWh/month													
	237.2825	209.9735	221.2070	198.9853	197.6142	180.9973	173.4092	193.3106	195.4455	208.9610	217.4296	231.3474	(219)
Water heating fuel used												2465.9632	(219)
Annual totals kWh/year													
Space heating fuel - main system												3496.8258	(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)												383.3551	(232)
Total delivered energy for all uses												6421.1441	(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	3496.8258	0.2160	755.3144	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2465.9632	0.2160	532.6481	(264)
Space and water heating			1287.9624	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	383.3551	0.5190	198.9613	(268)
Total CO2, kg/m2/year			1525.8487	(272)
Emissions per m2 for space and water heating			14.3554	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.2176	(272b)
Emissions per m2 for pumps and fans			0.4338	(272c)
Target Carbon Dioxide Emission Rate (TER) = (14.3554 * 1.00) + 2.2176 + 0.4338, rounded to 2 d.p.			17.0100	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	89.7200 (1b)	x	2.4000 (2b)	=	215.3280	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	89.7200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	215.3280	(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) =	0.1393	(8)
Pressure test		Yes	
Measured/design AP50		4.0000	
Infiltration rate		0.3393	(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) =	0.2884	(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	0.3677	0.3605	0.3533	0.3173	0.3101	0.2740	0.2740	0.2668	0.2884	0.3101	0.3245	0.3389	(22b)
Effective ac	0.5676	0.5650	0.5624	0.5503	0.5481	0.5375	0.5375	0.5356	0.5416	0.5481	0.5526	0.5574	(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	
Door			1.8900	1.4000	2.6460			(26)
Windows (Uw = 1.40)			16.2200	1.3258	21.5038			(27)
Sem. Exposed Floor			20.5600	0.2200	4.5232			(28b)
External Wall	67.2700	16.2200	51.0500	0.1800	9.1890			(29a)
Semi Exposed Wall	24.3100	1.8900	22.4200	0.2022	4.5335			(29a)
Roof ins.@Joists	29.2300		29.2300	0.0900	2.6307			(30)
Total net area of external elements Aum(A, m2)			141.3700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		45.0261			(33)
Party Wall 1			29.1400	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)	20.9621	(36)
Total fabric heat loss (33) + (36) =	65.9882	(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	40.3338	40.1473	39.9644	39.1054	38.9447	38.1966	38.1966	38.0580	38.4847	38.9447	39.2698	39.6097	(38)
Heat transfer coeff	106.3221	106.1355	105.9526	105.0937	104.9329	104.1848	104.1848	104.0463	104.4730	104.9329	105.2581	105.5980	(39)
Average = Sum(39)m / 12 =												105.0929	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1850	1.1830	1.1809	1.1714	1.1696	1.1612	1.1612	1.1597	1.1644	1.1696	1.1732	1.1770	(40)
HLP (average)												1.1713	(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	2.6219 (42)
Average daily hot water use (litres/day)	96.4694 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	106.1163	102.2575	98.3988	94.5400	90.6812	86.8224	86.8224	90.6812	94.5400	98.3988	102.2575	106.1163	(44)
Energy conte	157.3674	137.6346	142.0265	123.8222	118.8103	102.5243	95.0038	109.0183	110.3203	128.5677	140.3417	152.4020	(45)
Energy content (annual)										Total = Sum(45)m =		1517.8390	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)

Heat gains from water heating, kWh/month

	33.4406	29.2473	30.1806	26.3122	25.2472	21.7864	20.1883	23.1664	23.4431	27.3206	29.8226	32.3854 (65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	131.0934	131.0934	131.0934	131.0934	131.0934	131.0934	131.0934	131.0934	131.0934	131.0934	131.0934	131.0934	(66)

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

	21.7071	19.2801	15.6796	11.8705	8.8733	7.4912	8.0945	10.5216	14.1221	17.9312	20.9284	22.3105 (67)

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

	238.5617	241.0372	234.7990	221.5185	204.7543	188.9983	178.4723	175.9968	182.2350	195.5155	212.2797	228.0357 (68)

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

	36.1093	36.1093	36.1093	36.1093	36.1093	36.1093	36.1093	36.1093	36.1093	36.1093	36.1093	36.1093 (69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (70)

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

	-104.8747	-104.8747	-104.8747	-104.8747	-104.8747	-104.8747	-104.8747	-104.8747	-104.8747	-104.8747	-104.8747	-104.8747 (71)

Water heating gains (Table 5)

	44.9470	43.5228	40.5654	36.5447	33.9344	30.2589	27.1348	31.1376	32.5598	36.7213	41.4203	43.5288 (72)

Total internal gains

	367.5439	366.1682	353.3720	332.2617	309.8900	289.0764	276.0297	279.9840	291.2449	312.4960	336.9564	356.2030 (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	
East	0.8300	19.6403	0.6300	0.7000	0.7700	4.9819	(76)
South	9.8000	46.7521	0.6300	0.7000	0.7700	140.0228	(78)
West	5.5900	19.6403	0.6300	0.7000	0.7700	33.5530	(80)

