PRICE&MYERS

REPORT

Barnes High Street, 67A - 68A, London SW13 9LD
Energy Strategy Report

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Reviewed by: Deepika Singhal

Job Number: 24057.001

Date	Version	Notes/Amendments/Issue Purpose
September 2017	v2	Draft

CIBSE LOW CARBON ENERGY ASSESSORS

STRUCTURES GEOMETRICS SUSTAINABILITY INFRASTRUCTURE

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Acronyms	
ASHP	Air Source Heat Pumps
BRE	Building Research Establishment
CHP	Combined Heat and Power
GSHP	Ground Source Heat Pumps
LZC	Low and zero carbon
PV	Photovoltaic
SAP	Standard Assessment Procedure

Executive Summary

This report details the proposed energy strategy for the 67A-68A Barnes High Street development the London Borough of Richmond upon Thames. The current building house's two 2 bedroom flats above the commercial space at ground floor level. There is a further single self-contained unit at the rear of the property at ground level.

The proposed development involves a partial demolition to the main building with the refurbishment of the two commercial units. A new build extension shall be created to the rear of the development, the development will comprise 7 self-contained units.

The refurbishment works contain a cosmetic change to the elevations, with the walls being rendered, the windows being upgraded to sliding sash type and the roof to be changed from a gable design to a hip design, all to match the neighbouring building of Rose House.

The proposed works contain a demolition of the existing roof level and a conversion of upper level to accommodate 3 new flats. The building footprint will be maintained.

The proposed development addresses national planning policies on energy; in particular, mitigation of climate change and energy security through energy efficiency enhancements and use of alternative energy technologies. In order to reduce the carbon footprint of the building beyond the requirements of current regulatory and market standards, the development will benefit from the following integrated systems:

- Passive design features (Be Lean);
- Energy efficiency measures (Be Clean); and
- Low and zero carbon technologies (Be Green).

The building fabric performance will meet or exceed the Part L 2013 requirements where applicable.

An energy assessment has been carried out based on design information to identify the most appropriate renewable strategy. The proposed strategy has the potential to provide a 40% improvement in DER over the refurbished units 3, 4 and 7 and a 37% improvement in DER/TER for the new units 1, 2, 5 and 6; through passive design measures, energy efficient equipment and renewable technologies.

1 Introduction

1.1 Site Analysis

Price & Myers have been commissioned by Lewis Berkeley Ltd. on behalf of their client to produce an Energy Statement for the Barnes High Street development.

The proposed development involves a partial demolition to the main building with the refurbishment of the two commercial units. A new build extension shall be created to the rear of the development, the development will comprise 7 self-contained units.

The refurbishment works contain a cosmetic change to the elevations, with the walls being rendered, the windows being upgraded to new side hung and the roof to be changed from a gable design to a hip design, all to match the neighbouring building of Rose House.

The proposed works contain a demolition of the existing roof level and a conversion of upper level to accommodate 3 new flats. The building footprint will be maintained.

Figure 1.1: Google Maps extract indicating site location of Barnes High Street, 67A - 68A

Our assessment has been based on drawings and details provided by Architecture Initiative.

1.2 Objectives

This report summarises the work done to support the development of an energy strategy for the scheme. It outlines the energy strategy for the development, including passive design, energy and CO_2 footprint of the proposed scheme, and renewable energy options.

The final proposed strategy allows the scheme to demonstrate compliance with the guidelines set out by the Borough and the London Plan in demonstrating a positive commitment to sustainability through providing environmental improvements.

2 Policy

2.1 The London Plan Policies on Energy (March 2015)

Policy 5.2: Minimising Carbon Dioxide Emissions
Planning Decisions

Development proposals should make the fullest contribution to minimising carbon dioxide emissions in accordance with the following energy hierarchy:

i. Be Lean: use less energy
ii. Be Clean: supply energy efficiently
iii. Be Green: use Renewable energy

As this is not a major development the remaining London Plan policies are not applicable to this development.

As a minimum, energy assessments should include the following details:

- Calculation of the energy demand and carbon dioxide emissions covered by Building Regulations
- Calculations of the energy demand and carbon dioxide emissions from any other part of the development, including plant or equipment, that are not covered by the Building Regulations (see paragraph 5.22) at each stage of the energy hierarchy.
- Proposals to reduce carbon dioxide emissions through the energy efficient design of the site, buildings and services
- Proposals to further reduce carbon dioxide emissions through the use of decentralised energy where feasible, such as district heating and cooling and combined heat and power (CHP).
- Proposals to further reduce carbon dioxide emissions through the use of on-site renewable energy technologies.

Policy 5.7: Renewable Energy

Within the framework of the energy hierarchy (see Policy 5.2), major development proposals should provide a reduction in expected carbon dioxide emissions through the use of on-site renewable energy generation, where feasible.

2.2 London Borough of Richmond Upon Thames Policies on Energy

Core Strategy CP1 Sustainable Development

Domestic refurbishment will be required to meet BREEAM for Domestic Refurbishment 'Excellent'.

Policy DM SD 2: Renewable Energy and Decentralised Energy Networks

Developments of one dwelling unit or more, or 100sqm of non-residential floor space or more will be required to reduce their total CO2 emissions by following a hierarchy that first requires an efficient design to minimise the amount of energy used, secondly, by using low carbon technologies and finally, where feasible and viable, including a contribution from renewable sources.

The Council encourages developers to achieve a 20% reduction where feasible in total site CO2 emissions from the use of on-site renewable energy, to improve savings beyond those generated by energy efficiency measures, as set out in Core Strategy Policy CP2.

Development Management Plan Policy DM SD 3

Proposals for conversions and extensions will be encouraged to comply with the Sustainable Construction Checklist SPD as far as possible and opportunities for micro-generation of renewable energy will be supported.

2.3 Pre-Application Considerations

Sustainability

The applicant is required to demonstrate that new residential units would reduce adverse environmental impact by using resources efficiently. The application must conform to the Sustainable Construction Checklist and submit the document to the Council with any application and together with BREEAM Domestic Refurbishment Scheme and Energy Report in order to demonstrate that the development would achieve water efficiency by meeting the target for water consumption which is 105 litres per person per day. Moreover, the development should include measures capable of mitigating and adapting to climate change (materials, design, landscaping standard of construction and operation); new homes are required to achieve a minimum 35% reduction in carbon dioxide emissions beyond Building Regulations 2013.

3 Approach

The approach to achieving the planning policy energy objectives has been to consider strategies and technologies to achieve a low energy and carbon footprint for the scheme.

The development will adopt the following energy hierarchy:

- Use less energy through passive design measures (Be Lean);
- Supply and consume energy efficiently (Be Clean); and
- Utilise renewable energy sources to reduce carbon emissions (Be Green).

This energy strategy examines the energy performance of the proposed development based on the following methodology:

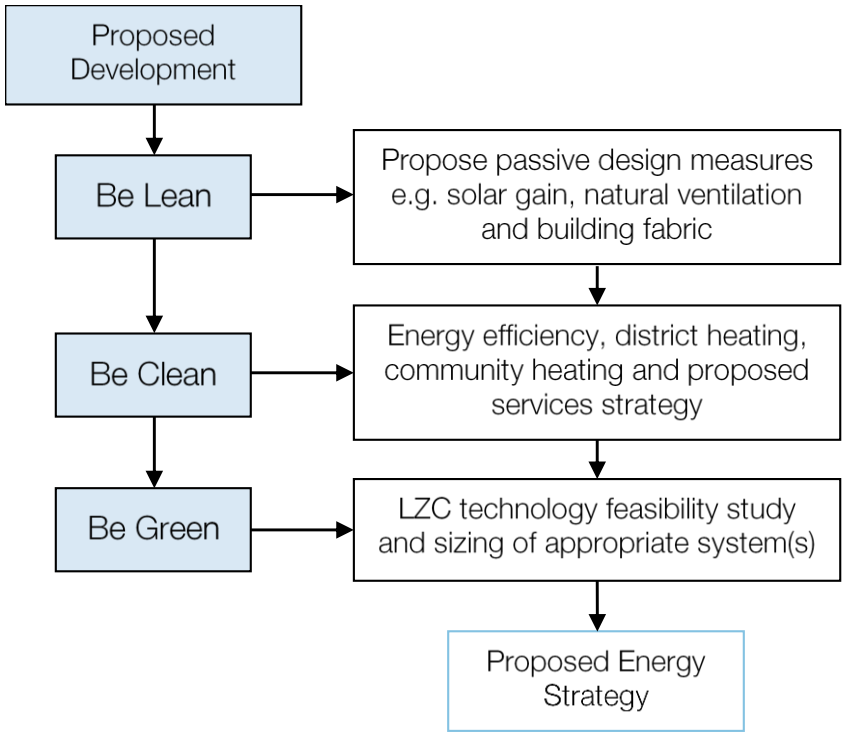

Figure 3.1 Methodology for Energy Perfomance Strategy.

The performance of the development in terms of energy consumption and carbon emissions is calculated at each stage of the assessment, ensuring that both regulated and unregulated energy is considered when determining the performance of the proposed energy strategy.

3.1 Accredited Energy Assessor

This report has been checked and reviewed by Deepika Singhal who is an accredited Low Carbon Energy Assessor and Fraser Wilson who is an On Construction Domestic Energy Assessor. The energy consumption and carbon emission figures within this report have been calculated using the approved Standard Assessment Procedure for the Energy Rating of Dwellings (SAP 2012 version).

4 Energy Targets

The target for the new proposed units is to achieve 35% improvement over Part L to meet the Borough's sustainability aspiration. There are no requirements for the refurbished units, however, they will achieve some level of improvements in carbon reductions against their existing scenarios.

The values in Table 4.1 show the target energy and carbon calculations before any passive design and energy efficient measures.
It details energy broken down by fuel types and fuel use categories for the refurbished and the proposed part of the development respectively.

Building Regulations Target Emission Rate Breakdown													
Regulated Energy & CO2													
	Gas Demand				Electricity Demand							Total Energy (kWh/yr)	Total CO_2 (kg/yr)
Type	Space Heating (kWh/yr)	Hot Water (kWh/yr)	Total (kWh/yr)	Gas CO_2 (kg/yr)	Space Heating (kWh/yr)	Hot Water (kWh/yr)	Cooling (kWh/yr)	Pumps & Fans (kWh/yr)	Lighting (kWh/yr)	Total (kWh/yr)	Electricity CO_2 (kgCO2/yr)		
Refurbished	15,769	6,143	21,912	4,733	0	0	0	603	1,194	1,797	933	23,709	5,666
Proposed	10,894	7,867	18,761	4,052	0	0	0	318	984	676	20,063	4,728	10,894

Table 4.1 Estimated regulated energy demand and carbon emissions per energy source

The energy consumption calculations include regulated energy fuel uses. Regulated energy is that used for space and water heating, lighting, pumps and fans. Energy consumption figures for these are calculated using SAP calculations.

5 Be Lean: Passive Design

As part of the Be Lean approach, passive design measures have been considered throughout the pre-planning stage to reduce energy demand.

5.1 Solar Gain Control and Overheating

Where possible, windows and natural daylight have been provided to ensure appropriate daylighting levels throughout the development and reduce the lighting demand. The size and orientation of external windows has been considered carefully to balance daylight with excessive solar gains. Windows are specified to incorporate low emissivity coatings to limit overheating while ensuring adequate daylight.

5.2 Building Fabric Efficiency

To further improve the passive design of the development, the thermal fabric has been specified to meet or exceed current Building Regulations targets. Table 5.1 shows the proposed U-values that will be considered for the development and have been assumed for the energy strategy analysis at this stage.

Element	Barnes High Street		
	Existing RdSAP 2009 Version 9.91	Proposed Refurbished	Proposed New
External walls	0.45 W/m^{2}K	0.45 W/m^{2}K	0.15 W/m^{2}K
Shelter Walls	0.45 W/m^{2}K	0.45 W/m^{2}K	0.15 W/m^{2}K
Party Wall	*0.00 W/m^{2}K	*0.00 W/m^{2}K	*0.00 W/m^{2}K
Sloped roof	0.38 W/m^{2}K	0.16 W/m^{2}K	0.11 W/m^{2}K
Windows	3.1 W/m^{2}K	1.4 W/m^{2}K	1.4 W/m^{2}K
Roof Light	1.4 W/m^{2}K	1.4 W/m^{2}K	1.4 W/m^{2}K
Floor	0.25 W/m^{2}K	0.11 W/m^{2}K	0.11 W/m^{2}K
External doors	2.0 W/m^{2}K	1.5 W/m^{2}K	1.5 W/m^{2}K
Air tightness	n/a	5 m^3/hr/m^2	3 m^3/hr/m^2
Thermal bridging	Default values have been applied y-value _ 0.15 w/mk		

Table 5.1 Proposed Be Lean passive design measures

* Where party walls have a cavity these are to meet the following requirements:

- Sealed to prevent air going in and out of any cavity
- Sealed at the top, bottom and vertically
- All cavities are to be fully filled

6 Be Clean: Energy Efficiency

As part of the Be Clean approach, the use of heat networks, community heating and cooling and energy efficient equipment has been considered for this development.

6.1 District Energy Systems

District energy systems produce steam, hot water or chilled water at a central energy centre. The steam or water is distributed in pre-insulated pipework to individual buildings for space heating, domestic hot water and air conditioning. As a result, individual buildings served by a district energy system don't require their own boilers or chillers.

The map in Figure 6.1 shows the site and the local district heating networks identified in the London Heat Map Study. The map shows that there are no networks or potential networks within close enough proximity of the site to consider connecting at this time.

Figure 6.1: London Heat Map

6.2 Community Heating

Community heating involves distributing space and water heating services throughout the development served from a central plant, making use of higher efficiencies available from larger systems.

As this development is small, the installation of a community energy system would not be cost effective. A CHP system would not be viable for such small development due to low peak demand. The potential savings associated with a communal gas heating system would not be significant enough to justify the additional cost. Fabric improvements would have a greater impact and are therefore more cost effective for this development.

6.3 Services Strategy

In addition to the passive design measures identified in Section 5, energy-efficient equipment has been proposed where possible to support the services strategy.

Table 6.1 shows the proposed services strategy and energy efficiency measures for the development.

Services	Measure - Existing	Measure – Proposed & Refurbished
Space Heating	Radiators	Radiators
Heating Controls	No time or thermostatic control of room temperature	Time and temperature zone control
Hot Water Heating	Mains gas post 98 gas combination with 84% efficiency	Gas condensing boilers with 92% efficiency Boiler interlock
Ventilation	Natural ventilation with mechanical extract in bathroom and kitchen	Natural ventilation with mechanical extract in bathroom and kitchen
Comfort Cooling	None	None
Lighting	50% low energy lighting	100% low energy lighting
Lighting control	No controls	PIR and daylight sensors fitted to lighting in external areas, where provided

Table 6.1 Proposed energy efficient design measures

7 Be Green: Low and Zero Carbon Technologies Feasibility Study

The final level of the energy hierarchy is to Be Green, therefore the following table discusses the options for on-site low and zero carbon (LZC) technologies and their feasibility on this development to contribute to meeting the relevant London Plan and Borough's sustainability targets.

LZC Technologies	Description	Advantages	Disadvantages	Feasibility	
Solar Thermal Collectors	Solar thermal collectors can be used to provide hot water using the irradiation from the sun They can generally provide approx. 50% of the hot water demand	No noise issues associated with Solar thermal collectors No additional land use from the installation of solar thermal collectors Low maintenance and easy to manage Favourable payback periods	The hot water cylinder will need to be larger than a traditional cylinder Needs unobstructed space on roof Low efficiencies Often not compatible with other LZC technologies Saves less carbon when offsetting gas systems	There is a south facing flat roof where solar thermal panels can be installed. However, solar PV is favoured due to greater potential carbon savings.	✗
Solar Photovoltaic Panels (PV)	Solar PV panels provide noiseless, low-maintenance, carbon free electricity	Can have significant impact on carbon emissions by offsetting grid electricity (which has a high carbon footprint) Low maintenance No noise issues No additional land use from the installation of PV panels Bolt on technology that does not need significant amounts of auxiliary equipment Favourable payback periods	Needs unobstructed space on roof Low efficiencies per unit area of PV Often used to supplement landlord's electricity so savings not always transferred to individual properties	There is a large flat roof on which Solar PV panels could be installed to contribute to the electricity demand of the new proposed units	✓

LZC Technologies	Description	Advantages	Disadvantages	Feasibility	
CHP (Combined Heat & Power)	CHP systems use an engine driven alternator to generate electricity while using the waste heat from the engine, jacket and exhaust to provide heating and hot water Economic viability relies on at least 4,000 hours running time per annum	Mature technology High CO_2 savings	Cost of the system is relatively high for small schemes Only appropriate for large development with high heat loads	Communal CHP is not viable for such a small development Micro CHP would be technically feasible but is unlikely to save enough carbon to meet the targets with incorporating multiple technologies	×
Biomass Heating	Solid, liquid or gaseous fuels derived from plant material can provide boiler heat for space and water heating	Potential to reduce large component of the total CO_2 A biomass boiler would supplement a standard gas heating system so some of the cost may be offset through money saved on using smaller traditional boilers	Regular maintenance is required Reliability of fuel access/supply can be a problem The noise generated by a biomass boiler is similar to that of a gas boiler. It is advisable not to locate next to particularly sensitive areas such as bedrooms A plant room and fuel store will be required which may take additional land from the proposed development or surroundings Biomass is often not a favoured technology in new development due to the potential local impacts of NOx emissions and delivery vehicles for the fuel	Biomass is not considered feasible for this development due to issues with fuel storage, access for delivery vehicles and local NOx emissions	×

LZC Technologies	Description	Advantages	Disadvantages	Feasibility	
Wind Turbines	Vertical and horizontal axis wind turbines enable electricity to be generated using the power within the wind	Low noise Bolt on technology that does not need significant amounts of auxiliary equipment	Not suitable for urban environments due to low wind conditions and obstructions High visual impact Noise impact (45-65dB at 3m) High capital cost and only achieve good paybacks in locations with strong wind profiles Requires foundations or vibration supports for building installations (generally not recommended)	This development is in an urban environment and so a wind turbine will not generate much energy	×
Ground Source Heat Pumps (GSHP)	Utilising horizontal loops or vertical boreholes, GSHP make use of the grounds almost constant temperature to provide heating and/or cooling using a heat exchanger connected to a space/water heating delivery system	Low maintenance and easy to manage High COP (ratio of energy output per energy input) Optimum efficiency with underfloor heating systems As heat pumps would replace standard heating systems, some of the cost may offset through savings on a traditional boiler	The heat pump has a noise level around 35-60dB so some attenuation may be required and it should be sensibly located Relatively high capital cost Requires electricity to run the pump, therefore limited carbon savings in some cases For communal systems a plant room is required which may take additional land from the proposed development/surroundings	GSHP are not a feasible technology for the site since there is a no external space available for installation of boreholes	×

LZC Technologies	Description	Advantages	Disadvantages	Feasibility	
Air Source Heat Pumps (ASHP)	Air Source Heat Pumps extract latent energy from the external air in a manner similar to ground source heat pumps	ASHP systems are generally cheaper than GSHP as there is no requirement for long lengths of buried piping or boreholes Low maintenance and easy to manage Optimum efficiency with underfloor heating systems As heat pumps would replace standard heating systems, some of the cost may offset through savings on a traditional boiler	The ASHP unit has a noise level around 50-60dB so some attenuation may be required and it should be sensibly located The potential noise from the external unit may mean there is local opposition to their installation Requires electricity to run the pump, therefore limited carbon savings in some cases For communal systems a plant room is required which may take additional land from the proposed development/surroundings	The use of ASHP is technically feasible for the development but is discounted due to noise issues and locating the unsightly units	✗

Table 7.1: Feasibility of LZC technologies for the development

Having reviewed potential LZC technologies for the development it has been identified that the most appropriate system would be solar PV panels, which would most suitably be installed on the roof space. The chosen system should be accurately sized during the detailed design stages and MCS (Microgeneration Certification Scheme) approved equipment and installers used.

7.1 Summary of CO_2 Emission Savings

The most appropriate LZC technology for the development has been identified as solar PV panels in order to meet the London Plan and Borough's target for on-site renewables.

Table 7.2 shows the proposed system size and the estimated energy and carbon emissions savings and financial feasibility for this development. The breakdown of energy use and carbon emissions for the final case have been calculated, as shown in Table 7.3.

	Energy & CO_2				Life Cycle Carbon and Cost Analysis		
Total Proposed LZC Technologies	Energy generated (kWh/yr)	% site energy demand met	CO_2 saved by system ($kgCO_2$/yr)	% reduction in site CO_2 emissions	25 year CO_2 saving ($kgCO_2$)	Estimated capital cost	Payback period
Solar PV – 4.75 kWp 30 deg, South West facing Approx. 15 panels Approx. gross array area = 24.48 m2	3,903	19.45%	2,025	9.5%	50,636	£8,200	7 y 6 m

Table 7.2 Energy, carbon and financial performance of the proposed LZC technologies

After following energy hierarchy														
Regulated Energy & CO2														
	Gas Demand				Electricity Demand								Total Energy (kWh/yr)	Total CO_2 (kg/yr)
Type	Space Heating (kWh/yr)	Hot Water (kWh/yr)	Total (kWh/yr)	Gas CO_2 (kg/yr)	Space Heating (kWh/yr)	Hot Water (kWh/yr)	Cooling (kWh/yr)	Pumps & Fans (kWh/yr)	Lighting (kWh/yr)	PV (kWh/yr)	Total (kWh/yr)	Electricity CO_2 (kgCO2/yr)		
Refurbished	7,641	5,640	13,281	2,869	0	0	0	225	796	1,021	530	14,302	3,399	1,021
Proposed	12,508	7,600	20,108	4,343	0	0	0	300	984	-3,903	-2,618	-1,359	17,490	2,984

Table 7.3 Estimated regulated energy demand and carbon emissions per energy source Carbon Savings

Table 7.4 demonstrates the percentage improvement over the notional baseline levels for the development incorporating all three stages of the energy hierarchy.

	Refurbished			Proposed		
	CO2 Emissions (T/yr)	CO2 Savings (T/yr)	% Savings	CO2 Emissions (T/yr)	CO2 Savings (T/yr)	% Savings
Building Regulations 2013 Baseline	7.29			4.73		
After Renewable Energy	4.28			2.98		
Total Cumulative Savings		3.01	41%		1.74	37 %

Table 7.4 Carbon savings at the be Green stage

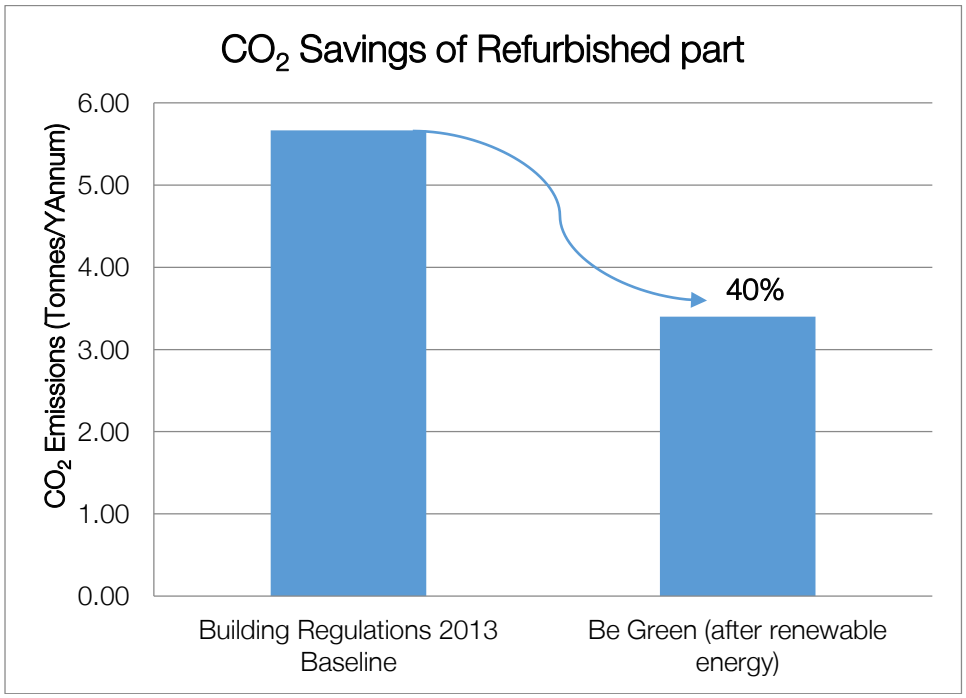

Figure 7.1: Summary of CO2 savings (tonnes CO2/annum) over Building Regulations 2013 baseline of Refurbished units

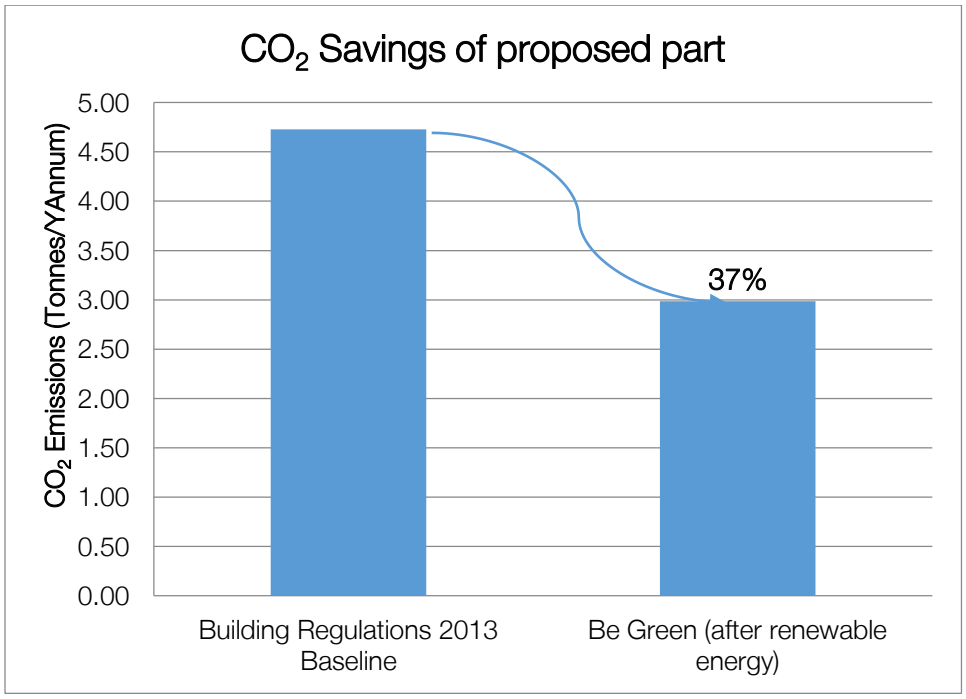

Figure 7.2: Summary of CO2 savings (tonnes CO2/annum) over Building Regulations 2013 baseline of proposed units

The overall target for the proposed part of the development is to achieve 35% above the requirements of Part L.

The development has followed the energy hierarchy incorporating all feasible measures, which are incorporated improved building envelopes and upgraded building services to achieve the targets.

Renewable energy systems have been incorporated into the development, resulting in a carbon saving of 1.74 tonnes per annum.

8 Conclusion

Following the energy hierarchy, passive design measures, energy efficient equipment and provision of LZCs have shown an improvement of 37% over the Building Regulations Part L 2013 target emissions rate for the new proposed units and a 40% improvement for the refurbished units. This is in line with the London Borough of Richmond upon Thames's requirement for the reduction in carbon emissions.

The design team have made all reasonable endeavours to achieve the minimum requirements of the London Plan and the Borough's target. The energy hierarchy has been followed, fabric improvements have been made to improve the windows, a high efficiency heating has been specified. PV panels have incorporated into the design to reduce carbon emissions from the site.

The figures within this report are based on preliminary analysis only and further detailed studies will be required at the detailed design stage before specifying any of the proposed systems.

Appendix A

Figures used in Low and Zero Carbon Technology Calculations

The following tables show figures used in the energy and CO_2 calculations to estimate energy produced and CO_2 savings from LZC technologies. These figures can be used to validate the results.

CO_2 Intensity Values	
Gas Intensity	0.216 $kgCO_2/kWh$
Electricity Intensity	0.519 $kgCO_2/kWh$
Oil Intensity	0.266 $kgCO_2/kWh$
Biodiesel Intensity	0.025 $kgCO_2/kWh$

Table B.2

Energy & Renewable Technology Outputs	
PV energy produced per kWp	858.4 kWh/kWp
PV kWp per m^2 panel	0.167 kWp/m^2
Efficiency of solar thermal collectors	600 kWh/m^2
COP of ASHP	2.5
COP of GSHP	3.5
Electricity efficiency	100%
Gas boiler efficiency	90%

Table B.3

Fuel Prices (as of Feb 2015)	
Natural Gas	3. p/kWh
Electricity (Grid)	14.05 p/kWh

Table B.4

Appendix B

SAP Calculations

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

Design SAP
elmhurst energy

Property Reference	Proposed Updated	**Issued on Date**	21/09/2017
Survey Reference	Updated Flat 1 - Be Lean/Clean	**Prop Type Ref**	67B Barnes High Street
Property	67b, Barnes High Street, LONDON, SW13 9LD		

SAP Rating	79 C	**DER**	25.78	**TER**	22.67
Environmental	80 C	**% DER<TER**	-13.73		
CO_2 Emissions (t/year)	1.53	**DFEE**	78.13	**TFEE**	73.04
General Requirements Compliance	Fail	**% DFEE<TFEE**	-6.97		

Surveyor	admin Admin, Tel: 4, Fax: s@l.f	**Surveyor ID**	Admin
Client			

SAP2012 - 9.92 input data (DesignData) -

```
SAP2012 Input Data (Flat)      21/09/2017

FullRefNo:                     Updated Flat 1 - Be Lean/Clean

Regs Region:                   England
SAP Region:                    Thames Valley
Postcode:                      SW13 9LD
DwellingOrientation:           South West
Property Type:                 Flat, End-Terrace
Storeys:                       1
Date Built:                    2017
Sheltered Sides:               1
Sunlight Shade:                Average or unknown
Measurements                   Perimeter, Floor Area, Storey Height
     1st Storey:               41.99, 74.48, 3.11
Living Area:                   29.71 m2, fraction: 39.9%
Thermal Mass:                  Simple calculation
Thermal Mass Simple:           High
Thermal MassValue:             450
External Walls                 Nett Area, Gross Area, Kappa, Element, Construction, Type, ShelterFactor, UValueFinal
External Wall 1                69.31, 97, 190, CavityWallDensePlasterDenseBlock, Cavity, 0, 0.15, Gross
Sheltered Wall                 33.59, 33.59, 190, CavityWallDensePlasterDenseBlock, Cavity, 0.9, 0.13215859030837, Gross
Party Walls                    Area, Kappa, Element, Construction, Type, ShelterFactor, UValueFinal
Party Wall 1                   5.94, 180, PartyWallDensePlaster, Solid, 0, 0
External Roofs                 Nett Area, Gross Area, Kappa, Construction, Element, UValueFinal
     External Roof 1           14.01, 15.22, 9, Plasterboard, insulated slope, 0.11
Party Ceilings                 Area, Kappa, Construction, Element
     Party Ceilings 1          59.26, 40, Precast concrete planks floor, screed, carpeted
Heat Loss Floors               Area, Kappa, Construction, Element, Type, ShelterFactor, UValueFinal
     Heat Loss Floor 1         74.48, 110, Slab on ground, screed over insulation, Ground Floor - Solid, 0, 0.11
Description                    Data Source, Type, Glazing, Glazing Gap, Argon Filled, Solar Trans, Frame Type, Frame Factor, U Value
     Windows                   Manufacturer, Window, Double Low-E Soft 0.05, , , 0.63, , 0.7,
     Roof Light                Manufacturer, Roof Window, Double Low-E Soft 0.05, , , 0.63, , 0.7,
     Door                      Manufacturer, Solid Door, , , , , , ,
Openings                       Opening Type, Location, Orientation, Pitch, Curtain Type, Overhang Ratio, Wide Overhang, Width, Height, Count, Area, Curtain Closed
     NE Facing                 Window, External Wall 1, North East, , None, 0, , 0, 0, 0, 6.59,
     Roof Light                Roof Window, External Roof 1, Horizontal, 0, None, , , 0, 0, 0, 1.21,
     Door                      Solid Door, External Wall 1, South West, , , , , 0, 0, 0, 2.00,
     SE Facing                 Window, External Wall 1, South East, , None, 0, , 0, 0, 0, 9.55,
     NW Facing                 Window, External Wall 1, North West, , None, 0, , 0, 0, 0, 9.55,
Conservatory:                  None
Draught Proofing:              100
Draught Lobby:                 No
Thermal Bridges
     Bridging:                 Default
     Y                         0.15
Pressure Test:                 True
Designed q50:                  3
AsBuilt q50:                   15
Property Tested:               False
Mechanical Ventilation         None
Chimneys MHS:                  0
Chimneys SHS:                  0
Chimneys Other:                0
Chimneys Total:                0
Open Flues MHS:                0
Open Flues SHS:                0
Open Flues Other:              0
Open Flues Total:              0
Intermittent Fans:             3
Passive Vents:                 0
Flueless Gas Fires:            0
Cooling System                 None
Light Fittings:                15
LEL Fittings:                  15
Percentage of LEL Fittings:    100
External Lights Fitted:        Yes
External LELs Fitted:          No
Electricity Tariff:            Standard
Main Heating 1
     Description               tbc
     Percentage                100
     MHS                       Mains gas BGW Post 98 Combi condens. with auto ign.
     SAP Code                  104
     Boiler Efficiency Type    Sedbuk 2009
     Efficiency                92
     Model Name                tbc
     Manufacturer              tbc
     Controls by PCDF          0
     MHS Controls              CBI Time and temperature zone control
```

SAP2012 - 9.92 input data (DesignData) -

Boiler Interlock	Yes
Compensator	0
Delayed Start Stat	No
Ctrl SAP Code	2110
Burner Control	OnOff
Flue Type	Balanced
Fan Assisted Flue	Yes
Pumped	Pump in heated space
Heat Pump Age	2013 or later
Heat Emitter	Radiators
Flow Temperature	Normal (> 45°C)
Combi boiler type	Standard Combi
Combi keep hot type	None
Main Heating 2	None
Heating Systems Interaction	Each system heats separate parts of dwelling
Smoke Control Area	Unknown
Community Heating	None
Secondary Heating	None
Water Heating	
Type	MainHeating1
WHS	HWP From main heating 1
Low Water Usage	Yes
SAP Code	901
Showers in Property	Non-electric only
Hot Water Cylinder	None
Flue Gas Heat Recovery System	None
Waste Water Heat Recovery	none
PV Unit	None
Wind Turbine	None
Terrain Type:	Urban
Small Scale Hydro	None
Special Features	None

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

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DWELLING AS DESIGNED

Ground-floor flat, total floor area 74 m²

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

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 22.67 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 25.78 kgCO□/m²Fail
Excess emissions =3.11 kgCO□/m² (13.7%)

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)73.0 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)78.1 kWh/m²/yrFail
Excess energy =5.1 kWh/m²/yr (7.0%)

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2 Fabric U-values

Element	Average	Highest	
External wall	0.14 (max. 0.30)	0.15 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.11 (max. 0.25)	0.11 (max. 0.70)	OK
Roof	0.11 (max. 0.20)	0.11 (max. 0.35)	OK
Openings	1.41 (max. 2.00)	1.50 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated using default y-value of 0.15

---

3 Air permeability
Air permeability at 50 pascals: 3.00 (design value)
Maximum 10.0 OK

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4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from manufacturer
tbc tbc
Combi boiler
Efficiency: 92.0% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

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5 Cylinder insulation
Hot water storage No cylinder

---

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

Hot water controls: No cylinder

Boiler interlock Yes OK

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

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8 Mechanical ventilation
Not applicable

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9 Summertime temperature

SAP2012 - 9.92 input data (DesignData) -

Overheating risk (Thames Valley):	Medium	OK
Based on:		
Overshading:	Average	
Windows facing North East:	6.59 m², No overhang	
Windows facing South East:	9.55 m², No overhang	
Windows facing North West:	9.55 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	0.11 W/m²K
Floor U-value	0.11 W/m²K
Air permeability	3.0 m³/m²h