Solar gains	178.5577	304.7037	416.2587	511.2097	565.9316	558.2373	539.7486	499.9173	449.5329	336.7921	214.0232	152.6818	(83)
Total gains	546.1015	670.8718	769.6307	843.4714	875.8217	847.3137	815.7783	779.9013	740.7778	649.2881	550.9796	508.8848	(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	58.6008	58.7038	58.8051	59.2857	59.3765	59.8029	59.8029	59.8826	59.6380	59.3765	59.1931	59.0026	
alpha	4.9067	4.9136	4.9203	4.9524	4.9584	4.9869	4.9869	4.9922	4.9759	4.9584	4.9462	4.9335	
util living area	0.9979	0.9938	0.9831	0.9517	0.8738	0.7203	0.5476	0.5918	0.8211	0.9677	0.9950	0.9985	(86)
MIT	19.7200	19.9157	20.1884	20.5111	20.7803	20.9410	20.9878	20.9822	20.8824	20.5171	20.0464	19.6813	(87)
Th 2	19.9320	19.9337	19.9353	19.9430	19.9444	19.9511	19.9511	19.9524	19.9486	19.9444	19.9415	19.9385	(88)
util rest of house	0.9971	0.9917	0.9771	0.9338	0.8270	0.6276	0.4244	0.4679	0.7438	0.9521	0.9930	0.9980	(89)
MIT 2	18.7697	18.9657	19.2363	19.5542	19.7976	19.9243	19.9481	19.9475	19.8859	19.5665	19.1029	18.7363	(90)
Living area fraction									fLA = Living area / (4) =			0.2006	(91)
MIT	18.9603	19.1563	19.4273	19.7462	19.9947	20.1282	20.1567	20.1550	20.0858	19.7572	19.2922	18.9259	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9603	19.1563	19.4273	19.7462	19.9947	20.1282	20.1567	20.1550	20.0858	19.7572	19.2922	18.9259	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9962	0.9897	0.9734	0.9298	0.8296	0.6445	0.4493	0.4929	0.7552	0.9486	0.9912	0.9973	(94)
Useful gains	544.0321	663.9513	749.1825	784.2447	726.5572	546.0932	366.5655	384.4130	559.4607	615.9112	546.1477	507.4989	(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	1558.7150	1513.0983	1369.6860	1139.8632	870.3910	575.9587	370.5523	390.6978	625.3543	960.8933	1283.3224	1555.0251	(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	754.9241	570.6268	461.6546	256.0453	107.0123	0.0000	0.0000	0.0000	0.0000	256.6667	530.7658	779.3595	(98)
Space heating												3717.0552	(98)
Space heating per m2											(98) / (4) =	41.4295	(99)

8c. Space cooling requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	979.3371	770.9675	790.7516	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8740	0.9325	0.9169	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	855.9335	718.9349	725.0319	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1089.3495	1050.4132	1010.2327	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	168.0596	246.6198	212.1894	0.0000	0.0000	0.0000	0.0000	(104)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Space cooling											626.8688	(104)
Cooled fraction									fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)												
0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh												
0.0000	0.0000	0.0000	0.0000	0.0000	42.0149	61.6549	53.0474	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling											156.7172	(107)
Space cooling per m2											1.7467	(108)
Energy for space heating											41.4295	(99)
Energy for space cooling											1.7467	(108)
Total											43.1762	(109)
Dwelling Fabric Energy Efficiency (DFEE)											43.2	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	89.7200 (1b)	x	2.4000 (2b)	=	215.3280	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	89.7200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	215.3280	(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) =	0.1393	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3893	(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) =	0.3309	(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	0.4219	0.4137	0.4054	0.3640	0.3557	0.3144	0.3144	0.3061	0.3309	0.3557	0.3723	0.3888	(22b)
Effective ac	0.5890	0.5856	0.5822	0.5663	0.5633	0.5494	0.5494	0.5469	0.5548	0.5633	0.5693	0.5756	(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			1.8900	1.0000	1.8900			(26)
TER Opening Type (Uw = 1.40)			16.2200	1.3258	21.5038			(27)
Sem. Exposed Floor			20.5600	0.1300	2.6728			(28b)
External Wall	67.2700	16.2200	51.0500	0.1800	9.1890			(29a)
Semi Exposed Wall	24.3100	1.8900	22.4200	0.1800	4.0356			(29a)
Roof ins.@Joists	29.2300		29.2300	0.1300	3.7999			(30)
Total net area of external elements Aum(A, m2)			141.3700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		43.0911			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							19.3377	(36)
Total fabric heat loss						(33) + (36) =	62.4288	(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	41.8541	41.6085	41.3678	40.2370	40.0254	39.0406	39.0406	38.8582	39.4199	40.0254	40.4534	40.9009	(38)
Heat transfer coeff	104.2829	104.0373	103.7966	102.6658	102.4542	101.4694	101.4694	101.2870	101.8487	102.4542	102.8822	103.3297	(39)
Average = Sum(39)m / 12 =												102.6648	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1623	1.1596	1.1569	1.1443	1.1419	1.1310	1.1310	1.1289	1.1352	1.1419	1.1467	1.1517	(40)
HLP (average)												1.1443	(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												2.6219	(42)
Average daily hot water use (litres/day)												96.4694	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	106.1163	102.2575	98.3988	94.5400	90.6812	86.8224	86.8224	90.6812	94.5400	98.3988	102.2575	106.1163	(44)
Energy conte	157.3674	137.6346	142.0265	123.8222	118.8103	102.5243	95.0038	109.0183	110.3203	128.5677	140.3417	152.4020	(45)
Energy content (annual)										Total = Sum(45)m =		1517.8390	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	33.4406	29.2473	30.1806	26.3122	25.2472	21.7864	20.1883	23.1664	23.4431	27.3206	29.8226	32.3854	(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	131.0934	131.0934	131.0934	131.0934	131.0934	131.0934	131.0934	131.0934	131.0934	131.0934	131.0934	131.0934	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	21.7071	19.2801	15.6796	11.8705	8.8733	7.4912	8.0945	10.5216	14.1221	17.9312	20.9284	22.3105	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	238.5617	241.0372	234.7990	221.5185	204.7543	188.9983	178.4723	175.9968	182.2350	195.5155	212.2797	228.0357	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.1093	36.1093	36.1093	36.1093	36.1093	36.1093	36.1093	36.1093	36.1093	36.1093	36.1093	36.1093	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-104.8747	-104.8747	-104.8747	-104.8747	-104.8747	-104.8747	-104.8747	-104.8747	-104.8747	-104.8747	-104.8747	-104.8747	(71)
Water heating gains (Table 5)													
	44.9470	43.5228	40.5654	36.5447	33.9344	30.2589	27.1348	31.1376	32.5598	36.7213	41.4203	43.5288	(72)
Total internal gains													
	367.5439	366.1682	353.3720	332.2617	309.8900	289.0764	276.0297	279.9840	291.2449	312.4960	336.9564	356.2030	(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	0.8300	19.6403	0.6300	0.7000	0.7700	4.9819	(76)
South	9.8000	46.7521	0.6300	0.7000	0.7700	140.0228	(78)
West	5.5900	19.6403	0.6300	0.7000	0.7700	33.5530	(80)