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	74.4800 (1b)	x	3.1100 (2b)	=	231.6328	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	74.4800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	231.6328	(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) =	0.1295	(8)
Pressure test		Yes	
Measured/design q50		3.0000	
Infiltration rate		0.2795	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2586	(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	0.3297	0.3232	0.3167	0.2844	0.2779	0.2456	0.2456	0.2392	0.2586	0.2779	0.2909	0.3038	(22b)
Effective ac	0.5543	0.5522	0.5502	0.5404	0.5386	0.5302	0.5302	0.5286	0.5334	0.5386	0.5423	0.5461	(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	
Windows (Uw = 1.40)			25.6900	1.3258	34.0587			(27)
Door			2.0000	1.5000	3.0000			(26)
Roof Light (Uw = 1.40)			1.2100	1.3258	1.6042			(27a)
Heat Loss Floor 1			74.4800	0.1100	8.1928			(28a)
External Wall 1	97.0000	27.6900	69.3100	0.1500	10.3965			(29a)
Sheltered Wall	33.5900		33.5900	0.1322	4.4392			(29a)
External Roof 1	15.2200	1.2100	14.0100	0.1100	1.5411			(30)
Total net area of external elements Aum(A, m2)			220.2900					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	63.2325			(33)
Party Wall 1			5.9400	0.0000	0.0000			(32)
Party Ceilings 1			59.2600					(32b)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							450.0000	(35)
Thermal bridges (Default value 0.150 * total exposed area)							33.0435	(36)
Total fabric heat loss					(33) + (36) =		96.2760	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	42.3728	42.2115	42.0534	41.3109	41.1720	40.5252	40.5252	40.4055	40.7743	41.1720	41.4530	41.7468	(38)
Heat transfer coeff	138.6488	138.4875	138.3294	137.5869	137.4479	136.8012	136.8012	136.6815	137.0503	137.4479	137.7290	138.0228	(39)
Average = Sum(39)m / 12 =												137.5862	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.8616	1.8594	1.8573	1.8473	1.8454	1.8368	1.8368	1.8351	1.8401	1.8454	1.8492	1.8532	(40)
HLP (average)												1.8473	(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		2.3498 (42)
Average daily hot water use (litres/day)		90.0078 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	99.0086	95.4083	91.8080	88.2077	84.6074	81.0070	81.0070	84.6074	88.2077	91.8080	95.4083	99.0086	(44)
Energy conte	146.8269	128.4158	132.5136	115.5285	110.8524	95.6572	88.6404	101.7162	102.9310	119.9562	130.9415	142.1940	(45)
Energy content (annual)										Total = Sum(45)m =		1416.1737	(45)
Distribution loss (46)m = 0.15 x (45)m	22.0240	19.2624	19.8770	17.3293	16.6279	14.3486	13.2961	15.2574	15.4397	17.9934	19.6412	21.3291	(46)

Water storage loss:

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Total storage loss

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.4537	43.9140	46.7843	43.4997	43.1150	39.9487	41.2803	43.1150	43.4997	46.7843	47.0507	50.4537	(61)

Total heat required for water heating calculated for each month

	197.2806	172.3297	179.2979	159.0282	153.9674	135.6059	129.9207	144.8312	146.4307	166.7405	177.9922	192.6477	(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

	197.2806	172.3297	179.2979	159.0282	153.9674	135.6059	129.9207	144.8312	146.4307	166.7405	177.9922	192.6477	(64)
								Total per year (kWh/year) = Sum(64)m =				1956.0727	(64)

Heat gains from water heating, kWh/month

	61.4334	53.6767	55.7568	49.2882	47.6372	41.7932	39.7930	44.5994	45.0995	51.5815	55.3007	59.8929	(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	117.4902	117.4902	117.4902	117.4902	117.4902	117.4902	117.4902	117.4902	117.4902	117.4902	117.4902	117.4902	(66)

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

	18.5005	16.4320	13.3634	10.1170	7.5625	6.3846	6.8988	8.9673	12.0359	15.2824	17.8368	19.0147	(67)

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

	207.5197	209.6731	204.2466	192.6942	178.1113	164.4055	155.2492	153.0958	158.5223	170.0747	184.6575	198.3633	(68)

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

	34.7490	34.7490	34.7490	34.7490	34.7490	34.7490	34.7490	34.7490	34.7490	34.7490	34.7490	34.7490	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)

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

	-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	(71)

Water heating gains (Table 5)

	82.5717	79.8761	74.9420	68.4558	64.0284	58.0461	53.4852	59.9454	62.6382	69.3300	76.8066	80.5013	(72)

Total internal gains

	369.8390	367.2282	353.7990	332.5139	310.9494	290.0833	276.8803	283.2556	294.4435	315.9341	340.5479	359.1264	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	6.5900	11.2829	0.6300	0.7000	0.7700	22.7237	(75)
Southeast	9.5500	36.7938	0.6300	0.7000	0.7700	107.3866	(77)
Northwest	9.5500	11.2829	0.6300	0.7000	0.7700	32.9304	(81)
Horizontal	1.2100	26.0000	0.6300	0.7000	1.0000	12.4865	(82)

Solar gains	175.5273	322.1383	500.4866	717.3425	890.1257	921.2414	872.5885	738.3127	574.9316	372.3051	214.5000	147.4358	(83)
Total gains	545.3663	689.3665	854.2856	1049.8564	1201.0751	1211.3246	1149.4688	1021.5683	869.3750	688.2393	555.0479	506.5622	(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	67.1481	67.2263	67.3031	67.6663	67.7347	68.0549	68.0549	68.1146	67.9313	67.7347	67.5965	67.4526	
alpha	5.4765	5.4818	5.4869	5.5111	5.5156	5.5370	5.5370	5.5410	5.5288	5.5156	5.5064	5.4968	
util living area	0.9997	0.9989	0.9947	0.9694	0.8716	0.6851	0.5166	0.5987	0.8801	0.9907	0.9992	0.9998	(86)
MIT	19.7332	19.8969	20.1723	20.5362	20.8341	20.9672	20.9942	20.9877	20.8705	20.4641	20.0256	19.7019	(87)
Th 2	19.4272	19.4287	19.4302	19.4371	19.4384	19.4444	19.4444	19.4455	19.4421	19.4384	19.4358	19.4330	(88)
util rest of house	0.9995	0.9981	0.9909	0.9469	0.7908	0.5381	0.3380	0.4058	0.7659	0.9806	0.9986	0.9997	(89)
MIT 2	17.8002	18.0407	18.4423	18.9588	19.3189	19.4330	19.4437	19.4437	19.3724	18.8715	18.2344	17.7586	(90)
Living area fraction									fLA = Living area / (4) =			0.3989	(91)
MIT	18.5713	18.7812	19.1324	19.5880	19.9233	20.0450	20.0622	20.0596	19.9700	19.5068	18.9489	18.5338	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.5713	18.7812	19.1324	19.5880	19.9233	20.0450	20.0622	20.0596	19.9700	19.5068	18.9489	18.5338	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9994	0.9977	0.9898	0.9497	0.8197	0.5982	0.4103	0.4848	0.8122	0.9813	0.9983	0.9996	(94)
Useful gains	545.0262	687.7646	845.5955	997.0841	984.4970	724.6121	471.5721	495.2716	706.0770	675.3639	554.0816	506.3514	(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	1978.6971	1922.3674	1747.4295	1470.5351	1130.2758	744.8810	473.6330	500.2002	804.4874	1224.2227	1631.9388	1978.3941	(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	1066.6512	829.6531	670.9645	340.8847	108.4594	0.0000	0.0000	0.0000	0.0000	408.3510	776.0572	1095.1998	(98)
Space heating												5296.2209	(98)
Space heating per m2											(98) / (4) =	71.1093	(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 %)												92.8000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												5707.1345	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1066.6512	829.6531	670.9645	340.8847	108.4594	0.0000	0.0000	0.0000	0.0000	408.3510	776.0572	1095.1998	(98)
Space heating efficiency (main heating system 1)													
	92.8000	92.8000	92.8000	92.8000	92.8000	0.0000	0.0000	0.0000	0.0000	92.8000	92.8000	92.8000	(210)
Space heating fuel (main heating system)													
	1149.4086	894.0227	723.0221	367.3327	116.8744	0.0000	0.0000	0.0000	0.0000	440.0334	836.2685	1180.1722	(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													
	197.2806	172.3297	179.2979	159.0282	153.9674	135.6059	129.9207	144.8312	146.4307	166.7405	177.9922	192.6477	(64)
Efficiency of water heater												83.5000	(216)
(217)m	91.2143	91.0558	90.6705	89.6246	87.1079	83.5000	83.5000	83.5000	83.5000	89.8970	90.9110	91.2792	(217)
Fuel for water heating, kWh/month													
	216.2826	189.2573	197.7468	177.4382	176.7548	162.4022	155.5937	173.4505	175.3661	185.4795	195.7874	211.0532	(219)
Water heating fuel used												2216.6123	(219)
Annual totals kWh/year													
Space heating fuel - main system												5707.1345	(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)												326.7251	(232)
Total delivered energy for all uses												8325.4720	(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	5707.1345	0.2160	1232.7411	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2216.6123	0.2160	478.7883	(264)
Space and water heating			1711.5293	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	326.7251	0.5190	169.5703	(268)
Total CO2, kg/year			1920.0247	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			25.7800	(273)

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

DER		25.7800	ZC1
Total Floor Area	TFA	74.4800	
Assumed number of occupants	N	2.3498	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		16.5107	ZC2
CO2 emissions from cooking, equation (L16)		2.3549	ZC3
Total CO2 emissions		44.6456	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		44.6456	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	74.4800 (1b)	x	3.1100 (2b)	=	231.6328	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	74.4800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	231.6328	(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) =	0.1295	(8)
Pressure test		Yes	
Measured/design q50		5.0000	
Infiltration rate		0.3795	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3511	(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	0.4476	0.4388	0.4300	0.3862	0.3774	0.3335	0.3335	0.3247	0.3511	0.3774	0.3949	0.4125	(22b)
Effective ac	0.6002	0.5963	0.5925	0.5746	0.5712	0.5556	0.5556	0.5527	0.5616	0.5712	0.5780	0.5851	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.0000	1.0000	2.0000			(26)
TER Opening Type (Uw = 1.40)			15.8700	1.3258	21.0398			(27)
TER Room Window (Uw = 1.70)			0.7500	1.5918	1.1938			(27a)
Heat Loss Floor 1			74.4800	0.1300	9.6824			(28a)
External Wall 1	97.0000	17.8700	79.1300	0.1800	14.2434			(29a)
Sheltered Wall	33.5900		33.5900	0.1800	6.0462			(29a)
External Roof 1	15.2200	0.7500	14.4700	0.1300	1.8811			(30)
Total net area of external elements Aum(A, m2)			220.2900					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	56.0867			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (User defined value 0.050 * total exposed area)	11.0145	(36)
Total fabric heat loss (33) + (36) =	67.1012	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	45.8762	45.5789	45.2874	43.9186	43.6625	42.4702	42.4702	42.2495	42.9295	43.6625	44.1806	44.7222	(38)
Heat transfer coeff	112.9774	112.6801	112.3886	111.0198	110.7637	109.5714	109.5714	109.3506	110.0307	110.7637	111.2818	111.8234	(39)
Average = Sum(39)m / 12 =												111.0185	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.5169	1.5129	1.5090	1.4906	1.4872	1.4712	1.4712	1.4682	1.4773	1.4872	1.4941	1.5014	(40)
HLP (average)												1.4906	(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	2.3498 (42)
Average daily hot water use (litres/day)	90.0078 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	99.0086	95.4083	91.8080	88.2077	84.6074	81.0070	81.0070	84.6074	88.2077	91.8080	95.4083	99.0086	(44)
Energy conte	146.8269	128.4158	132.5136	115.5285	110.8524	95.6572	88.6404	101.7162	102.9310	119.9562	130.9415	142.1940	(45)
Energy content (annual)										Total = Sum(45)m =		1416.1737	(45)
Distribution loss (46)m = 0.15 x (45)m	22.0240	19.2624	19.8770	17.3293	16.6279	14.3486	13.2961	15.2574	15.4397	17.9934	19.6412	21.3291	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.4537	43.9140	46.7843	43.4997	43.1150	39.9487	41.2803	43.1150	43.4997	46.7843	47.0507	50.4537 (61)
Total heat required for water heating calculated for each month												
	197.2806	172.3297	179.2979	159.0282	153.9674	135.6059	129.9207	144.8312	146.4307	166.7405	177.9922	192.6477 (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												
	197.2806	172.3297	179.2979	159.0282	153.9674	135.6059	129.9207	144.8312	146.4307	166.7405	177.9922	192.6477 (64)
								Total per year (kWh/year) = Sum(64)m =				1956.0727 (64)
Heat gains from water heating, kWh/month												
	61.4334	53.6767	55.7568	49.2882	47.6372	41.7932	39.7930	44.5994	45.0995	51.5815	55.3007	59.8929 (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	117.4902	117.4902	117.4902	117.4902	117.4902	117.4902	117.4902	117.4902	117.4902	117.4902	117.4902	117.4902	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	18.4977	16.4295	13.3614	10.1154	7.5614	6.3837	6.8978	8.9660	12.0341	15.2801	17.8341	19.0118	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	207.5197	209.6731	204.2466	192.6942	178.1113	164.4055	155.2492	153.0958	158.5223	170.0747	184.6575	198.3633	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	34.7490	34.7490	34.7490	34.7490	34.7490	34.7490	34.7490	34.7490	34.7490	34.7490	34.7490	34.7490	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	(71)
Water heating gains (Table 5)													
	82.5717	79.8761	74.9420	68.4558	64.0284	58.0461	53.4852	59.9454	62.6382	69.3300	76.8066	80.5013	(72)
Total internal gains													
	369.8362	367.2257	353.7970	332.5124	310.9482	290.0823	276.8793	283.2542	294.4416	315.9318	340.5453	359.1235	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	4.0700	11.2829	0.6300	0.7000	0.7700	14.0342	(75)
Southeast	5.9000	36.7938	0.6300	0.7000	0.7700	66.3436	(77)
Northwest	5.9000	11.2829	0.6300	0.7000	0.7700	20.3445	(81)
Horizontal	0.7500	26.0000	0.6300	0.7000	1.0000	7.7396	(82)

Solar gains	108.4618	199.0609	309.2784	443.2943	550.0716	569.3003	539.2342	456.2547	355.2855	230.0637	132.5449	91.1028	(83)
Total gains	478.2980	566.2866	663.0754	775.8067	861.0198	859.3826	816.1135	739.5089	649.7271	545.9956	473.0901	450.2263	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	45.7810	45.9018	46.0209	46.5883	46.6960	47.2041	47.2041	47.2994	47.0071	46.6960	46.4786	46.2535	
alpha	4.0521	4.0601	4.0681	4.1059	4.1131	4.1469	4.1469	4.1533	4.1338	4.1131	4.0986	4.0836	
util living area													
	0.9971	0.9939	0.9845	0.9528	0.8692	0.7164	0.5615	0.6293	0.8624	0.9751	0.9946	0.9978	(86)
MIT	19.3337	19.5200	19.8439	20.2827	20.6653	20.8981	20.9716	20.9552	20.7633	20.2640	19.7229	19.3060	(87)
Th 2	19.6749	19.6778	19.6808	19.6946	19.6971	19.7092	19.7092	19.7114	19.7046	19.6971	19.6919	19.6865	(88)
util rest of house													
	0.9961	0.9917	0.9786	0.9337	0.8157	0.6083	0.4109	0.4765	0.7836	0.9615	0.9922	0.9970	(89)
MIT 2	17.4926	17.7660	18.2377	18.8701	19.3779	19.6445	19.6999	19.6944	19.5172	18.8573	18.0725	17.4597	(90)
Living area fraction										fLA = Living area / (4) =		0.3989	(91)
MIT	18.2270	18.4657	18.8784	19.4336	19.8914	20.1445	20.2072	20.1973	20.0142	19.4184	18.7308	18.1962	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2270	18.4657	18.8784	19.4336	19.8914	20.1445	20.2072	20.1973	20.0142	19.4184	18.7308	18.1962	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9944	0.9888	0.9737	0.9288	0.8249	0.6478	0.4716	0.5379	0.8058	0.9575	0.9897	0.9956	(94)
Useful gains	475.6197	559.9189	645.6390	720.5845	710.2512	556.7465	384.9146	397.7787	523.5788	522.7966	468.2093	448.2438	(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													
	1573.4345	1528.5820	1391.1922	1169.4390	907.3128	607.5243	395.2414	415.2382	650.7476	976.7589	1294.2976	1565.0999	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	816.7742	650.9416	554.6916	323.1752	146.6138	0.0000	0.0000	0.0000	0.0000	337.7479	594.7836	830.9409	(98)
Space heating												4255.6689	(98)
Space heating per m2											(98) / (4) =	57.1384	(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												4556.3906	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	816.7742	650.9416	554.6916	323.1752	146.6138	0.0000	0.0000	0.0000	0.0000	337.7479	594.7836	830.9409	(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)													
	874.4906	696.9396	593.8882	346.0120	156.9741	0.0000	0.0000	0.0000	0.0000	361.6145	636.8132	889.6584	(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													
	197.2806	172.3297	179.2979	159.0282	153.9674	135.6059	129.9207	144.8312	146.4307	166.7405	177.9922	192.6477	(64)
Efficiency of water heater												80.3000	(216)
(217)m	88.2408	88.0810	87.7053	86.7995	84.9283	80.3000	80.3000	80.3000	80.3000	86.7919	87.8548	88.3095	(217)
Fuel for water heating, kWh/month													
	223.5708	195.6492	204.4323	183.2133	181.2911	168.8740	161.7942	180.3626	182.3545	192.1152	202.5981	218.1507	(219)
Water heating fuel used												2294.4061	(219)
Annual totals kWh/year													
Space heating fuel - main system												4556.3906	(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)												326.6758	(232)
Total delivered energy for all uses												7252.4725	(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	4556.3906	0.2160	984.1804	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2294.4061	0.2160	495.5917	(264)
Space and water heating			1479.7721	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	326.6758	0.5190	169.5447	(268)
Total CO2, kg/m2/year			1688.2418	(272)
Emissions per m2 for space and water heating			19.8680	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.2764	(272b)
Emissions per m2 for pumps and fans			0.5226	(272c)
Target Carbon Dioxide Emission Rate (TER) = (19.8680 * 1.00) + 2.2764 + 0.5226, rounded to 2 d.p.			22.6700	(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	74.4800 (1b)	x	3.1100 (2b)	=	231.6328	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	74.4800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	231.6328	(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) =	0.1295	(8)
Pressure test		Yes	
Measured/design q50		3.0000	
Infiltration rate		0.2795	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2586	(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	0.3297	0.3232	0.3167	0.2844	0.2779	0.2456	0.2456	0.2392	0.2586	0.2779	0.2909	0.3038	(22b)
Effective ac	0.5543	0.5522	0.5502	0.5404	0.5386	0.5302	0.5302	0.5286	0.5334	0.5386	0.5423	0.5461	(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	
Windows (Uw = 1.40)			25.6900	1.3258	34.0587			(27)
Door			2.0000	1.5000	3.0000			(26)
Roof Light (Uw = 1.40)			1.2100	1.3258	1.6042			(27a)
Heat Loss Floor 1			74.4800	0.1100	8.1928			(28a)
External Wall 1	97.0000	27.6900	69.3100	0.1500	10.3965			(29a)
Sheltered Wall	33.5900		33.5900	0.1322	4.4392			(29a)
External Roof 1	15.2200	1.2100	14.0100	0.1100	1.5411			(30)
Total net area of external elements Aum(A, m2)			220.2900					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	63.2325			(33)
Party Wall 1			5.9400	0.0000	0.0000			(32)
Party Ceilings 1			59.2600					(32b)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							450.0000	(35)
Thermal bridges (Default value 0.150 * total exposed area)							33.0435	(36)
Total fabric heat loss					(33) + (36) =		96.2760	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	42.3728	42.2115	42.0534	41.3109	41.1720	40.5252	40.5252	40.4055	40.7743	41.1720	41.4530	41.7468	(38)
Heat transfer coeff	138.6488	138.4875	138.3294	137.5869	137.4479	136.8012	136.8012	136.6815	137.0503	137.4479	137.7290	138.0228	(39)
Average = Sum(39)m / 12 =												137.5862	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.8616	1.8594	1.8573	1.8473	1.8454	1.8368	1.8368	1.8351	1.8401	1.8454	1.8492	1.8532	(40)
HLP (average)												1.8473	(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	2.3498	(42)
Average daily hot water use (litres/day)	90.0078	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	99.0086	95.4083	91.8080	88.2077	84.6074	81.0070	81.0070	84.6074	88.2077	91.8080	95.4083	99.0086	(44)
Energy conte	146.8269	128.4158	132.5136	115.5285	110.8524	95.6572	88.6404	101.7162	102.9310	119.9562	130.9415	142.1940	(45)
Energy content (annual)										Total = Sum(45)m =		1416.1737	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Total storage loss