Solar gains	178.5577	304.7037	416.2587	511.2097	565.9316	558.2373	539.7486	499.9173	449.5329	336.7921	214.0232	152.6818	(83)
Total gains	546.1015	670.8718	769.6307	843.4714	875.8217	847.3137	815.7783	779.9013	740.7778	649.2881	550.9796	508.8848	(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	59.7467	59.8877	60.0266	60.6877	60.8131	61.4033	61.4033	61.5139	61.1746	60.8131	60.5601	60.2978	
alpha	4.9831	4.9925	5.0018	5.0458	5.0542	5.0936	5.0936	5.1009	5.0783	5.0542	5.0373	5.0199	
util living area													
	0.9979	0.9938	0.9826	0.9496	0.8679	0.7089	0.5355	0.5793	0.8127	0.9664	0.9949	0.9985	(86)
MIT	19.7503	19.9464	20.2172	20.5376	20.7980	20.9488	20.9899	20.9851	20.8943	20.5408	20.0763	19.7152	(87)
Th 2	19.9503	19.9525	19.9546	19.9648	19.9667	19.9756	19.9756	19.9773	19.9722	19.9667	19.9629	19.9588	(88)
util rest of house													
	0.9972	0.9916	0.9765	0.9313	0.8205	0.6176	0.4169	0.4596	0.7353	0.9505	0.9929	0.9980	(89)
MIT 2	18.8144	19.0112	19.2804	19.5976	19.8322	19.9524	19.9731	19.9732	19.9161	19.6076	19.1498	18.7863	(90)
Living area fraction									fLA = Living area / (4) =			0.2006	(91)
MIT	19.0022	19.1988	19.4683	19.7862	20.0260	20.1523	20.1771	20.1762	20.1124	19.7949	19.3357	18.9727	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.0022	19.1988	19.4683	19.7862	20.0260	20.1523	20.1771	20.1762	20.1124	19.7949	19.3357	18.9727	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9962	0.9896	0.9729	0.9275	0.8236	0.6345	0.4409	0.4837	0.7472	0.9471	0.9912	0.9973	(94)
Useful gains	544.0461	663.9014	748.7836	782.3100	721.3504	537.6290	359.6857	377.2653	553.4752	614.9215	546.1209	507.5161	(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													
	1533.1875	1487.6137	1346.0657	1117.6412	853.0310	563.3871	362.9660	382.4783	612.3533	942.0515	1258.8333	1526.4539	(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													
	735.9211	553.5347	444.3779	241.4384	97.9704	0.0000	0.0000	0.0000	0.0000	243.3847	513.1529	758.0897	(98)
Space heating												3587.8699	(98)
Space heating per m2											(98) / (4) =	39.9896	(99)

8c. Space cooling requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	953.8121	750.8733	769.7811	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8861	0.9408	0.9265	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	845.1312	706.3912	713.2172	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1089.3495	1050.4132	1010.2327	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	175.8372	255.9524	220.9795	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												652.7691	(104)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Cooled fraction											fC = cooled area / (4) =	1.0000 (105)
Intermittency factor (Table 10b)												
0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh												
0.0000	0.0000	0.0000	0.0000	0.0000	43.9593	63.9881	55.2449	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												163.1923 (107)
Space cooling per m2												1.8189 (108)
Energy for space heating												39.9896 (99)
Energy for space cooling												1.8189 (108)
Total												41.8085 (109)
Target Fabric Energy Efficiency (TFEE)												48.1 (109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	89.7200 (1b)	x	2.4000 (2b)	=	215.3280	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	89.7200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	215.3280	(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) =	0.1858	(8)
Pressure test		Yes	
Measured/design AP50		4.0000	
Infiltration rate		0.3858	(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) =	0.3279	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.6000	4.1000	4.1000	4.0000	3.8000	3.3000	3.3000	3.2000	3.4000	3.9000	3.8000	3.9000	(22)
Wind factor	1.1500	1.0250	1.0250	1.0000	0.9500	0.8250	0.8250	0.8000	0.8500	0.9750	0.9500	0.9750	(22a)
Adj infilt rate	0.3771	0.3361	0.3361	0.3279	0.3115	0.2705	0.2705	0.2623	0.2787	0.3197	0.3115	0.3197	(22b)
Effective ac	0.5711	0.5565	0.5565	0.5538	0.5485	0.5366	0.5366	0.5344	0.5388	0.5511	0.5485	0.5511	(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	
Door			1.8900	1.4000	2.6460			(26)
Windows (Uw = 1.40)			16.2200	1.3258	21.5038			(27)
Sem. Exposed Floor			20.5600	0.2200	4.5232			(28b)
External Wall	67.2700	16.2200	51.0500	0.1800	9.1890			(29a)
Semi Exposed Wall	24.3100	1.8900	22.4200	0.2022	4.5335			(29a)
Roof ins.@Joists	29.2300		29.2300	0.0900	2.6307			(30)
Total net area of external elements Aum(A, m2)			141.3700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		45.0261			(33)
Party Wall 1			29.1400	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)	20.9621	(36)
Total fabric heat loss (33) + (36) =	65.9882	(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	40.5811	39.5425	39.5425	39.3491	38.9767	38.1291	38.1291	37.9739	38.2891	39.1605	38.9767	39.1605	(38)
Heat transfer coeff	106.5693	105.5308	105.5308	105.3374	104.9649	104.1174	104.1174	103.9622	104.2773	105.1488	104.9649	105.1488	(39)
Average = Sum(39)m / 12 =												104.9725	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1878	1.1762	1.1762	1.1741	1.1699	1.1605	1.1605	1.1587	1.1623	1.1720	1.1699	1.1720	(40)
HLP (average)												1.1700	(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	2.6219 (42)
Average daily hot water use (litres/day)	96.4694 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	106.1163	102.2575	98.3988	94.5400	90.6812	86.8224	86.8224	90.6812	94.5400	98.3988	102.2575	106.1163	(44)
Energy conte	157.3674	137.6346	142.0265	123.8222	118.8103	102.5243	95.0038	109.0183	110.3203	128.5677	140.3417	152.4020	(45)
Energy content (annual)										Total = Sum(45)m =		1517.8390	(45)
Distribution loss (46)m = 0.15 x (45)m	23.6051	20.6452	21.3040	18.5733	17.8215	15.3786	14.2506	16.3527	16.5480	19.2851	21.0512	22.8603	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)