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)

If cylinder contains dedicated solar storage

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

Heat gains from water heating, kWh/month

31.2007	27.2883	28.1591	24.5498	23.5561	20.3271	18.8361	21.6147	21.8728	25.4907	27.8251	30.2162	(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	117.4902	117.4902	117.4902	117.4902	117.4902	117.4902	117.4902	117.4902	117.4902	117.4902	117.4902	117.4902	(66)

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

18.5005	16.4320	13.3634	10.1170	7.5625	6.3846	6.8988	8.9673	12.0359	15.2824	17.8368	19.0147	(67)

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

207.5197	209.6731	204.2466	192.6942	178.1113	164.4055	155.2492	153.0958	158.5223	170.0747	184.6575	198.3633	(68)

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

34.7490	34.7490	34.7490	34.7490	34.7490	34.7490	34.7490	34.7490	34.7490	34.7490	34.7490	34.7490	(69)
Pumps, fans 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)

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

-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	(71)

Water heating gains (Table 5)

41.9365	40.6077	37.8483	34.0970	31.6615	28.2322	25.3173	29.0520	30.3789	34.2617	38.6459	40.6132	(72)

Total internal gains

326.2037	324.9598	313.7053	295.1551	275.5824	257.2693	245.7124	249.3622	259.1842	277.8658	299.3873	316.2383	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	6.5900	11.2829	0.6300	0.7000	0.7700	22.7237	(75)
Southeast	9.5500	36.7938	0.6300	0.7000	0.7700	107.3866	(77)
Northwest	9.5500	11.2829	0.6300	0.7000	0.7700	32.9304	(81)
Horizontal	1.2100	26.0000	0.6300	0.7000	1.0000	12.4865	(82)

Solar gains	175.5273	322.1383	500.4866	717.3425	890.1257	921.2414	872.5885	738.3127	574.9316	372.3051	214.5000	147.4358	(83)
Total gains	501.7310	647.0981	814.1919	1012.4976	1165.7081	1178.5107	1118.3009	987.6749	834.1158	650.1710	513.8873	463.6741	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	67.1481	67.2263	67.3031	67.6663	67.7347	68.0549	68.0549	68.1146	67.9313	67.7347	67.5965	67.4526	
alpha	5.4765	5.4818	5.4869	5.5111	5.5156	5.5370	5.5370	5.5410	5.5288	5.5156	5.5064	5.4968	
util living area	0.9998	0.9992	0.9958	0.9737	0.8827	0.6999	0.5301	0.6166	0.8946	0.9929	0.9995	0.9999	(86)
MIT	19.7020	19.8669	20.1444	20.5134	20.8213	20.9636	20.9934	20.9858	20.8570	20.4381	19.9963	19.6712	(87)
Th 2	19.4272	19.4287	19.4302	19.4371	19.4384	19.4444	19.4444	19.4455	19.4421	19.4384	19.4358	19.4330	(88)
util rest of house	0.9997	0.9986	0.9927	0.9538	0.8052	0.5519	0.3473	0.4194	0.7867	0.9850	0.9990	0.9998	(89)
MIT 2	18.2852	18.4511	18.7283	19.0902	19.3488	19.4356	19.4439	19.4441	19.3876	19.0266	18.5862	18.2592	(90)
Living area fraction									fLA = Living area / (4) =			0.3989	(91)
MIT	18.8504	19.0158	19.2932	19.6579	19.9362	20.0451	20.0620	20.0591	19.9737	19.5896	19.1487	18.8224	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8504	19.0158	19.2932	19.6579	19.9362	20.0451	20.0620	20.0591	19.9737	19.5896	19.1487	18.8224	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9996	0.9984	0.9923	0.9574	0.8339	0.6128	0.4214	0.5005	0.8314	0.9861	0.9989	0.9998	(94)
Useful gains	501.5461	646.0872	807.9417	969.3997	972.0283	722.1541	471.2497	494.3724	693.4768	641.1086	513.3291	463.5640	(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	2017.3926	1954.8664	1769.6735	1480.1474	1132.0453	744.8999	473.6031	500.1273	804.9970	1235.6078	1659.4535	2018.2296	(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	1127.7898	879.4996	715.5285	367.7384	119.0526	0.0000	0.0000	0.0000	0.0000	442.3074	825.2096	1156.6712	(98)
Space heating												5633.7971	(98)
Space heating per m2											(98) / (4) =	75.6417	(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	1285.9315	1012.3290	1038.7791	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8927	0.9444	0.9085	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1147.8983	956.0286	943.7609	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1448.5792	1377.3085	1228.6494	0.0000	0.0000	0.0000	0.0000	(103)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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	216.4902	313.4323	211.9571	0.0000	0.0000	0.0000	0.0000 (104)
Space cooling												741.8796 (104)
Cooled fraction											fC = cooled area / (4) =	1.0000 (105)
Intermittency factor (Table 10b)												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000 (106)
Space cooling kWh												
	0.0000	0.0000	0.0000	0.0000	0.0000	54.1226	78.3581	52.9893	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												185.4699 (107)
Space cooling per m2												2.4902 (108)
Energy for space heating												75.6417 (99)
Energy for space cooling												2.4902 (108)
Total												78.1319 (109)
Dwelling Fabric Energy Efficiency (DFEE)												78.1 (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	74.4800 (1b)	x	3.1100 (2b)	=	231.6328	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	74.4800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	231.6328	(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) =	0.1295	(8)
Pressure test		Yes	
Measured/design q50		5.0000	
Infiltration rate		0.3795	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3511	(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	0.4476	0.4388	0.4300	0.3862	0.3774	0.3335	0.3335	0.3247	0.3511	0.3774	0.3949	0.4125	(22b)
Effective ac	0.6002	0.5963	0.5925	0.5746	0.5712	0.5556	0.5556	0.5527	0.5616	0.5712	0.5780	0.5851	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.0000	1.0000	2.0000			(26)
TER Opening Type (Uw = 1.40)			15.8700	1.3258	21.0398			(27)
TER Room Window (Uw = 1.70)			0.7500	1.5918	1.1938			(27a)
Heat Loss Floor 1			74.4800	0.1300	9.6824			(28a)
External Wall 1	97.0000	17.8700	79.1300	0.1800	14.2434			(29a)
Sheltered Wall	33.5900		33.5900	0.1800	6.0462			(29a)
External Roof 1	15.2200	0.7500	14.4700	0.1300	1.8811			(30)
Total net area of external elements Aum(A, m2)			220.2900					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	56.0867			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (User defined value 0.050 * total exposed area)							11.0145	(36)
Total fabric heat loss					(33) + (36) =		67.1012	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	45.8762	45.5789	45.2874	43.9186	43.6625	42.4702	42.4702	42.2495	42.9295	43.6625	44.1806	44.7222	(38)
Heat transfer coeff	112.9774	112.6801	112.3886	111.0198	110.7637	109.5714	109.5714	109.3506	110.0307	110.7637	111.2818	111.8234	(39)
Average = Sum(39)m / 12 =												111.0185	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.5169	1.5129	1.5090	1.4906	1.4872	1.4712	1.4712	1.4682	1.4773	1.4872	1.4941	1.5014	(40)
HLP (average)												1.4906	(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	2.3498	(42)
Average daily hot water use (litres/day)	90.0078	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	99.0086	95.4083	91.8080	88.2077	84.6074	81.0070	81.0070	84.6074	88.2077	91.8080	95.4083	99.0086	(44)
Energy conte	146.8269	128.4158	132.5136	115.5285	110.8524	95.6572	88.6404	101.7162	102.9310	119.9562	130.9415	142.1940	(45)
Energy content (annual)										Total = Sum(45)m =		1416.1737	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	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													
	31.2007	27.2883	28.1591	24.5498	23.5561	20.3271	18.8361	21.6147	21.8728	25.4907	27.8251	30.2162	(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	117.4902	117.4902	117.4902	117.4902	117.4902	117.4902	117.4902	117.4902	117.4902	117.4902	117.4902	117.4902	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	18.4977	16.4295	13.3614	10.1154	7.5614	6.3837	6.8978	8.9660	12.0341	15.2801	17.8341	19.0118	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	207.5197	209.6731	204.2466	192.6942	178.1113	164.4055	155.2492	153.0958	158.5223	170.0747	184.6575	198.3633	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	34.7490	34.7490	34.7490	34.7490	34.7490	34.7490	34.7490	34.7490	34.7490	34.7490	34.7490	34.7490	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	(71)
Water heating gains (Table 5)													
	41.9365	40.6077	37.8483	34.0970	31.6615	28.2322	25.3173	29.0520	30.3789	34.2617	38.6459	40.6132	(72)
Total internal gains													
	326.2009	324.9573	313.7033	295.1536	275.5812	257.2684	245.7114	249.3608	259.1824	277.8635	299.3846	316.2354	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	4.0700	11.2829	0.6300	0.7000	0.7700	14.0342	(75)
Southeast	5.9000	36.7938	0.6300	0.7000	0.7700	66.3436	(77)
Northwest	5.9000	11.2829	0.6300	0.7000	0.7700	20.3445	(81)
Horizontal	0.7500	26.0000	0.6300	0.7000	1.0000	7.7396	(82)

Solar gains	108.4618	199.0609	309.2784	443.2943	550.0716	569.3003	539.2342	456.2547	355.2855	230.0637	132.5449	91.1028	(83)
Total gains	434.6627	524.0182	622.9817	738.4479	825.6528	826.5686	784.9456	705.6155	614.4679	507.9272	431.9295	407.3383	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	45.7810	45.9018	46.0209	46.5883	46.6960	47.2041	47.2041	47.2994	47.0071	46.6960	46.4786	46.2535	
alpha	4.0521	4.0601	4.0681	4.1059	4.1131	4.1469	4.1469	4.1533	4.1338	4.1131	4.0986	4.0836	
util living area													
	0.9980	0.9954	0.9875	0.9595	0.8821	0.7345	0.5800	0.6521	0.8799	0.9804	0.9961	0.9985	(86)
MIT	19.2827	19.4712	19.7994	20.2463	20.6414	20.8878	20.9680	20.9489	20.7400	20.2231	19.6751	19.2556	(87)
Th 2	19.6749	19.6778	19.6808	19.6946	19.6971	19.7092	19.7092	19.7114	19.7046	19.6971	19.6919	19.6865	(88)
util rest of house													
	0.9973	0.9937	0.9827	0.9426	0.8316	0.6271	0.4262	0.4970	0.8067	0.9694	0.9944	0.9979	(89)
MIT 2	18.1341	18.3242	18.6521	19.0981	19.4605	19.6598	19.7019	19.6979	19.5605	19.0851	18.5389	18.1159	(90)
Living area fraction										fLA = Living area / (4) =		0.3989	(91)
MIT	18.5923	18.7818	19.1097	19.5561	19.9316	20.1497	20.2070	20.1969	20.0310	19.5390	18.9921	18.5705	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.5923	18.7818	19.1097	19.5561	19.9316	20.1497	20.2070	20.1969	20.0310	19.5390	18.9921	18.5705	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9964	0.9921	0.9799	0.9404	0.8421	0.6671	0.4885	0.5598	0.8287	0.9677	0.9931	0.9972	(94)
Useful gains	433.1028	519.8920	610.4597	694.4008	695.3227	551.4040	383.4747	394.9918	509.1841	491.5001	428.9629	406.2178	(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													
	1614.7038	1564.1969	1417.1892	1183.0403	911.7615	608.0832	395.2200	415.1906	652.5940	990.1190	1323.3761	1606.9616	(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													
	879.1111	701.7729	600.2067	351.8205	161.0305	0.0000	0.0000	0.0000	0.0000	370.9725	643.9774	893.3534	(98)
Space heating												4602.2450	(98)
Space heating per m2											(98) / (4) =	61.7917	(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	1029.9715	810.8286	831.0649	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8109	0.8779	0.8382	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	835.1890	711.8462	696.5952	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1043.3819	993.4969	903.8072	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	149.8989	209.5481	154.1657	0.0000	0.0000	0.0000	0.0000 (104)
Space cooling												513.6127 (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	37.4747	52.3870	38.5414	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												128.4032 (107)
Space cooling per m2												1.7240 (108)
Energy for space heating												61.7917 (99)
Energy for space cooling												1.7240 (108)
Total												63.5157 (109)
Target Fabric Energy Efficiency (TFEE)												73.0 (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	74.4800 (1b)	x	3.1100 (2b)	=	231.6328	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	74.4800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	231.6328	(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) =	0.1295	(8)
Pressure test		Yes	
Measured/design q50		3.0000	
Infiltration rate		0.2795	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2586	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	3.8000	3.6000	3.5000	3.4000	3.4000	3.0000	3.2000	3.0000	2.9000	3.1000	3.0000	3.4000	(22)
Wind factor	0.9500	0.9000	0.8750	0.8500	0.8500	0.7500	0.8000	0.7500	0.7250	0.7750	0.7500	0.8500	(22a)
Adj infilt rate	0.2456	0.2327	0.2262	0.2198	0.2198	0.1939	0.2068	0.1939	0.1874	0.2004	0.1939	0.2198	(22b)
Effective ac	0.5302	0.5271	0.5256	0.5241	0.5241	0.5188	0.5214	0.5188	0.5176	0.5201	0.5188	0.5241	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Windows (Uw = 1.40)			25.6900	1.3258	34.0587			(27)
Door			2.0000	1.5000	3.0000			(26)
Roof Light (Uw = 1.40)			1.2100	1.3258	1.6042			(27a)
Heat Loss Floor 1			74.4800	0.1100	8.1928			(28a)
External Wall 1	97.0000	27.6900	69.3100	0.1500	10.3965			(29a)
Sheltered Wall	33.5900		33.5900	0.1322	4.4392			(29a)
External Roof 1	15.2200	1.2100	14.0100	0.1100	1.5411			(30)
Total net area of external elements Aum(A, m2)			220.2900					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	63.2325			(33)
Party Wall 1			5.9400	0.0000	0.0000			(32)
Party Ceilings 1			59.2600					(32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		450.0000	(35)
Thermal bridges (Default value 0.150 * total exposed area)		33.0435	(36)
Total fabric heat loss	(33) + (36) =	96.2760	(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	40.5252	40.2889	40.1755	40.0653	40.0653	39.6566	39.8546	39.6566	39.5623	39.7540	39.6566	40.0653	(38)
Heat transfer coeff	136.8012	136.5649	136.4515	136.3413	136.3413	135.9325	136.1306	135.9325	135.8383	136.0300	135.9325	136.3413	(39)
Average = Sum(39)m / 12 =												136.2198	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.8368	1.8336	1.8321	1.8306	1.8306	1.8251	1.8277	1.8251	1.8238	1.8264	1.8251	1.8306	(40)
HLP (average)												1.8289	(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		2.3498 (42)
Average daily hot water use (litres/day)		90.0078 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	99.0086	95.4083	91.8080	88.2077	84.6074	81.0070	81.0070	84.6074	88.2077	91.8080	95.4083	99.0086	(44)
Energy conte	146.8269	128.4158	132.5136	115.5285	110.8524	95.6572	88.6404	101.7162	102.9310	119.9562	130.9415	142.1940	(45)
Energy content (annual)										Total = Sum(45)m =		1416.1737	(45)
Distribution loss (46)m = 0.15 x (45)m	22.0240	19.2624	19.8770	17.3293	16.6279	14.3486	13.2961	15.2574	15.4397	17.9934	19.6412	21.3291	(46)

Water storage loss:

CALCULATION OF HEAT DEMAND 09 Jan 2014

Total storage loss
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (56)
If cylinder contains dedicated solar storage
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (57)
Combi loss 50.4537 43.9140 46.7843 43.4997 43.1150 39.9487 41.2803 43.1150 43.4997 46.7843 47.0507 50.4537 (61)
Total heat required for water heating calculated for each month
197.2806 172.3297 179.2979 159.0282 153.9674 135.6059 129.9207 144.8312 146.4307 166.7405 177.9922 192.6477 (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
197.2806 172.3297 179.2979 159.0282 153.9674 135.6059 129.9207 144.8312 146.4307 166.7405 177.9922 192.6477 (64)
Total per year (kWh/year) = Sum(64)m = 1956.0727 (64)
RHI water heating demand 1956 (64)
Heat gains from water heating, kWh/month
61.4334 53.6767 55.7568 49.2882 47.6372 41.7932 39.7930 44.5994 45.0995 51.5815 55.3007 59.8929 (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	140.9882	140.9882	140.9882	140.9882	140.9882	140.9882	140.9882	140.9882	140.9882	140.9882	140.9882	140.9882	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
46.2513 41.0800 33.4085 25.2924 18.9064 15.9615 17.2470 22.4183 30.0898 38.2059 44.5920 47.5368 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
309.7308 312.9449 304.8456 287.6032 265.8378 245.3814 231.7152 228.5012 236.6005 253.8429 275.6083 296.0647 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
51.4486 51.4486 51.4486 51.4486 51.4486 51.4486 51.4486 51.4486 51.4486 51.4486 51.4486 51.4486 (69)
Pumps, fans 3.0000 3.0000 3.0000 3.0000 3.0000 3.0000 3.0000 3.0000 3.0000 3.0000 3.0000 3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
-93.9921 -93.9921 -93.9921 -93.9921 -93.9921 -93.9921 -93.9921 -93.9921 -93.9921 -93.9921 -93.9921 -93.9921 (71)
Water heating gains (Table 5)
82.5717 79.8761 74.9420 68.4558 64.0284 58.0461 53.4852 59.9454 62.6382 69.3300 76.8066 80.5013 (72)
Total internal gains
539.9986 535.3457 514.6408 482.7961 450.2173 420.8337 403.8922 412.3096 430.7731 462.8235 498.4515 525.5474 (73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	6.5900	12.4885	0.6300	0.7000	0.7700	25.1517	(75)
Southeast	9.5500	39.0225	0.6300	0.7000	0.7700	113.8911	(77)
Northwest	9.5500	12.4885	0.6300	0.7000	0.7700	36.4490	(81)
Horizontal	1.2100	29.0000	0.6300	0.7000	1.0000	13.9272	(82)

Solar gains	189.4191	313.2190	491.0581	729.6488	882.3442	974.9280	921.1492	798.8981	615.6714	396.1611	239.2759	162.8440	(83)
Total gains	729.4177	848.5647	1005.6989	1212.4449	1332.5615	1395.7617	1325.0414	1211.2078	1046.4445	858.9845	737.7274	688.3915	(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	68.0549	68.1727	68.2294	68.2845	68.2845	68.4899	68.3902	68.4899	68.5374	68.4408	68.4899	68.2845	
alpha	5.5370	5.5448	5.5486	5.5523	5.5523	5.5660	5.5593	5.5660	5.5692	5.5627	5.5660	5.5523	
util living area	0.9982	0.9953	0.9810	0.9083	0.7103	0.4169	0.2465	0.2916	0.6587	0.9497	0.9945	0.9986	(86)
MIT	20.0109	20.1555	20.4348	20.7628	20.9552	20.9981	20.9999	20.9998	20.9780	20.7262	20.3065	19.9861	(87)
Th 2	19.4444	19.4466	19.4476	19.4487	19.4487	19.4525	19.4506	19.4525	19.4534	19.4516	19.4525	19.4487	(88)
util rest of house	0.9969	0.9920	0.9672	0.8500	0.5840	0.2679	0.0874	0.1181	0.4826	0.8997	0.9898	0.9977	(89)
MIT 2	18.2183	18.4298	18.8281	19.2495	19.4285	19.4523	19.4506	19.4525	19.4483	19.2269	18.6543	18.1854	(90)
Living area fraction									fLA = Living area / (4) =			0.3989	(91)
MIT	18.9333	19.1182	19.4690	19.8531	20.0375	20.0689	20.0686	20.0697	20.0585	19.8249	19.3134	18.9037	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9333	19.1182	19.4690	19.8531	20.0375	20.0689	20.0686	20.0697	20.0585	19.8249	19.3134	18.9037	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9962	0.9910	0.9675	0.8679	0.6350	0.3276	0.1509	0.1874	0.5552	0.9152	0.9891	0.9971	(94)
Useful gains	726.6744	840.8908	972.9850	1052.3137	846.1658	457.3213	199.9235	226.9520	581.0130	786.1345	729.7190	686.4185	(95)
Ext temp.	5.6000	6.2000	8.0000	10.5000	13.6000	16.7000	18.6000	18.4000	15.7000	12.2000	8.5000	5.6000	(96)
Heat loss rate W	1824.0171	1764.1731	1564.9643	1275.2187	877.7006	457.9443	199.9281	226.9686	592.0521	1037.2198	1469.8900	1813.8481	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	816.4230	620.4457	440.4326	160.4916	23.4619	0.0000	0.0000	0.0000	0.0000	186.8075	532.9231	838.8076	(98)
Space heating												3619.7929	(98)
RHI space heating demand												3620	(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	74.4800 (1b)	x	3.1100 (2b)	=	231.6328	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	74.4800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	231.6328	(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) =	0.1295	(8)
Pressure test		Yes	
Measured/design q50		3.0000	
Infiltration rate		0.2795	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2586	(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	0.3297	0.3232	0.3167	0.2844	0.2779	0.2456	0.2456	0.2392	0.2586	0.2779	0.2909	0.3038	(22b)
Effective ac	0.5543	0.5522	0.5502	0.5404	0.5386	0.5302	0.5302	0.5286	0.5334	0.5386	0.5423	0.5461	(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	
Windows (Uw = 1.40)			25.6900	1.3258	34.0587			(27)
Door			2.0000	1.5000	3.0000			(26)
Roof Light (Uw = 1.40)			1.2100	1.3258	1.6042			(27a)
Heat Loss Floor 1			74.4800	0.1100	8.1928			(28a)
External Wall 1	97.0000	27.6900	69.3100	0.1500	10.3965			(29a)
Sheltered Wall	33.5900		33.5900	0.1322	4.4392			(29a)
External Roof 1	15.2200	1.2100	14.0100	0.1100	1.5411			(30)
Total net area of external elements Aum(A, m2)			220.2900					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	63.2325			(33)
Party Wall 1			5.9400	0.0000	0.0000			(32)
Party Ceilings 1			59.2600					(32b)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							450.0000	(35)
Thermal bridges (Default value 0.150 * total exposed area)							33.0435	(36)
Total fabric heat loss					(33) + (36) =		96.2760	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	42.3728	42.2115	42.0534	41.3109	41.1720	40.5252	40.5252	40.4055	40.7743	41.1720	41.4530	41.7468	(38)
Heat transfer coeff	138.6488	138.4875	138.3294	137.5869	137.4479	136.8012	136.8012	136.6815	137.0503	137.4479	137.7290	138.0228	(39)
Average = Sum(39)m / 12 =												137.5862	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.8616	1.8594	1.8573	1.8473	1.8454	1.8368	1.8368	1.8351	1.8401	1.8454	1.8492	1.8532	(40)
HLP (average)												1.8473	(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	2.3498	(42)
Average daily hot water use (litres/day)	90.0078	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	99.0086	95.4083	91.8080	88.2077	84.6074	81.0070	81.0070	84.6074	88.2077	91.8080	95.4083	99.0086	(44)
Energy conte	146.8269	128.4158	132.5136	115.5285	110.8524	95.6572	88.6404	101.7162	102.9310	119.9562	130.9415	142.1940	(45)
Energy content (annual)										Total = Sum(45)m =		1416.1737	(45)
Distribution loss (46)m = 0.15 x (45)m	22.0240	19.2624	19.8770	17.3293	16.6279	14.3486	13.2961	15.2574	15.4397	17.9934	19.6412	21.3291	(46)

Water storage loss:

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Total storage loss

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)

If cylinder contains dedicated solar storage

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss 50.4537	43.9140	46.7843	43.4997	43.1150	39.9487	41.2803	43.1150	43.4997	46.7843	47.0507	50.4537	(61)

Total heat required for water heating calculated for each month

197.2806	172.3297	179.2979	159.0282	153.9674	135.6059	129.9207	144.8312	146.4307	166.7405	177.9922	192.6477	(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

197.2806	172.3297	179.2979	159.0282	153.9674	135.6059	129.9207	144.8312	146.4307	166.7405	177.9922	192.6477	(64)
							Total per year (kWh/year) = Sum(64)m =				1956.0727	(64)

Heat gains from water heating, kWh/month

61.4334	53.6767	55.7568	49.2882	47.6372	41.7932	39.7930	44.5994	45.0995	51.5815	55.3007	59.8929	(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	140.9882	140.9882	140.9882	140.9882	140.9882	140.9882	140.9882	140.9882	140.9882	140.9882	140.9882	140.9882	(66)

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

46.2513	41.0800	33.4085	25.2924	18.9064	15.9615	17.2470	22.4183	30.0898	38.2059	44.5920	47.5368	(67)

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

309.7308	312.9449	304.8456	287.6032	265.8378	245.3814	231.7152	228.5012	236.6005	253.8429	275.6083	296.0647	(68)

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

51.4486	51.4486	51.4486	51.4486	51.4486	51.4486	51.4486	51.4486	51.4486	51.4486	51.4486	51.4486	(69)
Pumps, fans 3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)

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

-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	(71)

Water heating gains (Table 5)

82.5717	79.8761	74.9420	68.4558	64.0284	58.0461	53.4852	59.9454	62.6382	69.3300	76.8066	80.5013	(72)

Total internal gains

539.9986	535.3457	514.6408	482.7961	450.2173	420.8337	403.8922	412.3096	430.7731	462.8235	498.4515	525.5474	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	6.5900	11.2829	0.6300	0.7000	0.7700	22.7237	(75)
Southeast	9.5500	36.7938	0.6300	0.7000	0.7700	107.3866	(77)
Northwest	9.5500	11.2829	0.6300	0.7000	0.7700	32.9304	(81)
Horizontal	1.2100	26.0000	0.6300	0.7000	1.0000	12.4865	(82)

Solar gains 175.5273	322.1383	500.4866	717.3425	890.1257	921.2414	872.5885	738.3127	574.9316	372.3051	214.5000	147.4358	(83)
Total gains 715.5259	857.4839	1015.1274	1200.1386	1340.3430	1342.0751	1276.4806	1150.6224	1005.7047	835.1286	712.9515	672.9832	(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	67.1481	67.2263	67.3031	67.6663	67.7347	68.0549	68.0549	68.1146	67.9313	67.7347	67.5965	67.4526	
alpha	5.4765	5.4818	5.4869	5.5111	5.5156	5.5370	5.5370	5.5410	5.5288	5.5156	5.5064	5.4968	
util living area	0.9989	0.9967	0.9881	0.9478	0.8258	0.6297	0.4676	0.5376	0.8196	0.9779	0.9973	0.9992	(86)
MIT	19.8545	20.0158	20.2821	20.6221	20.8771	20.9781	20.9964	20.9927	20.9129	20.5607	20.1377	19.8208	(87)
Th 2	19.4272	19.4287	19.4302	19.4371	19.4384	19.4444	19.4444	19.4455	19.4421	19.4384	19.4358	19.4330	(88)
util rest of house	0.9982	0.9946	0.9802	0.9141	0.7348	0.4887	0.3045	0.3609	0.6888	0.9567	0.9951	0.9987	(89)
MIT 2	17.9775	18.2135	18.5980	19.0669	19.3556	19.4372	19.4440	19.4445	19.4007	19.0018	18.3973	17.9325	(90)
Living area fraction									fLA = Living area / (4) =			0.3989	(91)
MIT	18.7262	18.9324	19.2698	19.6873	19.9625	20.0519	20.0633	20.0621	20.0039	19.6236	19.0915	18.6857	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7262	18.9324	19.2698	19.6873	19.9625	20.0519	20.0633	20.0621	20.0039	19.6236	19.0915	18.6857	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9977	0.9937	0.9791	0.9208	0.7687	0.5460	0.3702	0.4326	0.7422	0.9601	0.9944	0.9983	(94)
Useful gains	713.8741	852.0533	993.8785	1105.0577	1030.3682	732.7343	472.5430	497.7161	746.4648	801.8030	708.9656	671.8592	(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	2000.1784	1943.3158	1766.4350	1484.1859	1135.6698	745.8266	473.7773	500.5365	809.1360	1240.2791	1651.5810	1999.3613	(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	957.0104	733.3284	574.7820	272.9723	78.3444	0.0000	0.0000	0.0000	0.0000	326.2263	678.6831	987.6615	(98)
Space heating												4609.0084	(98)
Space heating per m2											(98) / (4) =	61.8825	(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 %)												92.8000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4966.6039	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	957.0104	733.3284	574.7820	272.9723	78.3444	0.0000	0.0000	0.0000	0.0000	326.2263	678.6831	987.6615	(98)
Space heating efficiency (main heating system 1)													
	92.8000	92.8000	92.8000	92.8000	92.8000	0.0000	0.0000	0.0000	0.0000	92.8000	92.8000	92.8000	(210)
Space heating fuel (main heating system)													
	1031.2612	790.2246	619.3772	294.1512	84.4229	0.0000	0.0000	0.0000	0.0000	351.5369	731.3395	1064.2904	(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													
	197.2806	172.3297	179.2979	159.0282	153.9674	135.6059	129.9207	144.8312	146.4307	166.7405	177.9922	192.6477	(64)
Efficiency of water heater												83.5000	(216)
(217)m	92.8000	90.8741	90.4059	89.1450	86.4207	83.5000	83.5000	83.5000	83.5000	89.4309	90.7011	91.1431	(217)
Fuel for water heating, kWh/month													
	216.6336	189.6357	198.3256	178.3927	178.1602	162.4022	155.5937	173.4505	175.3661	186.4461	196.2404	211.3684	(219)
Water heating fuel used												2222.0151	(219)
Annual totals kWh/year													
Space heating fuel - main system												4966.6039	(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)												326.7251	(232)
Total delivered energy for all uses												7590.3441	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4966.6039	3.4800	172.8378	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2222.0151	3.4800	77.3261	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	326.7251	13.1900	43.0950	(250)
Additional standing charges			120.0000	(251)
Total energy cost			423.1515	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	1.4875	(257)
SAP value		79.2497	
SAP rating (Section 12)		79	(258)
SAP band		C	

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	4966.6039	0.2160	1072.7864	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2222.0151	0.2160	479.9553	(264)
Space and water heating			1552.7417	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	326.7251	0.5190	169.5703	(268)
Total kg/year			1761.2370	(272)
CO2 emissions per m2			23.6500	(273)
EI value			80.2473	
EI rating			80	(274)
EI band			C	

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9280 = 3.750, stars = 5
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9280 = 0.2328, stars = 4
Water heating energy efficiency	3.48 / 0.8777 = 3.965, stars = 4
Water heating environmental impact	0.216 / 0.8777 = 0.2461, 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	74.4800 (1b)	x	3.1100 (2b)	=	231.6328	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	74.4800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	231.6328	(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) =	0.1295	(8)
Pressure test		Yes	
Measured/design q50		3.0000	
Infiltration rate		0.2795	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2586	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	3.8000	3.6000	3.5000	3.4000	3.4000	3.0000	3.2000	3.0000	2.9000	3.1000	3.0000	3.4000	(22)
Wind factor	0.9500	0.9000	0.8750	0.8500	0.8500	0.7500	0.8000	0.7500	0.7250	0.7750	0.7500	0.8500	(22a)
Adj infilt rate	0.2456	0.2327	0.2262	0.2198	0.2198	0.1939	0.2068	0.1939	0.1874	0.2004	0.1939	0.2198	(22b)
Effective ac	0.5302	0.5271	0.5256	0.5241	0.5241	0.5188	0.5214	0.5188	0.5176	0.5201	0.5188	0.5241	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Windows (Uw = 1.40)			25.6900	1.3258	34.0587			(27)
Door			2.0000	1.5000	3.0000			(26)
Roof Light (Uw = 1.40)			1.2100	1.3258	1.6042			(27a)
Heat Loss Floor 1			74.4800	0.1100	8.1928			(28a)
External Wall 1	97.0000	27.6900	69.3100	0.1500	10.3965			(29a)
Sheltered Wall	33.5900		33.5900	0.1322	4.4392			(29a)
External Roof 1	15.2200	1.2100	14.0100	0.1100	1.5411			(30)
Total net area of external elements Aum(A, m2)			220.2900					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	63.2325			(33)
Party Wall 1			5.9400	0.0000	0.0000			(32)
Party Ceilings 1			59.2600					(32b)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							450.0000	(35)
Thermal bridges (Default value 0.150 * total exposed area)							33.0435	(36)
Total fabric heat loss					(33) + (36) =		96.2760	(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	40.5252	40.2889	40.1755	40.0653	40.0653	39.6566	39.8546	39.6566	39.5623	39.7540	39.6566	40.0653	(38)
Heat transfer coeff	136.8012	136.5649	136.4515	136.3413	136.3413	135.9325	136.1306	135.9325	135.8383	136.0300	135.9325	136.3413	(39)
Average = Sum(39)m / 12 =												136.2198	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.8368	1.8336	1.8321	1.8306	1.8306	1.8251	1.8277	1.8251	1.8238	1.8264	1.8251	1.8306	(40)
HLP (average)												1.8289	(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		2.3498 (42)
Average daily hot water use (litres/day)		90.0078 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	99.0086	95.4083	91.8080	88.2077	84.6074	81.0070	81.0070	84.6074	88.2077	91.8080	95.4083	99.0086	(44)
Energy conte	146.8269	128.4158	132.5136	115.5285	110.8524	95.6572	88.6404	101.7162	102.9310	119.9562	130.9415	142.1940	(45)
Energy content (annual)										Total = Sum(45)m =		1416.1737	(45)
Distribution loss (46)m = 0.15 x (45)m	22.0240	19.2624	19.8770	17.3293	16.6279	14.3486	13.2961	15.2574	15.4397	17.9934	19.6412	21.3291	(46)