CALCULATION OF HEAT DEMAND 09 Jan 2014

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	25.3200	22.8687	25.2911	24.4262	25.2047	24.3504	25.1365	25.1807	24.3917	25.2553	24.4832	25.3072 (61)
Total heat required for water heating calculated for each month												
	182.6875	160.5033	167.3176	148.2483	144.0150	126.8747	120.1403	134.1990	134.7120	153.8230	164.8249	177.7092 (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												
	182.6875	160.5033	167.3176	148.2483	144.0150	126.8747	120.1403	134.1990	134.7120	153.8230	164.8249	177.7092 (64)
Total per year (kWh/year) = Sum(64)m =												1815.0548 (64)
RHI water heating demand												1815 (64)
Heat gains from water heating, kWh/month												
	58.6547	51.4807	53.5466	47.2774	45.8056	40.1769	37.8729	42.5437	42.7794	49.0626	52.7844	57.0005 (65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	157.3121	157.3121	157.3121	157.3121	157.3121	157.3121	157.3121	157.3121	157.3121	157.3121	157.3121	157.3121	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	54.2679	48.2002	39.1991	29.6762	22.1833	18.7281	20.2364	26.3040	35.3052	44.8280	52.3209	55.7761	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	356.0622	359.7570	350.4462	330.6246	305.6034	282.0870	266.3766	262.6818	271.9926	291.8142	316.8354	340.3518	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.3531	53.3531	53.3531	53.3531	53.3531	53.3531	53.3531	53.3531	53.3531	53.3531	53.3531	53.3531	(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)													
	-104.8747	-104.8747	-104.8747	-104.8747	-104.8747	-104.8747	-104.8747	-104.8747	-104.8747	-104.8747	-104.8747	-104.8747	(71)
Water heating gains (Table 5)													
	78.8369	76.6081	71.9712	65.6631	61.5667	55.8013	50.9044	57.1825	59.4159	65.9443	73.3117	76.6135	(72)
Total internal gains													
	597.9575	593.3558	570.4070	534.7543	498.1438	465.4068	446.3078	454.9587	475.5040	511.3770	551.2584	581.5319	(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	
East	0.8300	23.1112	0.6300	0.7000	0.7700	5.8624	(76)
South	9.8000	52.9996	0.6300	0.7000	0.7700	158.7341	(78)
West	5.5900	23.1112	0.6300	0.7000	0.7700	39.4827	(80)