Water storage loss:

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

Total storage loss

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.4537	43.9140	46.7843	43.4997	43.1150	39.9487	41.2803	43.1150	43.4997	46.7843	47.0507	50.4537	(61)

Total heat required for water heating calculated for each month

	197.2806	172.3297	179.2979	159.0282	153.9674	135.6059	129.9207	144.8312	146.4307	166.7405	177.9922	192.6477	(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

	197.2806	172.3297	179.2979	159.0282	153.9674	135.6059	129.9207	144.8312	146.4307	166.7405	177.9922	192.6477	(64)
								Total per year (kWh/year) = Sum(64)m =				1956.0727	(64)

Heat gains from water heating, kWh/month

	61.4334	53.6767	55.7568	49.2882	47.6372	41.7932	39.7930	44.5994	45.0995	51.5815	55.3007	59.8929	(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	140.9882	140.9882	140.9882	140.9882	140.9882	140.9882	140.9882	140.9882	140.9882	140.9882	140.9882	140.9882	(66)

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

	46.2513	41.0800	33.4085	25.2924	18.9064	15.9615	17.2470	22.4183	30.0898	38.2059	44.5920	47.5368	(67)

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

	309.7308	312.9449	304.8456	287.6032	265.8378	245.3814	231.7152	228.5012	236.6005	253.8429	275.6083	296.0647	(68)

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

	51.4486	51.4486	51.4486	51.4486	51.4486	51.4486	51.4486	51.4486	51.4486	51.4486	51.4486	51.4486	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)

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

	-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	(71)

Water heating gains (Table 5)

	82.5717	79.8761	74.9420	68.4558	64.0284	58.0461	53.4852	59.9454	62.6382	69.3300	76.8066	80.5013	(72)

Total internal gains

	539.9986	535.3457	514.6408	482.7961	450.2173	420.8337	403.8922	412.3096	430.7731	462.8235	498.4515	525.5474	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	6.5900	12.4885	0.6300	0.7000	0.7700	25.1517	(75)
Southeast	9.5500	39.0225	0.6300	0.7000	0.7700	113.8911	(77)
Northwest	9.5500	12.4885	0.6300	0.7000	0.7700	36.4490	(81)
Horizontal	1.2100	29.0000	0.6300	0.7000	1.0000	13.9272	(82)

Solar gains	189.4191	313.2190	491.0581	729.6488	882.3442	974.9280	921.1492	798.8981	615.6714	396.1611	239.2759	162.8440	(83)
Total gains	729.4177	848.5647	1005.6989	1212.4449	1332.5615	1395.7617	1325.0414	1211.2078	1046.4445	858.9845	737.7274	688.3915	(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	68.0549	68.1727	68.2294	68.2845	68.2845	68.4899	68.3902	68.4899	68.5374	68.4408	68.4899	68.2845	
alpha	5.5370	5.5448	5.5486	5.5523	5.5523	5.5660	5.5593	5.5660	5.5692	5.5627	5.5660	5.5523	
util living area	0.9982	0.9953	0.9810	0.9083	0.7103	0.4169	0.2465	0.2916	0.6587	0.9497	0.9945	0.9986	(86)
MIT	20.0109	20.1555	20.4348	20.7628	20.9552	20.9981	20.9999	20.9998	20.9780	20.7262	20.3065	19.9861	(87)
Th 2	19.4444	19.4466	19.4476	19.4487	19.4487	19.4525	19.4506	19.4525	19.4534	19.4516	19.4525	19.4487	(88)
util rest of house	0.9969	0.9920	0.9672	0.8500	0.5840	0.2679	0.0874	0.1181	0.4826	0.8997	0.9898	0.9977	(89)
MIT 2	18.2183	18.4298	18.8281	19.2495	19.4285	19.4523	19.4506	19.4525	19.4483	19.2269	18.6543	18.1854	(90)
Living area fraction									fLA = Living area / (4) =			0.3989	(91)
MIT	18.9333	19.1182	19.4690	19.8531	20.0375	20.0689	20.0686	20.0697	20.0585	19.8249	19.3134	18.9037	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9333	19.1182	19.4690	19.8531	20.0375	20.0689	20.0686	20.0697	20.0585	19.8249	19.3134	18.9037	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9962	0.9910	0.9675	0.8679	0.6350	0.3276	0.1509	0.1874	0.5552	0.9152	0.9891	0.9971	(94)
Useful gains	726.6744	840.8908	972.9850	1052.3137	846.1658	457.3213	199.9235	226.9520	581.0130	786.1345	729.7190	686.4185	(95)
Ext temp.	5.6000	6.2000	8.0000	10.5000	13.6000	16.7000	18.6000	18.4000	15.7000	12.2000	8.5000	5.6000	(96)
Heat loss rate W	1824.0171	1764.1731	1564.9643	1275.2187	877.7006	457.9443	199.9281	226.9686	592.0521	1037.2198	1469.8900	1813.8481	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	816.4230	620.4457	440.4326	160.4916	23.4619	0.0000	0.0000	0.0000	0.0000	186.8075	532.9231	838.8076	(98)
Space heating												3619.7929	(98)
Space heating per m2											(98) / (4) =	48.6009	(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 %)												92.8000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3900.6389	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	816.4230	620.4457	440.4326	160.4916	23.4619	0.0000	0.0000	0.0000	0.0000	186.8075	532.9231	838.8076	(98)
Space heating efficiency (main heating system 1)													
	92.8000	92.8000	92.8000	92.8000	92.8000	0.0000	0.0000	0.0000	0.0000	92.8000	92.8000	92.8000	(210)
Space heating fuel (main heating system)													
	879.7661	668.5837	474.6041	172.9436	25.2822	0.0000	0.0000	0.0000	0.0000	201.3012	574.2706	903.8875	(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													
	197.2806	172.3297	179.2979	159.0282	153.9674	135.6059	129.9207	144.8312	146.4307	166.7405	177.9922	192.6477	(64)
Efficiency of water heater												83.5000	(216)
(217)m	90.8312	90.6064	89.9030	87.9260	84.6214	83.5000	83.5000	83.5000	83.5000	88.1687	90.2824	90.9089	(217)
Fuel for water heating, kWh/month													
	217.1948	190.1960	199.4348	180.8661	181.9485	162.4022	155.5937	173.4505	175.3661	189.1153	197.1505	211.9130	(219)
Water heating fuel used												2234.6315	(219)
Annual totals kWh/year													
Space heating fuel - main system												3900.6389	(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)												326.7251	(232)
Total delivered energy for all uses												6536.9955	(238)

10a. Fuel costs - using BEDF prices (410)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3900.6389	4.2000	163.8268	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2234.6315	4.2000	93.8545	(247)
Pumps and fans for heating	75.0000	15.5400	11.6550	(249)
Energy for lighting	326.7251	15.5400	50.7731	(250)
Additional standing charges			90.0000	(251)
Total energy cost			410.1094	(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	3900.6389	0.2160	842.5380	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2234.6315	0.2160	482.6804	(264)
Space and water heating			1325.2184	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	326.7251	0.5190	169.5703	(268)
Total kg/year			1533.7137	(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	3900.6389	1.2200	4758.7795	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2234.6315	1.2200	2726.2504	(264)
Space and water heating			7485.0299	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	326.7251	3.0700	1003.0461	(268)
Primary energy kWh/year			8718.3260	(272)
Primary energy kWh/m2/year			117.0559	(273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: C 79
Current environmental impact rating: C 80

(For testing purposes):

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

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: C 79
Potential environmental impact rating: C 80

Fuel prices for cost data on this page from database revision number 410 TEST (03 Apr 2017)
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	£62	£62	£0
Mains gas	£348	£348	£0
Space heating	£265	£265	£0
Water heating	£94	£94	£0
Lighting	£51	£51	£0
Total cost of fuels	£410	£410	£0
Total cost of uses	£410	£410	£0
Delivered energy	88 kWh/m²	88 kWh/m²	0 kWh/m²
Carbon dioxide emissions	1.5 tonnes	1.5 tonnes	0.0 tonnes
CO2 emissions per m²	21 kg/m²	21 kg/m²	0 kg/m²
Primary energy	117 kWh/m²	117 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

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

No improvements selected / applicable

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

Overheating Calculation Input Data

Dwelling type	EndTerrace Flat
Number of storeys	1
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	South West
Overshading	Average or unknown
Thermal mass parameter	450.0
Night ventilation	No
Ventilation rate during hot weather (ach)	3.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	229.32	(P1)
Transmission heat loss coefficient	96.28	(37)
Summer heat loss coefficient	325.59	(P2)

Overhangs

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

Solar shading

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

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North East	6.5900	98.8453	0.6300	0.7000	0.9000	232.6831
South East	9.5500	119.9223	0.6300	0.7000	0.9000	409.0978
North West	9.5500	98.8453	0.6300	0.7000	0.9000	337.1964
Horizontal	1.2100	203.0000	0.6300	0.7000	1.0000	97.4905
total:						1076.4678

	Jun	Jul	Aug	
Solar gains	1149	1076	931	(P3)
Internal gains	418	401	409	
Total summer gains	1567	1477	1340	(P5)
Summer gain/loss ratio	4.81	4.54	4.12	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 450.0)	0.00	0.00	0.00	
Threshold temperature	20.81	22.44	21.92	(P7)
Likelihood of high internal temperature	Slight	Medium	Slight	
Assessment of likelihood of high internal temperature:	Medium			

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

Design SAP
elmhurst energy

Property Reference	Proposed Updated	**Issued on Date**	21/09/2017
Survey Reference	Updated Flat 1 - Be Green	**Prop Type Ref**	67B Barnes High Street
Property	67b, Barnes High Street, LONDON, SW13 9LD		

SAP Rating	88 B	**DER**	16.39	**TER**	22.67
Environmental	88 B	**% DER<TER**	27.69		
CO_2 Emissions (t/year)	0.83	**DFEE**	78.13	**TFEE**	73.04
General Requirements Compliance	Fail	**% DFEE<TFEE**	-6.97		

Surveyor	admin Admin, Tel: 4, Fax: s@l.f	**Surveyor ID**	Admin
Client			

SAP2012 - 9.92 input data (DesignData) -

```
SAP2012 Input Data (Flat)      21/09/2017

FullRefNo:                     Updated Flat 1 - Be Green

Regs Region:                   England
SAP Region:                    Thames Valley
Postcode:                      SW13 9LD
DwellingOrientation:           South West
Property Type:                 Flat, End-Terrace
Storeys:                       1
Date Built:                    2017
Sheltered Sides:               1
Sunlight Shade:                Average or unknown
Measurements                   Perimeter, Floor Area, Storey Height
     1st Storey:               41.99, 74.48, 3.11
Living Area:                   29.71 m2, fraction: 39.9%
Thermal Mass:                  Simple calculation
Thermal Mass Simple:           High
Thermal MassValue:             450
External Walls                 Nett Area, Gross Area, Kappa, Element, Construction, Type, ShelterFactor, UValueFinal
External Wall 1                69.31, 97, 190, CavityWallDensePlasterDenseBlock, Cavity, 0, 0.15, Gross
Sheltered Wall                 33.59, 33.59, 190, CavityWallDensePlasterDenseBlock, Cavity, 0.9, 0.13215859030837, Gross
Party Walls                    Area, Kappa, Element, Construction, Type, ShelterFactor, UValueFinal
Party Wall 1                   5.94, 180, PartyWallDensePlaster, Solid, 0, 0
External Roofs                 Nett Area, Gross Area, Kappa, Construction, Element, UValueFinal
     External Roof 1           14.01, 15.22, 9, Plasterboard, insulated slope, 0.11
Party Ceilings                 Area, Kappa, Construction, Element
     Party Ceilings 1          59.26, 40, Precast concrete planks floor, screed, carpeted
Heat Loss Floors               Area, Kappa, Construction, Element, Type, ShelterFactor, UValueFinal
     Heat Loss Floor 1         74.48, 110, Slab on ground, screed over insulation, Ground Floor - Solid, 0, 0.11
Description                    Data Source, Type, Glazing, Glazing Gap, Argon Filled, Solar Trans, Frame Type, Frame Factor, U Value
     Windows                   Manufacturer, Window, Double Low-E Soft 0.05, , , 0.63, , 0.7,
     Roof Light                Manufacturer, Roof Window, Double Low-E Soft 0.05, , , 0.63, , 0.7,
     Door                      Manufacturer, Solid Door, , , , , , ,
Openings                       Opening Type, Location, Orientation, Pitch, Curtain Type, Overhang Ratio, Wide Overhang, Width, Height, Count, Area, Curtain Closed
     NE Facing                 Window, External Wall 1, North East, , None, 0, , 0, 0, 0, 6.59,
     Roof Light                Roof Window, External Roof 1, Horizontal, 0, None, , , 0, 0, 0, 1.21,
     Door                      Solid Door, External Wall 1, South West, , , , , 0, 0, 0, 2.00,
     SE Facing                 Window, External Wall 1, South East, , None, 0, , 0, 0, 0, 9.55,
     NW Facing                 Window, External Wall 1, North West, , None, 0, , 0, 0, 0, 9.55,
Conservatory:                  None
Draught Proofing:              100
Draught Lobby:                 No
Thermal Bridges
     Bridging:                 Default
     Y                         0.15
Pressure Test:                 True
Designed q50:                  3
AsBuilt q50:                   15
Property Tested:               False
Mechanical Ventilation         None
Chimneys MHS:                  0
Chimneys SHS:                  0
Chimneys Other:                0
Chimneys Total:                0
Open Flues MHS:                0
Open Flues SHS:                0
Open Flues Other:              0
Open Flues Total:              0
Intermittent Fans:             3
Passive Vents:                 0
Flueless Gas Fires:            0
Cooling System                 None
Light Fittings:                15
LEL Fittings:                  15
Percentage of LEL Fittings:    100
External Lights Fitted:        Yes
External LELs Fitted:          No
Electricity Tariff:            Standard
Main Heating 1
     Description               tbc
     Percentage                100
     MHS                       Mains gas BGW Post 98 Combi condens. with auto ign.
     SAP Code                  104
     Boiler Efficiency Type    Sedbuk 2009
     Efficiency                92
     Model Name                tbc
     Manufacturer              tbc
     Controls by PCDF          0
     MHS Controls              CBI Time and temperature zone control
```

SAP2012 - 9.92 input data (DesignData) -

Boiler Interlock	Yes
Compensator	0
Delayed Start Stat	No
Ctrl SAP Code	2110
Burner Control	OnOff
Flue Type	Balanced
Fan Assisted Flue	Yes
Pumped	Pump in heated space
Heat Pump Age	2013 or later
Heat Emitter	Radiators
Flow Temperature	Normal (> 45°C)
Combi boiler type	Standard Combi
Combi keep hot type	None
Main Heating 2	None
Heating Systems Interaction	Each system heats separate parts of dwelling
Smoke Control Area	Unknown
Community Heating	None
Secondary Heating	None
Water Heating	
Type	MainHeating1
WHS	HWP From main heating 1
Low Water Usage	Yes
SAP Code	901
Showers in Property	Non-electric only
Hot Water Cylinder	None
Flue Gas Heat Recovery System	None
Waste Water Heat Recovery	none
PV Unit	
Type	More Dwellings, One Block
Apportioned Energy	1347
Wind Turbine	None
Terrain Type:	Urban
Small Scale Hydro	None
Special Features	None

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

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DWELLING AS DESIGNED

Ground-floor flat, total floor area 74 m²

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

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 22.67 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 16.39 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)73.0 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)78.1 kWh/m²/yrFail
Excess energy =5.1 kWh/m²/yr (7.0%)

---

2 Fabric U-values

Element	Average	Highest	
External wall	0.14 (max. 0.30)	0.15 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.11 (max. 0.25)	0.11 (max. 0.70)	OK
Roof	0.11 (max. 0.20)	0.11 (max. 0.35)	OK
Openings	1.41 (max. 2.00)	1.50 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated using default y-value of 0.15

---

3 Air permeability
Air permeability at 50 pascals: 3.00 (design value)
Maximum 10.0 OK

---

4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from manufacturer
tbc tbc
Combi boiler
Efficiency: 92.0% 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

SAP2012 - 9.92 input data (DesignData) -

9 Summertime temperature		
Overheating risk (Thames Valley):	Medium	OK
Based on:		
Overshading:	Average	
Windows facing North East:	6.59 m², No overhang	
Windows facing South East:	9.55 m², No overhang	
Windows facing North West:	9.55 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	0.11 W/m²K
Floor U-value	0.11 W/m²K
Air permeability	3.0 m³/m²h
Photovoltaic array	

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	74.4800 (1b)	x	3.1100 (2b)	=	231.6328	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	74.4800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	231.6328	(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) =	0.1295	(8)
Pressure test		Yes	
Measured/design q50		3.0000	
Infiltration rate		0.2795	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2586	(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	0.3297	0.3232	0.3167	0.2844	0.2779	0.2456	0.2456	0.2392	0.2586	0.2779	0.2909	0.3038	(22b)
Effective ac	0.5543	0.5522	0.5502	0.5404	0.5386	0.5302	0.5302	0.5286	0.5334	0.5386	0.5423	0.5461	(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	
Windows (Uw = 1.40)			25.6900	1.3258	34.0587			(27)
Door			2.0000	1.5000	3.0000			(26)
Roof Light (Uw = 1.40)			1.2100	1.3258	1.6042			(27a)
Heat Loss Floor 1			74.4800	0.1100	8.1928			(28a)
External Wall 1	97.0000	27.6900	69.3100	0.1500	10.3965			(29a)
Sheltered Wall	33.5900		33.5900	0.1322	4.4392			(29a)
External Roof 1	15.2200	1.2100	14.0100	0.1100	1.5411			(30)
Total net area of external elements Aum(A, m2)			220.2900					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	63.2325			(33)
Party Wall 1			5.9400	0.0000	0.0000			(32)
Party Ceilings 1			59.2600					(32b)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							450.0000	(35)
Thermal bridges (Default value 0.150 * total exposed area)							33.0435	(36)
Total fabric heat loss					(33) + (36) =		96.2760	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	42.3728	42.2115	42.0534	41.3109	41.1720	40.5252	40.5252	40.4055	40.7743	41.1720	41.4530	41.7468	(38)
Heat transfer coeff	138.6488	138.4875	138.3294	137.5869	137.4479	136.8012	136.8012	136.6815	137.0503	137.4479	137.7290	138.0228	(39)
Average = Sum(39)m / 12 =												137.5862	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.8616	1.8594	1.8573	1.8473	1.8454	1.8368	1.8368	1.8351	1.8401	1.8454	1.8492	1.8532	(40)
HLP (average)												1.8473	(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		2.3498 (42)
Average daily hot water use (litres/day)		90.0078 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	99.0086	95.4083	91.8080	88.2077	84.6074	81.0070	81.0070	84.6074	88.2077	91.8080	95.4083	99.0086	(44)
Energy conte	146.8269	128.4158	132.5136	115.5285	110.8524	95.6572	88.6404	101.7162	102.9310	119.9562	130.9415	142.1940	(45)
Energy content (annual)										Total = Sum(45)m =		1416.1737	(45)
Distribution loss (46)m = 0.15 x (45)m	22.0240	19.2624	19.8770	17.3293	16.6279	14.3486	13.2961	15.2574	15.4397	17.9934	19.6412	21.3291	(46)