Solar gains	204.0792	313.8400	421.4756	528.8932	570.5114	605.3070	570.7250	532.9631	482.8462	362.4382	242.4482	174.2677	(83)
Total gains	802.0366	907.1959	991.8826	1063.6475	1068.6552	1070.7138	1017.0328	987.9217	958.3502	873.8152	793.7066	755.7996	(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	58.4648	59.0402	59.0402	59.1486	59.3585	59.8417	59.8417	59.9310	59.7499	59.2547	59.3585	59.2547	
alpha	4.8977	4.9360	4.9360	4.9432	4.9572	4.9894	4.9894	4.9954	4.9833	4.9503	4.9572	4.9503	
util living area													
	0.9867	0.9750	0.9439	0.8717	0.7314	0.4972	0.3268	0.3564	0.6148	0.8824	0.9720	0.9897	(86)
MIT	20.0500	20.2174	20.4801	20.7368	20.9175	20.9905	20.9991	20.9986	20.9728	20.7624	20.3596	20.0149	(87)
Th 2	19.9298	19.9391	19.9391	19.9408	19.9441	19.9518	19.9518	19.9531	19.9503	19.9425	19.9441	19.9425	(88)
util rest of house													
	0.9824	0.9672	0.9263	0.8335	0.6606	0.4011	0.2202	0.2475	0.5172	0.8384	0.9617	0.9863	(89)
MIT 2	18.7068	18.9529	19.3219	19.6635	19.8770	19.9475	19.9516	19.9529	19.9349	19.7057	19.1629	18.6655	(90)
Living area fraction									fLA = Living area / (4) =			0.2006	(91)
MIT	18.9763	19.2066	19.5543	19.8789	20.0857	20.1567	20.1618	20.1627	20.1431	19.9177	19.4030	18.9363	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.8263	19.0566	19.4043	19.7289	19.9357	20.0067	20.0118	20.0127	19.9931	19.7677	19.2530	18.7863	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9762	0.9586	0.9153	0.8247	0.6600	0.4063	0.2263	0.2537	0.5214	0.8298	0.9526	0.9811	(94)
Useful gains	782.9225	869.6424	907.8805	877.1467	705.2654	434.9865	230.1755	250.6288	499.6816	725.0893	756.0976	741.5171	(95)
Ext temp.	5.0000	5.5000	7.4000	9.8000	12.8000	15.8000	17.8000	17.6000	15.1000	11.5000	7.8000	4.9000	(96)
Heat loss rate W													
	1473.4615	1430.6339	1266.8227	1045.8797	749.0022	437.9935	230.2832	250.8276	510.2391	869.3370	1202.1609	1460.1221	(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													
	513.7610	376.9863	267.0530	121.4877	32.5402	0.0000	0.0000	0.0000	0.0000	107.3203	321.1656	534.6421	(98)
Space heating												2274.9563	(98)
RHI space heating demand												2275	(98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	89.7200 (1b)	x	2.4000 (2b)	=	215.3280	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	89.7200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	215.3280	(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) =	0.1858	(8)
Pressure test		Yes	
Measured/design AP50		4.0000	
Infiltration rate		0.3858	(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) =	0.3279	(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	0.4181	0.4099	0.4017	0.3607	0.3525	0.3115	0.3115	0.3033	0.3279	0.3525	0.3689	0.3853	(22b)
Effective ac	0.5874	0.5840	0.5807	0.5650	0.5621	0.5485	0.5485	0.5460	0.5538	0.5621	0.5680	0.5742	(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	
Door			1.8900	1.4000	2.6460			(26)
Windows (Uw = 1.40)			16.2200	1.3258	21.5038			(27)
Sem. Exposed Floor			20.5600	0.2200	4.5232			(28b)
External Wall	67.2700	16.2200	51.0500	0.1800	9.1890			(29a)
Semi Exposed Wall	24.3100	1.8900	22.4200	0.2022	4.5335			(29a)
Roof ins.@Joists	29.2300		29.2300	0.0900	2.6307			(30)
Total net area of external elements Aum(A, m2)			141.3700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		45.0261			(33)
Party Wall 1			29.1400	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)	20.9621	(36)
Total fabric heat loss (33) + (36) =	65.9882	(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	41.7390	41.4979	41.2615	40.1513	39.9436	38.9767	38.9767	38.7976	39.3491	39.9436	40.3638	40.8031	(38)
Heat transfer coeff	107.7273	107.4861	107.2498	106.1396	105.9319	104.9649	104.9649	104.7859	105.3374	105.9319	106.3521	106.7914	(39)
Average = Sum(39)m / 12 =												106.1386	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2007	1.1980	1.1954	1.1830	1.1807	1.1699	1.1699	1.1679	1.1741	1.1807	1.1854	1.1903	(40)
HLP (average)												1.1830	(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	2.6219 (42)
Average daily hot water use (litres/day)	96.4694 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	106.1163	102.2575	98.3988	94.5400	90.6812	86.8224	86.8224	90.6812	94.5400	98.3988	102.2575	106.1163	(44)
Energy conte	157.3674	137.6346	142.0265	123.8222	118.8103	102.5243	95.0038	109.0183	110.3203	128.5677	140.3417	152.4020	(45)
Energy content (annual)										Total = Sum(45)m =		1517.8390	(45)
Distribution loss (46)m = 0.15 x (45)m	23.6051	20.6452	21.3040	18.5733	17.8215	15.3786	14.2506	16.3527	16.5480	19.2851	21.0512	22.8603	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	25.3200	22.8687	25.2911	24.4262	25.2047	24.3504	25.1365	25.1807	24.3917	25.2553	24.4832	25.3072 (61)
Total heat required for water heating calculated for each month												
	182.6875	160.5033	167.3176	148.2483	144.0150	126.8747	120.1403	134.1990	134.7120	153.8230	164.8249	177.7092 (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												
	182.6875	160.5033	167.3176	148.2483	144.0150	126.8747	120.1403	134.1990	134.7120	153.8230	164.8249	177.7092 (64)
								Total per year (kWh/year) = Sum(64)m =				1815.0548 (64)
Heat gains from water heating, kWh/month												
	58.6547	51.4807	53.5466	47.2774	45.8056	40.1769	37.8729	42.5437	42.7794	49.0626	52.7844	57.0005 (65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	157.3121	157.3121	157.3121	157.3121	157.3121	157.3121	157.3121	157.3121	157.3121	157.3121	157.3121	157.3121	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	54.2679	48.2002	39.1991	29.6762	22.1833	18.7281	20.2364	26.3040	35.3052	44.8280	52.3209	55.7761	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	356.0622	359.7570	350.4462	330.6246	305.6034	282.0870	266.3766	262.6818	271.9926	291.8142	316.8354	340.3518	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.3531	53.3531	53.3531	53.3531	53.3531	53.3531	53.3531	53.3531	53.3531	53.3531	53.3531	53.3531	(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)													
	-104.8747	-104.8747	-104.8747	-104.8747	-104.8747	-104.8747	-104.8747	-104.8747	-104.8747	-104.8747	-104.8747	-104.8747	(71)
Water heating gains (Table 5)													
	78.8369	76.6081	71.9712	65.6631	61.5667	55.8013	50.9044	57.1825	59.4159	65.9443	73.3117	76.6135	(72)
Total internal gains													
	597.9575	593.3558	570.4070	534.7543	498.1438	465.4068	446.3078	454.9587	475.5040	511.3770	551.2584	581.5319	(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	
East	0.8300	19.6403	0.6300	0.7000	0.7700	4.9819	(76)
South	9.8000	46.7521	0.6300	0.7000	0.7700	140.0228	(78)
West	5.5900	19.6403	0.6300	0.7000	0.7700	33.5530	(80)

Solar gains	178.5577	304.7037	416.2587	511.2097	565.9316	558.2373	539.7486	499.9173	449.5329	336.7921	214.0232	152.6818	(83)
Total gains	776.5151	898.0595	986.6657	1045.9640	1064.0755	1023.6441	986.0564	954.8759	925.0370	848.1690	765.2817	734.2137	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	57.8364	57.9661	58.0939	58.7015	58.8166	59.3585	59.3585	59.4599	59.1486	58.8166	58.5843	58.3433	
alpha	4.8558	4.8644	4.8729	4.9134	4.9211	4.9572	4.9572	4.9640	4.9432	4.9211	4.9056	4.8896	
util living area													
	0.9903	0.9798	0.9572	0.9037	0.7976	0.6258	0.4625	0.4963	0.7186	0.9193	0.9805	0.9925	(86)
MIT	19.9316	20.1173	20.3660	20.6472	20.8579	20.9675	20.9940	20.9915	20.9353	20.6649	20.2429	19.8929	(87)
Th 2	19.9194	19.9216	19.9237	19.9336	19.9355	19.9441	19.9441	19.9457	19.9408	19.9355	19.9317	19.9278	(88)
util rest of house													
	0.9873	0.9736	0.9440	0.8742	0.7395	0.5351	0.3546	0.3869	0.6326	0.8880	0.9734	0.9901	(89)
MIT 2	18.5279	18.7965	19.1508	19.5423	19.8051	19.9239	19.9421	19.9425	19.8948	19.5761	18.9876	18.4779	(90)
Living area fraction									fLA = Living area / (4) =			0.2006	(91)
MIT	18.8095	19.0615	19.3946	19.7640	20.0163	20.1333	20.1531	20.1530	20.1036	19.7945	19.2395	18.7617	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.6595	18.9115	19.2446	19.6140	19.8663	19.9833	20.0031	20.0030	19.9536	19.6445	19.0895	18.6117	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9822	0.9657	0.9334	0.8636	0.7353	0.5386	0.3607	0.3930	0.6337	0.8775	0.9656	0.9858	(94)
Useful gains	762.6560	867.2550	920.9066	903.3444	782.4107	551.3522	355.7194	375.2519	586.1859	744.2419	738.9888	723.7853	(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													
	1546.9124	1506.0369	1366.8575	1137.1798	865.0733	565.0583	357.2072	377.5416	616.6000	958.1028	1275.1047	1539.0499	(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													
	583.4868	429.2614	331.7875	168.3615	61.5010	0.0000	0.0000	0.0000	0.0000	159.1125	386.0035	606.5569	(98)
Space heating												2726.0710	(98)
Space heating per m2											(98) / (4) =	30.3842	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF ENERGY RATINGS 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 %)												93.1000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												2928.1107	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	583.4868	429.2614	331.7875	168.3615	61.5010	0.0000	0.0000	0.0000	0.0000	159.1125	386.0035	606.5569	(98)
Space heating efficiency (main heating system 1)													
	93.1000	93.1000	93.1000	93.1000	93.1000	0.0000	0.0000	0.0000	0.0000	93.1000	93.1000	93.1000	(210)
Space heating fuel (main heating system)													
	626.7312	461.0757	356.3775	180.8394	66.0591	0.0000	0.0000	0.0000	0.0000	170.9049	414.6117	651.5112	(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													
	182.6875	160.5033	167.3176	148.2483	144.0150	126.8747	120.1403	134.1990	134.7120	153.8230	164.8249	177.7092	(64)
Efficiency of water heater												87.2000	(216)
(217)m	89.8402	89.7200	89.4958	89.0268	88.2187	87.2000	87.2000	87.2000	87.2000	88.9451	89.6236	89.8825	(217)
Fuel for water heating, kWh/month													
	203.3472	178.8936	186.9559	166.5210	163.2476	145.4985	137.7756	153.8979	154.4862	172.9414	183.9080	197.7127	(219)
Water heating fuel used												2045.1856	(219)
Annual totals kWh/year													
Space heating fuel - main system												2928.1107	(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)												383.3551	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.80 * 853 * 1.00) =										-1228.3631		-1228.3631	(233)
Total delivered energy for all uses												4203.2882	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2928.1107	3.4800	101.8983	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2045.1856	3.4800	71.1725	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	383.3551	13.1900	50.5645	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1228.3631	13.1900	-162.0211	(252)
Total energy cost			191.5066	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.5970	(257)
SAP value		91.6713	
SAP rating (Section 12)		92	(258)
SAP band		A	

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2928.1107	0.2160	632.4719	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2045.1856	0.2160	441.7601	(264)
Space and water heating			1074.2320	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	383.3551	0.5190	198.9613	(268)
Energy saving/generation technologies				
PV Unit	-1228.3631	0.5190	-637.5204	(269)
Total kg/year			674.5978	(272)
CO2 emissions per m2			7.5200	(273)
EI value			93.2901	
EI rating			93	(274)
EI band			A	

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9070 = 3.837, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9070 = 0.2381, stars = 4
Water heating energy efficiency	3.48 / 0.8863 = 3.926, stars = 4
Water heating environmental impact	0.216 / 0.8863 = 0.2437, stars = 4

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

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	89.7200 (1b)	x	2.4000 (2b)	=	215.3280	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	89.7200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	215.3280	(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) =	0.1858	(8)
Pressure test		Yes	
Measured/design AP50		4.0000	
Infiltration rate		0.3858	(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) =	0.3279	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.6000	4.1000	4.1000	4.0000	3.8000	3.3000	3.3000	3.2000	3.4000	3.9000	3.8000	3.9000	(22)
Wind factor	1.1500	1.0250	1.0250	1.0000	0.9500	0.8250	0.8250	0.8000	0.8500	0.9750	0.9500	0.9750	(22a)
Adj infilt rate	0.3771	0.3361	0.3361	0.3279	0.3115	0.2705	0.2705	0.2623	0.2787	0.3197	0.3115	0.3197	(22b)
Effective ac	0.5711	0.5565	0.5565	0.5538	0.5485	0.5366	0.5366	0.5344	0.5388	0.5511	0.5485	0.5511	(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	
Door			1.8900	1.4000	2.6460			(26)
Windows (Uw = 1.40)			16.2200	1.3258	21.5038			(27)
Sem. Exposed Floor			20.5600	0.2200	4.5232			(28b)
External Wall	67.2700	16.2200	51.0500	0.1800	9.1890			(29a)
Semi Exposed Wall	24.3100	1.8900	22.4200	0.2022	4.5335			(29a)
Roof ins.@Joists	29.2300		29.2300	0.0900	2.6307			(30)
Total net area of external elements Aum(A, m2)			141.3700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		45.0261			(33)
Party Wall 1			29.1400	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)	20.9621	(36)
Total fabric heat loss (33) + (36) =	65.9882	(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	40.5811	39.5425	39.5425	39.3491	38.9767	38.1291	38.1291	37.9739	38.2891	39.1605	38.9767	39.1605	(38)
Heat transfer coeff	106.5693	105.5308	105.5308	105.3374	104.9649	104.1174	104.1174	103.9622	104.2773	105.1488	104.9649	105.1488	(39)
Average = Sum(39)m / 12 =												104.9725	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1878	1.1762	1.1762	1.1741	1.1699	1.1605	1.1605	1.1587	1.1623	1.1720	1.1699	1.1720	(40)
HLP (average)												1.1700	(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	2.6219 (42)
Average daily hot water use (litres/day)	96.4694 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	106.1163	102.2575	98.3988	94.5400	90.6812	86.8224	86.8224	90.6812	94.5400	98.3988	102.2575	106.1163	(44)
Energy conte	157.3674	137.6346	142.0265	123.8222	118.8103	102.5243	95.0038	109.0183	110.3203	128.5677	140.3417	152.4020	(45)
Energy content (annual)										Total = Sum(45)m =		1517.8390	(45)
Distribution loss (46)m = 0.15 x (45)m	23.6051	20.6452	21.3040	18.5733	17.8215	15.3786	14.2506	16.3527	16.5480	19.2851	21.0512	22.8603	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)

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

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	25.3200	22.8687	25.2911	24.4262	25.2047	24.3504	25.1365	25.1807	24.3917	25.2553	24.4832	25.3072 (61)
Total heat required for water heating calculated for each month												
	182.6875	160.5033	167.3176	148.2483	144.0150	126.8747	120.1403	134.1990	134.7120	153.8230	164.8249	177.7092 (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												
	182.6875	160.5033	167.3176	148.2483	144.0150	126.8747	120.1403	134.1990	134.7120	153.8230	164.8249	177.7092 (64)
								Total per year (kWh/year) = Sum(64)m =				1815.0548 (64)
Heat gains from water heating, kWh/month												
	58.6547	51.4807	53.5466	47.2774	45.8056	40.1769	37.8729	42.5437	42.7794	49.0626	52.7844	57.0005 (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	157.3121	157.3121	157.3121	157.3121	157.3121	157.3121	157.3121	157.3121	157.3121	157.3121	157.3121	157.3121	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	54.2679	48.2002	39.1991	29.6762	22.1833	18.7281	20.2364	26.3040	35.3052	44.8280	52.3209	55.7761	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	356.0622	359.7570	350.4462	330.6246	305.6034	282.0870	266.3766	262.6818	271.9926	291.8142	316.8354	340.3518	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.3531	53.3531	53.3531	53.3531	53.3531	53.3531	53.3531	53.3531	53.3531	53.3531	53.3531	53.3531	(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)													
	-104.8747	-104.8747	-104.8747	-104.8747	-104.8747	-104.8747	-104.8747	-104.8747	-104.8747	-104.8747	-104.8747	-104.8747	(71)
Water heating gains (Table 5)													
	78.8369	76.6081	71.9712	65.6631	61.5667	55.8013	50.9044	57.1825	59.4159	65.9443	73.3117	76.6135	(72)
Total internal gains													
	597.9575	593.3558	570.4070	534.7543	498.1438	465.4068	446.3078	454.9587	475.5040	511.3770	551.2584	581.5319	(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	0.8300	23.1112	0.6300	0.7000	0.7700	5.8624	(76)
South	9.8000	52.9996	0.6300	0.7000	0.7700	158.7341	(78)
West	5.5900	23.1112	0.6300	0.7000	0.7700	39.4827	(80)

Solar gains	204.0792	313.8400	421.4756	528.8932	570.5114	605.3070	570.7250	532.9631	482.8462	362.4382	242.4482	174.2677	(83)
Total gains	802.0366	907.1959	991.8826	1063.6475	1068.6552	1070.7138	1017.0328	987.9217	958.3502	873.8152	793.7066	755.7996	(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	58.4648	59.0402	59.0402	59.1486	59.3585	59.8417	59.8417	59.9310	59.7499	59.2547	59.3585	59.2547	
alpha	4.8977	4.9360	4.9360	4.9432	4.9572	4.9894	4.9894	4.9954	4.9833	4.9503	4.9572	4.9503	
util living area													
	0.9867	0.9750	0.9439	0.8717	0.7314	0.4972	0.3268	0.3564	0.6148	0.8824	0.9720	0.9897	(86)
MIT	20.0500	20.2174	20.4801	20.7368	20.9175	20.9905	20.9991	20.9986	20.9728	20.7624	20.3596	20.0149	(87)
Th 2	19.9298	19.9391	19.9391	19.9408	19.9441	19.9518	19.9518	19.9531	19.9503	19.9425	19.9441	19.9425	(88)
util rest of house													
	0.9824	0.9672	0.9263	0.8335	0.6606	0.4011	0.2202	0.2475	0.5172	0.8384	0.9617	0.9863	(89)
MIT 2	18.7068	18.9529	19.3219	19.6635	19.8770	19.9475	19.9516	19.9529	19.9349	19.7057	19.1629	18.6655	(90)
Living area fraction									fLA = Living area / (4) =			0.2006	(91)
MIT	18.9763	19.2066	19.5543	19.8789	20.0857	20.1567	20.1618	20.1627	20.1431	19.9177	19.4030	18.9363	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.8263	19.0566	19.4043	19.7289	19.9357	20.0067	20.0118	20.0127	19.9931	19.7677	19.2530	18.7863	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9762	0.9586	0.9153	0.8247	0.6600	0.4063	0.2263	0.2537	0.5214	0.8298	0.9526	0.9811	(94)
Useful gains	782.9225	869.6424	907.8805	877.1467	705.2654	434.9865	230.1755	250.6288	499.6816	725.0893	756.0976	741.5171	(95)
Ext temp.	5.0000	5.5000	7.4000	9.8000	12.8000	15.8000	17.8000	17.6000	15.1000	11.5000	7.8000	4.9000	(96)
Heat loss rate W													
	1473.4615	1430.6339	1266.8227	1045.8797	749.0022	437.9935	230.2832	250.8276	510.2391	869.3370	1202.1609	1460.1221	(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													
	513.7610	376.9863	267.0530	121.4877	32.5402	0.0000	0.0000	0.0000	0.0000	107.3203	321.1656	534.6421	(98)
Space heating												2274.9563	(98)
Space heating per m2											(98) / (4) =	25.3562	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 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 %)												93.1000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												2443.5620	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	513.7610	376.9863	267.0530	121.4877	32.5402	0.0000	0.0000	0.0000	0.0000	107.3203	321.1656	534.6421	(98)
Space heating efficiency (main heating system 1)													
	93.1000	93.1000	93.1000	93.1000	93.1000	0.0000	0.0000	0.0000	0.0000	93.1000	93.1000	93.1000	(210)
Space heating fuel (main heating system)													
	551.8378	404.9262	286.8454	130.4917	34.9519	0.0000	0.0000	0.0000	0.0000	115.2742	344.9684	574.2665	(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													
	182.6875	160.5033	167.3176	148.2483	144.0150	126.8747	120.1403	134.1990	134.7120	153.8230	164.8249	177.7092	(64)
Efficiency of water heater												87.2000	(216)
(217)m	89.7550	89.6258	89.3191	88.7424	87.8246	87.2000	87.2000	87.2000	87.2000	88.6051	89.4819	89.8008	(217)
Fuel for water heating, kWh/month													
	203.5402	179.0816	187.3258	167.0548	163.9802	145.4985	137.7756	153.8979	154.4862	173.6050	184.1992	197.8926	(219)
Water heating fuel used												2048.3376	(219)
Annual totals kWh/year													
Space heating fuel - main system												2443.5620	(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)												383.3551	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.80 * 923 * 1.00) =										-1329.8342		-1329.8342	(233)
Total delivered energy for all uses												3620.4204	(238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2443.5620	3.6300	88.7013	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2048.3376	3.6300	74.3547	(247)
Pumps and fans for heating	75.0000	19.4400	14.5800	(249)
Energy for lighting	383.3551	19.4400	74.5242	(250)
Additional standing charges			95.0000	(251)
Energy saving/generation technologies				
PV Unit	-1329.8342	19.4400	-258.5198	(252)
Total energy cost			88.6404	(255)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2443.5620	0.2160	527.8094	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2048.3376	0.2160	442.4409	(264)
Space and water heating			970.2503	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	383.3551	0.5190	198.9613	(268)
Energy saving/generation technologies				
PV Unit	-1329.8342	0.5190	-690.1840	(269)
Total kg/year			517.9526	(272)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2443.5620	1.2200	2981.1457	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2048.3376	1.2200	2498.9718	(264)
Space and water heating			5480.1175	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	383.3551	3.0700	1176.9000	(268)
Energy saving/generation technologies				
PV Unit	-1329.8342	3.0700	-4082.5911	(269)
Primary energy kWh/year			2804.6764	(272)
Primary energy kWh/m2/year			31.2603	(273)

SAP 2012 EPC IMPROVEMENTS

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

Current energy efficiency rating: A 92
Current environmental impact rating: A 93

(For testing purposes):

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

Recommended measures:	SAP change	Cost change	CO2 change
(none)			

Recommended measures	Typical annual savings	Energy efficiency	Environmental impact
(none)			
Total Savings	£0	0.00 kg/m²	

Potential energy efficiency rating: A 92
Potential environmental impact rating: A 93

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

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

	Current	Potential	Saving
Electricity	£89	£89	£0
Mains gas	£258	£258	£0
Space heating	£198	£198	£0
Water heating	£74	£74	£0
Lighting	£75	£75	£0
Generated (PV)	-£259	-£259	£0
Total cost of fuels	£88	£88	£0
Total cost of uses	£88	£88	£0
Delivered energy	40 kWh/m²	40 kWh/m²	0 kWh/m²
Carbon dioxide emissions	0.5 tonnes	0.5 tonnes	0.0 tonnes
CO2 emissions per m²	6 kg/m²	6 kg/m²	0 kg/m²
Primary energy	31 kWh/m²	31 kWh/m²	0 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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

No improvements selected / applicable

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

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SAP 2012 WORKSHEET FOR New Build (As Designed)   (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING      09 Jan 2014
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No improvements selected / applicable
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Job no:	PRXXXX
Date:	XX/XX/XXXX
Assessor name:	Rajohn Ali
Registration no:	BRE400012
Development name:	Appendix G of Energy Statement

PRINTING: before printing please make sure that in "Page Setup" you have selected the page to be as "Landscape" and that the Scale has been set up to 70% (maximum)

WATER EFFICIENCY CALCULATOR FOR NEW DWELLINGS - (BASIC CALCULATOR)

		Type 1		Type 2		Type 3		Type 4		Type 5		Type 6		Type 7		Type 8		Type 9		Type 10	
	House Type:																				
	Description:	Dwelling																			
Installation Type	**Unit of measure**	Capacity/ flow rate	Litres/ person/ day	Capacity/ flow rate	Litres/ person/ day	Capacity/ flow rate	Litres/ person/ day	Capacity/ flow rate	Litres/ person/ day	Capacity/ flow rate	Litres/ person/ day	Capacity/ flow rate	Litres/ person/ day	Capacity/ flow rate	Litres/ person/ day	Capacity/ flow rate	Litres/ person/ day	Capacity/ flow rate	Litres/ person/ day	Capacity/ flow rate	Litres/ person/ day
Is a dual or single flush WC specified?		Dual																			
WC	Full flush volume	6	8.76		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00
	Part flush volume	3	8.88		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00
Taps (excluding kitchen and external taps)	Flow rate (litres / minute)	6	11.06		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00
Are both a Bath & Shower Present?		Bath & Shower																			
Bath	Capacity to overflow	155	17.05		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00
Shower	Flow rate (litres / minute)	8	34.96		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00
Kitchen sink taps	Flow rate (litres / minute)	6	13.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00
Has a washing machine been specified?		No																			
Washing Machine	Litres / kg	7	17.16		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00
Has a dishwasher been specified?		No																			
Dishwasher	Litres / place setting	0.9	4.50		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00
Has a waste disposal unit been specified?		No	0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00
Water Softener	Litres / person / day		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00		0.00
	Calculated Use		115.4		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0
	Normalisation factor		0.91		0.91		0.91		0.91		0.91		0.91		0.91		0.91		0.91		0.91
Code for Sustainable Homes	**Total Consumption**		**105.0**		**0.0**		**0.0**		**0.0**		**0.0**		**0.0**		**0.0**		**0.0**		**0.0**		**0.0**
	Mandatory level		**Level 3/4**		-		-		-		-		-		-		-		-		-
Building Regulations 17.K	External use		5.0		5.0		5.0		5.0		5.0		5.0		5.0		5.0		5.0		5.0
	Total Consumption		**110.0**		**0.0**		**0.0**		**0.0**		**0.0**		**0.0**		**0.0**		**0.0**		**0.0**		**0.0**
	17.K Compliance?		**Yes**		-		-		-		-		-		-		-		-		-