Water storage loss:

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.4537	43.9140	46.7843	43.4997	43.1150	39.9487	41.2803	43.1150	43.4997	46.7843	47.0507	50.4537	(61)
Total heat required for water heating calculated for each month													
	197.2806	172.3297	179.2979	159.0282	153.9674	135.6059	129.9207	144.8312	146.4307	166.7405	177.9922	192.6477	(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													
	197.2806	172.3297	179.2979	159.0282	153.9674	135.6059	129.9207	144.8312	146.4307	166.7405	177.9922	192.6477	(64)
								Total per year (kWh/year) = Sum(64)m =				1956.0727	(64)
Heat gains from water heating, kWh/month													
	61.4334	53.6767	55.7568	49.2882	47.6372	41.7932	39.7930	44.5994	45.0995	51.5815	55.3007	59.8929	(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	117.4902	117.4902	117.4902	117.4902	117.4902	117.4902	117.4902	117.4902	117.4902	117.4902	117.4902	117.4902	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	18.5005	16.4320	13.3634	10.1170	7.5625	6.3846	6.8988	8.9673	12.0359	15.2824	17.8368	19.0147	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	207.5197	209.6731	204.2466	192.6942	178.1113	164.4055	155.2492	153.0958	158.5223	170.0747	184.6575	198.3633	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	34.7490	34.7490	34.7490	34.7490	34.7490	34.7490	34.7490	34.7490	34.7490	34.7490	34.7490	34.7490	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	(71)
Water heating gains (Table 5)													
	82.5717	79.8761	74.9420	68.4558	64.0284	58.0461	53.4852	59.9454	62.6382	69.3300	76.8066	80.5013	(72)
Total internal gains													
	369.8390	367.2282	353.7990	332.5139	310.9494	290.0833	276.8803	283.2556	294.4435	315.9341	340.5479	359.1264	(73)

---

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	6.5900	11.2829	0.6300	0.7000	0.7700	22.7237	(75)
Southeast	9.5500	36.7938	0.6300	0.7000	0.7700	107.3866	(77)
Northwest	9.5500	11.2829	0.6300	0.7000	0.7700	32.9304	(81)
Horizontal	1.2100	26.0000	0.6300	0.7000	1.0000	12.4865	(82)

Solar gains	175.5273	322.1383	500.4866	717.3425	890.1257	921.2414	872.5885	738.3127	574.9316	372.3051	214.5000	147.4358	(83)
Total gains	545.3663	689.3665	854.2856	1049.8564	1201.0751	1211.3246	1149.4688	1021.5683	869.3750	688.2393	555.0479	506.5622	(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	67.1481	67.2263	67.3031	67.6663	67.7347	68.0549	68.0549	68.1146	67.9313	67.7347	67.5965	67.4526	
alpha	5.4765	5.4818	5.4869	5.5111	5.5156	5.5370	5.5370	5.5410	5.5288	5.5156	5.5064	5.4968	
util living area													
	0.9997	0.9989	0.9947	0.9694	0.8716	0.6851	0.5166	0.5987	0.8801	0.9907	0.9992	0.9998	(86)
MIT	19.7332	19.8969	20.1723	20.5362	20.8341	20.9672	20.9942	20.9877	20.8705	20.4641	20.0256	19.7019	(87)
Th 2	19.4272	19.4287	19.4302	19.4371	19.4384	19.4444	19.4444	19.4455	19.4421	19.4384	19.4358	19.4330	(88)
util rest of house													
	0.9995	0.9981	0.9909	0.9469	0.7908	0.5381	0.3380	0.4058	0.7659	0.9806	0.9986	0.9997	(89)
MIT 2	17.8002	18.0407	18.4423	18.9588	19.3189	19.4330	19.4437	19.4437	19.3724	18.8715	18.2344	17.7586	(90)
Living area fraction										fLA = Living area / (4) =		0.3989	(91)
MIT	18.5713	18.7812	19.1324	19.5880	19.9233	20.0450	20.0622	20.0596	19.9700	19.5068	18.9489	18.5338	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.5713	18.7812	19.1324	19.5880	19.9233	20.0450	20.0622	20.0596	19.9700	19.5068	18.9489	18.5338	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9994	0.9977	0.9898	0.9497	0.8197	0.5982	0.4103	0.4848	0.8122	0.9813	0.9983	0.9996	(94)
Useful gains	545.0262	687.7646	845.5955	997.0841	984.4970	724.6121	471.5721	495.2716	706.0770	675.3639	554.0816	506.3514	(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													
	1978.6971	1922.3674	1747.4295	1470.5351	1130.2758	744.8810	473.6330	500.2002	804.4874	1224.2227	1631.9388	1978.3941	(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													
	1066.6512	829.6531	670.9645	340.8847	108.4594	0.0000	0.0000	0.0000	0.0000	408.3510	776.0572	1095.1998	(98)
Space heating												5296.2209	(98)
Space heating per m2											(98) / (4) =	71.1093	(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 %)												92.8000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												5707.1345	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1066.6512	829.6531	670.9645	340.8847	108.4594	0.0000	0.0000	0.0000	0.0000	408.3510	776.0572	1095.1998	(98)
Space heating efficiency (main heating system 1)													
	92.8000	92.8000	92.8000	92.8000	92.8000	0.0000	0.0000	0.0000	0.0000	92.8000	92.8000	92.8000	(210)
Space heating fuel (main heating system)													
	1149.4086	894.0227	723.0221	367.3327	116.8744	0.0000	0.0000	0.0000	0.0000	440.0334	836.2685	1180.1722	(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													
	197.2806	172.3297	179.2979	159.0282	153.9674	135.6059	129.9207	144.8312	146.4307	166.7405	177.9922	192.6477	(64)
Efficiency of water heater												83.5000	(216)
(217)m	91.2143	91.0558	90.6705	89.6246	87.1079	83.5000	83.5000	83.5000	83.5000	89.8970	90.9110	91.2792	(217)
Fuel for water heating, kWh/month													
	216.2826	189.2573	197.7468	177.4382	176.7548	162.4022	155.5937	173.4505	175.3661	185.4795	195.7874	211.0532	(219)
Water heating fuel used												2216.6123	(219)
Annual totals kWh/year													
Space heating fuel - main system												5707.1345	(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)												326.7251	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
Total delivered energy for all uses												8325.4720	(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	5707.1345	0.2160	1232.7411	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2216.6123	0.2160	478.7883	(264)
Space and water heating			1711.5293	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	326.7251	0.5190	169.5703	(268)
Energy saving/generation technologies				
PV Unit	-1347.0000	0.5190	-699.0930	(269)
Total CO2, kg/year			1220.9317	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			16.3900	(273)

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

DER		16.3900	ZC1
Total Floor Area	TFA	74.4800	
Assumed number of occupants	N	2.3498	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		16.5107	ZC2
CO2 emissions from cooking, equation (L16)		2.3549	ZC3
Total CO2 emissions		35.2556	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		35.2556	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	74.4800 (1b)	x	3.1100 (2b)	=	231.6328	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	74.4800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	231.6328	(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) =	0.1295	(8)
Pressure test		Yes	
Measured/design q50		5.0000	
Infiltration rate		0.3795	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3511	(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	0.4476	0.4388	0.4300	0.3862	0.3774	0.3335	0.3335	0.3247	0.3511	0.3774	0.3949	0.4125	(22b)
Effective ac	0.6002	0.5963	0.5925	0.5746	0.5712	0.5556	0.5556	0.5527	0.5616	0.5712	0.5780	0.5851	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.0000	1.0000	2.0000			(26)
TER Opening Type (Uw = 1.40)			15.8700	1.3258	21.0398			(27)
TER Room Window (Uw = 1.70)			0.7500	1.5918	1.1938			(27a)
Heat Loss Floor 1			74.4800	0.1300	9.6824			(28a)
External Wall 1	97.0000	17.8700	79.1300	0.1800	14.2434			(29a)
Sheltered Wall	33.5900		33.5900	0.1800	6.0462			(29a)
External Roof 1	15.2200	0.7500	14.4700	0.1300	1.8811			(30)
Total net area of external elements Aum(A, m2)			220.2900					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	56.0867			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (User defined value 0.050 * total exposed area)	11.0145	(36)
Total fabric heat loss (33) + (36) =	67.1012	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	45.8762	45.5789	45.2874	43.9186	43.6625	42.4702	42.4702	42.2495	42.9295	43.6625	44.1806	44.7222	(38)
Heat transfer coeff	112.9774	112.6801	112.3886	111.0198	110.7637	109.5714	109.5714	109.3506	110.0307	110.7637	111.2818	111.8234	(39)
Average = Sum(39)m / 12 =												111.0185	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.5169	1.5129	1.5090	1.4906	1.4872	1.4712	1.4712	1.4682	1.4773	1.4872	1.4941	1.5014	(40)
HLP (average)												1.4906	(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	2.3498 (42)
Average daily hot water use (litres/day)	90.0078 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	99.0086	95.4083	91.8080	88.2077	84.6074	81.0070	81.0070	84.6074	88.2077	91.8080	95.4083	99.0086	(44)
Energy conte	146.8269	128.4158	132.5136	115.5285	110.8524	95.6572	88.6404	101.7162	102.9310	119.9562	130.9415	142.1940	(45)
Energy content (annual)										Total = Sum(45)m =		1416.1737	(45)
Distribution loss (46)m = 0.15 x (45)m	22.0240	19.2624	19.8770	17.3293	16.6279	14.3486	13.2961	15.2574	15.4397	17.9934	19.6412	21.3291	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.4537	43.9140	46.7843	43.4997	43.1150	39.9487	41.2803	43.1150	43.4997	46.7843	47.0507	50.4537 (61)
Total heat required for water heating calculated for each month												
	197.2806	172.3297	179.2979	159.0282	153.9674	135.6059	129.9207	144.8312	146.4307	166.7405	177.9922	192.6477 (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												
	197.2806	172.3297	179.2979	159.0282	153.9674	135.6059	129.9207	144.8312	146.4307	166.7405	177.9922	192.6477 (64)
								Total per year (kWh/year) = Sum(64)m =				1956.0727 (64)
Heat gains from water heating, kWh/month												
	61.4334	53.6767	55.7568	49.2882	47.6372	41.7932	39.7930	44.5994	45.0995	51.5815	55.3007	59.8929 (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	117.4902	117.4902	117.4902	117.4902	117.4902	117.4902	117.4902	117.4902	117.4902	117.4902	117.4902	117.4902	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	18.4977	16.4295	13.3614	10.1154	7.5614	6.3837	6.8978	8.9660	12.0341	15.2801	17.8341	19.0118	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	207.5197	209.6731	204.2466	192.6942	178.1113	164.4055	155.2492	153.0958	158.5223	170.0747	184.6575	198.3633	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	34.7490	34.7490	34.7490	34.7490	34.7490	34.7490	34.7490	34.7490	34.7490	34.7490	34.7490	34.7490	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	(71)
Water heating gains (Table 5)													
	82.5717	79.8761	74.9420	68.4558	64.0284	58.0461	53.4852	59.9454	62.6382	69.3300	76.8066	80.5013	(72)
Total internal gains													
	369.8362	367.2257	353.7970	332.5124	310.9482	290.0823	276.8793	283.2542	294.4416	315.9318	340.5453	359.1235	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	4.0700	11.2829	0.6300	0.7000	0.7700	14.0342	(75)
Southeast	5.9000	36.7938	0.6300	0.7000	0.7700	66.3436	(77)
Northwest	5.9000	11.2829	0.6300	0.7000	0.7700	20.3445	(81)
Horizontal	0.7500	26.0000	0.6300	0.7000	1.0000	7.7396	(82)

Solar gains	108.4618	199.0609	309.2784	443.2943	550.0716	569.3003	539.2342	456.2547	355.2855	230.0637	132.5449	91.1028	(83)
Total gains	478.2980	566.2866	663.0754	775.8067	861.0198	859.3826	816.1135	739.5089	649.7271	545.9956	473.0901	450.2263	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	45.7810	45.9018	46.0209	46.5883	46.6960	47.2041	47.2041	47.2994	47.0071	46.6960	46.4786	46.2535	
alpha	4.0521	4.0601	4.0681	4.1059	4.1131	4.1469	4.1469	4.1533	4.1338	4.1131	4.0986	4.0836	
util living area													
	0.9971	0.9939	0.9845	0.9528	0.8692	0.7164	0.5615	0.6293	0.8624	0.9751	0.9946	0.9978	(86)
MIT	19.3337	19.5200	19.8439	20.2827	20.6653	20.8981	20.9716	20.9552	20.7633	20.2640	19.7229	19.3060	(87)
Th 2	19.6749	19.6778	19.6808	19.6946	19.6971	19.7092	19.7092	19.7114	19.7046	19.6971	19.6919	19.6865	(88)
util rest of house													
	0.9961	0.9917	0.9786	0.9337	0.8157	0.6083	0.4109	0.4765	0.7836	0.9615	0.9922	0.9970	(89)
MIT 2	17.4926	17.7660	18.2377	18.8701	19.3779	19.6445	19.6999	19.6944	19.5172	18.8573	18.0725	17.4597	(90)
Living area fraction										fLA = Living area / (4) =		0.3989	(91)
MIT	18.2270	18.4657	18.8784	19.4336	19.8914	20.1445	20.2072	20.1973	20.0142	19.4184	18.7308	18.1962	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2270	18.4657	18.8784	19.4336	19.8914	20.1445	20.2072	20.1973	20.0142	19.4184	18.7308	18.1962	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9944	0.9888	0.9737	0.9288	0.8249	0.6478	0.4716	0.5379	0.8058	0.9575	0.9897	0.9956	(94)
Useful gains	475.6197	559.9189	645.6390	720.5845	710.2512	556.7465	384.9146	397.7787	523.5788	522.7966	468.2093	448.2438	(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													
	1573.4345	1528.5820	1391.1922	1169.4390	907.3128	607.5243	395.2414	415.2382	650.7476	976.7589	1294.2976	1565.0999	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	816.7742	650.9416	554.6916	323.1752	146.6138	0.0000	0.0000	0.0000	0.0000	337.7479	594.7836	830.9409	(98)
Space heating												4255.6689	(98)
Space heating per m2											(98) / (4) =	57.1384	(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												4556.3906	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	816.7742	650.9416	554.6916	323.1752	146.6138	0.0000	0.0000	0.0000	0.0000	337.7479	594.7836	830.9409	(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)													
	874.4906	696.9396	593.8882	346.0120	156.9741	0.0000	0.0000	0.0000	0.0000	361.6145	636.8132	889.6584	(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													
	197.2806	172.3297	179.2979	159.0282	153.9674	135.6059	129.9207	144.8312	146.4307	166.7405	177.9922	192.6477	(64)
Efficiency of water heater												80.3000	(216)
(217)m	88.2408	88.0810	87.7053	86.7995	84.9283	80.3000	80.3000	80.3000	80.3000	86.7919	87.8548	88.3095	(217)
Fuel for water heating, kWh/month													
	223.5708	195.6492	204.4323	183.2133	181.2911	168.8740	161.7942	180.3626	182.3545	192.1152	202.5981	218.1507	(219)
Water heating fuel used												2294.4061	(219)
Annual totals kWh/year													
Space heating fuel - main system												4556.3906	(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)												326.6758	(232)
Total delivered energy for all uses												7252.4725	(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	4556.3906	0.2160	984.1804	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2294.4061	0.2160	495.5917	(264)
Space and water heating			1479.7721	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	326.6758	0.5190	169.5447	(268)
Total CO2, kg/m2/year			1688.2418	(272)
Emissions per m2 for space and water heating			19.8680	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.2764	(272b)
Emissions per m2 for pumps and fans			0.5226	(272c)
Target Carbon Dioxide Emission Rate (TER) = (19.8680 * 1.00) + 2.2764 + 0.5226, rounded to 2 d.p.			22.6700	(273)

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1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	74.4800 (1b)	x	3.1100 (2b)	=	231.6328	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	74.4800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	231.6328	(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) =	0.1295	(8)
Pressure test		Yes	
Measured/design q50		3.0000	
Infiltration rate		0.2795	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2586	(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	0.3297	0.3232	0.3167	0.2844	0.2779	0.2456	0.2456	0.2392	0.2586	0.2779	0.2909	0.3038	(22b)
Effective ac	0.5543	0.5522	0.5502	0.5404	0.5386	0.5302	0.5302	0.5286	0.5334	0.5386	0.5423	0.5461	(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	
Windows (Uw = 1.40)			25.6900	1.3258	34.0587			(27)
Door			2.0000	1.5000	3.0000			(26)
Roof Light (Uw = 1.40)			1.2100	1.3258	1.6042			(27a)
Heat Loss Floor 1			74.4800	0.1100	8.1928			(28a)
External Wall 1	97.0000	27.6900	69.3100	0.1500	10.3965			(29a)
Sheltered Wall	33.5900		33.5900	0.1322	4.4392			(29a)
External Roof 1	15.2200	1.2100	14.0100	0.1100	1.5411			(30)
Total net area of external elements Aum(A, m2)			220.2900					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	63.2325			(33)
Party Wall 1			5.9400	0.0000	0.0000			(32)
Party Ceilings 1			59.2600					(32b)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							450.0000	(35)
Thermal bridges (Default value 0.150 * total exposed area)							33.0435	(36)
Total fabric heat loss					(33) + (36) =		96.2760	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	42.3728	42.2115	42.0534	41.3109	41.1720	40.5252	40.5252	40.4055	40.7743	41.1720	41.4530	41.7468	(38)
Heat transfer coeff	138.6488	138.4875	138.3294	137.5869	137.4479	136.8012	136.8012	136.6815	137.0503	137.4479	137.7290	138.0228	(39)
Average = Sum(39)m / 12 =												137.5862	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.8616	1.8594	1.8573	1.8473	1.8454	1.8368	1.8368	1.8351	1.8401	1.8454	1.8492	1.8532	(40)
HLP (average)												1.8473	(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		2.3498 (42)
Average daily hot water use (litres/day)		90.0078 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	99.0086	95.4083	91.8080	88.2077	84.6074	81.0070	81.0070	84.6074	88.2077	91.8080	95.4083	99.0086	(44)
Energy conte	146.8269	128.4158	132.5136	115.5285	110.8524	95.6572	88.6404	101.7162	102.9310	119.9562	130.9415	142.1940	(45)
Energy content (annual)										Total = Sum(45)m =		1416.1737	(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:

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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

31.2007	27.2883	28.1591	24.5498	23.5561	20.3271	18.8361	21.6147	21.8728	25.4907	27.8251	30.2162	(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	117.4902	117.4902	117.4902	117.4902	117.4902	117.4902	117.4902	117.4902	117.4902	117.4902	117.4902	117.4902	(66)

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

18.5005	16.4320	13.3634	10.1170	7.5625	6.3846	6.8988	8.9673	12.0359	15.2824	17.8368	19.0147	(67)

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

207.5197	209.6731	204.2466	192.6942	178.1113	164.4055	155.2492	153.0958	158.5223	170.0747	184.6575	198.3633	(68)

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

34.7490	34.7490	34.7490	34.7490	34.7490	34.7490	34.7490	34.7490	34.7490	34.7490	34.7490	34.7490	(69)
Pumps, fans 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)

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

-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	(71)

Water heating gains (Table 5)

41.9365	40.6077	37.8483	34.0970	31.6615	28.2322	25.3173	29.0520	30.3789	34.2617	38.6459	40.6132	(72)

Total internal gains

326.2037	324.9598	313.7053	295.1551	275.5824	257.2693	245.7124	249.3622	259.1842	277.8658	299.3873	316.2383	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	6.5900	11.2829	0.6300	0.7000	0.7700	22.7237	(75)
Southeast	9.5500	36.7938	0.6300	0.7000	0.7700	107.3866	(77)
Northwest	9.5500	11.2829	0.6300	0.7000	0.7700	32.9304	(81)
Horizontal	1.2100	26.0000	0.6300	0.7000	1.0000	12.4865	(82)

Solar gains	175.5273	322.1383	500.4866	717.3425	890.1257	921.2414	872.5885	738.3127	574.9316	372.3051	214.5000	147.4358	(83)
Total gains	501.7310	647.0981	814.1919	1012.4976	1165.7081	1178.5107	1118.3009	987.6749	834.1158	650.1710	513.8873	463.6741	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	67.1481	67.2263	67.3031	67.6663	67.7347	68.0549	68.0549	68.1146	67.9313	67.7347	67.5965	67.4526	
alpha	5.4765	5.4818	5.4869	5.5111	5.5156	5.5370	5.5370	5.5410	5.5288	5.5156	5.5064	5.4968	
util living area	0.9998	0.9992	0.9958	0.9737	0.8827	0.6999	0.5301	0.6166	0.8946	0.9929	0.9995	0.9999	(86)
MIT	19.7020	19.8669	20.1444	20.5134	20.8213	20.9636	20.9934	20.9858	20.8570	20.4381	19.9963	19.6712	(87)
Th 2	19.4272	19.4287	19.4302	19.4371	19.4384	19.4444	19.4444	19.4455	19.4421	19.4384	19.4358	19.4330	(88)
util rest of house	0.9997	0.9986	0.9927	0.9538	0.8052	0.5519	0.3473	0.4194	0.7867	0.9850	0.9990	0.9998	(89)
MIT 2	18.2852	18.4511	18.7283	19.0902	19.3488	19.4356	19.4439	19.4441	19.3876	19.0266	18.5862	18.2592	(90)
Living area fraction									fLA = Living area / (4) =			0.3989	(91)
MIT	18.8504	19.0158	19.2932	19.6579	19.9362	20.0451	20.0620	20.0591	19.9737	19.5896	19.1487	18.8224	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8504	19.0158	19.2932	19.6579	19.9362	20.0451	20.0620	20.0591	19.9737	19.5896	19.1487	18.8224	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9996	0.9984	0.9923	0.9574	0.8339	0.6128	0.4214	0.5005	0.8314	0.9861	0.9989	0.9998	(94)
Useful gains	501.5461	646.0872	807.9417	969.3997	972.0283	722.1541	471.2497	494.3724	693.4768	641.1086	513.3291	463.5640	(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	2017.3926	1954.8664	1769.6735	1480.1474	1132.0453	744.8999	473.6031	500.1273	804.9970	1235.6078	1659.4535	2018.2296	(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	1127.7898	879.4996	715.5285	367.7384	119.0526	0.0000	0.0000	0.0000	0.0000	442.3074	825.2096	1156.6712	(98)
Space heating												5633.7971	(98)
Space heating per m2											(98) / (4) =	75.6417	(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	1285.9315	1012.3290	1038.7791	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8927	0.9444	0.9085	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1147.8983	956.0286	943.7609	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1448.5792	1377.3085	1228.6494	0.0000	0.0000	0.0000	0.0000	(103)

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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	216.4902	313.4323	211.9571	0.0000	0.0000	0.0000	0.0000 (104)
Space cooling												741.8796 (104)
Cooled fraction											fC = cooled area / (4) =	1.0000 (105)
Intermittency factor (Table 10b)												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000 (106)
Space cooling kWh												
	0.0000	0.0000	0.0000	0.0000	0.0000	54.1226	78.3581	52.9893	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												185.4699 (107)
Space cooling per m2												2.4902 (108)
Energy for space heating												75.6417 (99)
Energy for space cooling												2.4902 (108)
Total												78.1319 (109)
Dwelling Fabric Energy Efficiency (DFEE)												78.1 (109)

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CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	74.4800 (1b)	x	3.1100 (2b)	=	231.6328	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	74.4800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	231.6328	(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) =	0.1295	(8)
Pressure test		Yes	
Measured/design q50		5.0000	
Infiltration rate		0.3795	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3511	(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	0.4476	0.4388	0.4300	0.3862	0.3774	0.3335	0.3335	0.3247	0.3511	0.3774	0.3949	0.4125	(22b)
Effective ac	0.6002	0.5963	0.5925	0.5746	0.5712	0.5556	0.5556	0.5527	0.5616	0.5712	0.5780	0.5851	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.0000	1.0000	2.0000			(26)
TER Opening Type (Uw = 1.40)			15.8700	1.3258	21.0398			(27)
TER Room Window (Uw = 1.70)			0.7500	1.5918	1.1938			(27a)
Heat Loss Floor 1			74.4800	0.1300	9.6824			(28a)
External Wall 1	97.0000	17.8700	79.1300	0.1800	14.2434			(29a)
Sheltered Wall	33.5900		33.5900	0.1800	6.0462			(29a)
External Roof 1	15.2200	0.7500	14.4700	0.1300	1.8811			(30)
Total net area of external elements Aum(A, m2)			220.2900					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	56.0867			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (User defined value 0.050 * total exposed area)	11.0145	(36)
Total fabric heat loss (33) + (36) =	67.1012	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	45.8762	45.5789	45.2874	43.9186	43.6625	42.4702	42.4702	42.2495	42.9295	43.6625	44.1806	44.7222	(38)
Heat transfer coeff	112.9774	112.6801	112.3886	111.0198	110.7637	109.5714	109.5714	109.3506	110.0307	110.7637	111.2818	111.8234	(39)
Average = Sum(39)m / 12 =												111.0185	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.5169	1.5129	1.5090	1.4906	1.4872	1.4712	1.4712	1.4682	1.4773	1.4872	1.4941	1.5014	(40)
HLP (average)												1.4906	(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	2.3498 (42)
Average daily hot water use (litres/day)	90.0078 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	99.0086	95.4083	91.8080	88.2077	84.6074	81.0070	81.0070	84.6074	88.2077	91.8080	95.4083	99.0086	(44)
Energy conte	146.8269	128.4158	132.5136	115.5285	110.8524	95.6572	88.6404	101.7162	102.9310	119.9562	130.9415	142.1940	(45)
Energy content (annual)										Total = Sum(45)m =		1416.1737	(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)

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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

31.2007	27.2883	28.1591	24.5498	23.5561	20.3271	18.8361	21.6147	21.8728	25.4907	27.8251	30.2162	(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	117.4902	117.4902	117.4902	117.4902	117.4902	117.4902	117.4902	117.4902	117.4902	117.4902	117.4902	117.4902	(66)

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

18.4977	16.4295	13.3614	10.1154	7.5614	6.3837	6.8978	8.9660	12.0341	15.2801	17.8341	19.0118	(67)

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

207.5197	209.6731	204.2466	192.6942	178.1113	164.4055	155.2492	153.0958	158.5223	170.0747	184.6575	198.3633	(68)

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

34.7490	34.7490	34.7490	34.7490	34.7490	34.7490	34.7490	34.7490	34.7490	34.7490	34.7490	34.7490	(69)
Pumps, fans 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)

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

-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	(71)

Water heating gains (Table 5)

41.9365	40.6077	37.8483	34.0970	31.6615	28.2322	25.3173	29.0520	30.3789	34.2617	38.6459	40.6132	(72)

Total internal gains

326.2009	324.9573	313.7033	295.1536	275.5812	257.2684	245.7114	249.3608	259.1824	277.8635	299.3846	316.2354	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	4.0700	11.2829	0.6300	0.7000	0.7700	14.0342	(75)
Southeast	5.9000	36.7938	0.6300	0.7000	0.7700	66.3436	(77)
Northwest	5.9000	11.2829	0.6300	0.7000	0.7700	20.3445	(81)
Horizontal	0.7500	26.0000	0.6300	0.7000	1.0000	7.7396	(82)

Solar gains	108.4618	199.0609	309.2784	443.2943	550.0716	569.3003	539.2342	456.2547	355.2855	230.0637	132.5449	91.1028	(83)
Total gains	434.6627	524.0182	622.9817	738.4479	825.6528	826.5686	784.9456	705.6155	614.4679	507.9272	431.9295	407.3383	(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	45.7810	45.9018	46.0209	46.5883	46.6960	47.2041	47.2041	47.2994	47.0071	46.6960	46.4786	46.2535	
alpha	4.0521	4.0601	4.0681	4.1059	4.1131	4.1469	4.1469	4.1533	4.1338	4.1131	4.0986	4.0836	
util living area	0.9980	0.9954	0.9875	0.9595	0.8821	0.7345	0.5800	0.6521	0.8799	0.9804	0.9961	0.9985	(86)
MIT	19.2827	19.4712	19.7994	20.2463	20.6414	20.8878	20.9680	20.9489	20.7400	20.2231	19.6751	19.2556	(87)
Th 2	19.6749	19.6778	19.6808	19.6946	19.6971	19.7092	19.7092	19.7114	19.7046	19.6971	19.6919	19.6865	(88)
util rest of house	0.9973	0.9937	0.9827	0.9426	0.8316	0.6271	0.4262	0.4970	0.8067	0.9694	0.9944	0.9979	(89)
MIT 2	18.1341	18.3242	18.6521	19.0981	19.4605	19.6598	19.7019	19.6979	19.5605	19.0851	18.5389	18.1159	(90)
Living area fraction									fLA = Living area / (4) =			0.3989	(91)
MIT	18.5923	18.7818	19.1097	19.5561	19.9316	20.1497	20.2070	20.1969	20.0310	19.5390	18.9921	18.5705	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.5923	18.7818	19.1097	19.5561	19.9316	20.1497	20.2070	20.1969	20.0310	19.5390	18.9921	18.5705	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9964	0.9921	0.9799	0.9404	0.8421	0.6671	0.4885	0.5598	0.8287	0.9677	0.9931	0.9972	(94)
Useful gains	433.1028	519.8920	610.4597	694.4008	695.3227	551.4040	383.4747	394.9918	509.1841	491.5001	428.9629	406.2178	(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	1614.7038	1564.1969	1417.1892	1183.0403	911.7615	608.0832	395.2200	415.1906	652.5940	990.1190	1323.3761	1606.9616	(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	879.1111	701.7729	600.2067	351.8205	161.0305	0.0000	0.0000	0.0000	0.0000	370.9725	643.9774	893.3534	(98)
Space heating												4602.2450	(98)
Space heating per m2											(98) / (4) =	61.7917	(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	1029.9715	810.8286	831.0649	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8109	0.8779	0.8382	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	835.1890	711.8462	696.5952	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1043.3819	993.4969	903.8072	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

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                0.0000     0.0000     0.0000     0.0000     0.0000   149.8989   209.5481   154.1657     0.0000     0.0000     0.0000     0.0000 (104)
Space cooling                                                                                                                          513.6127 (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    37.4747    52.3870    38.5414     0.0000     0.0000     0.0000     0.0000 (107)
Space cooling                                                                                                                          128.4032 (107)
Space cooling per m2                                                                                                                     1.7240 (108)
Energy for space heating                                                                                                                61.7917 (99)
Energy for space cooling                                                                                                                 1.7240 (108)
Total                                                                                                                                   63.5157 (109)
Target Fabric Energy Efficiency (TFEE)                                                                                                  73.0 (109)


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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	74.4800 (1b)	x	3.1100 (2b)	=	231.6328	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	74.4800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	231.6328	(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) =	0.1295	(8)
Pressure test		Yes	
Measured/design q50		3.0000	
Infiltration rate		0.2795	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2586	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	3.8000	3.6000	3.5000	3.4000	3.4000	3.0000	3.2000	3.0000	2.9000	3.1000	3.0000	3.4000	(22)
Wind factor	0.9500	0.9000	0.8750	0.8500	0.8500	0.7500	0.8000	0.7500	0.7250	0.7750	0.7500	0.8500	(22a)
Adj infilt rate	0.2456	0.2327	0.2262	0.2198	0.2198	0.1939	0.2068	0.1939	0.1874	0.2004	0.1939	0.2198	(22b)
Effective ac	0.5302	0.5271	0.5256	0.5241	0.5241	0.5188	0.5214	0.5188	0.5176	0.5201	0.5188	0.5241	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Windows (Uw = 1.40)			25.6900	1.3258	34.0587			(27)
Door			2.0000	1.5000	3.0000			(26)
Roof Light (Uw = 1.40)			1.2100	1.3258	1.6042			(27a)
Heat Loss Floor 1			74.4800	0.1100	8.1928			(28a)
External Wall 1	97.0000	27.6900	69.3100	0.1500	10.3965			(29a)
Sheltered Wall	33.5900		33.5900	0.1322	4.4392			(29a)
External Roof 1	15.2200	1.2100	14.0100	0.1100	1.5411			(30)
Total net area of external elements Aum(A, m2)			220.2900					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	63.2325			(33)
Party Wall 1			5.9400	0.0000	0.0000			(32)
Party Ceilings 1			59.2600					(32b)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							450.0000	(35)
Thermal bridges (Default value 0.150 * total exposed area)							33.0435	(36)
Total fabric heat loss					(33) + (36) =		96.2760	(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	40.5252	40.2889	40.1755	40.0653	40.0653	39.6566	39.8546	39.6566	39.5623	39.7540	39.6566	40.0653	(38)
Heat transfer coeff	136.8012	136.5649	136.4515	136.3413	136.3413	135.9325	136.1306	135.9325	135.8383	136.0300	135.9325	136.3413	(39)
Average = Sum(39)m / 12 =												136.2198	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.8368	1.8336	1.8321	1.8306	1.8306	1.8251	1.8277	1.8251	1.8238	1.8264	1.8251	1.8306	(40)
HLP (average)												1.8289	(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	2.3498	(42)
Average daily hot water use (litres/day)	90.0078	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	99.0086	95.4083	91.8080	88.2077	84.6074	81.0070	81.0070	84.6074	88.2077	91.8080	95.4083	99.0086	(44)
Energy conte	146.8269	128.4158	132.5136	115.5285	110.8524	95.6572	88.6404	101.7162	102.9310	119.9562	130.9415	142.1940	(45)
Energy content (annual)										Total = Sum(45)m =		1416.1737	(45)
Distribution loss (46)m = 0.15 x (45)m	22.0240	19.2624	19.8770	17.3293	16.6279	14.3486	13.2961	15.2574	15.4397	17.9934	19.6412	21.3291	(46)

Water storage loss:

CALCULATION OF HEAT DEMAND 09 Jan 2014

Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.4537	43.9140	46.7843	43.4997	43.1150	39.9487	41.2803	43.1150	43.4997	46.7843	47.0507	50.4537	(61)
Total heat required for water heating calculated for each month													
	197.2806	172.3297	179.2979	159.0282	153.9674	135.6059	129.9207	144.8312	146.4307	166.7405	177.9922	192.6477	(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													
	197.2806	172.3297	179.2979	159.0282	153.9674	135.6059	129.9207	144.8312	146.4307	166.7405	177.9922	192.6477	(64)
								Total per year (kWh/year) = Sum(64)m =				1956.0727	(64)
RHI water heating demand												1956	(64)
Heat gains from water heating, kWh/month													
	61.4334	53.6767	55.7568	49.2882	47.6372	41.7932	39.7930	44.5994	45.0995	51.5815	55.3007	59.8929	(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	140.9882	140.9882	140.9882	140.9882	140.9882	140.9882	140.9882	140.9882	140.9882	140.9882	140.9882	140.9882	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	46.2513	41.0800	33.4085	25.2924	18.9064	15.9615	17.2470	22.4183	30.0898	38.2059	44.5920	47.5368	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	309.7308	312.9449	304.8456	287.6032	265.8378	245.3814	231.7152	228.5012	236.6005	253.8429	275.6083	296.0647	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	51.4486	51.4486	51.4486	51.4486	51.4486	51.4486	51.4486	51.4486	51.4486	51.4486	51.4486	51.4486	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	(71)
Water heating gains (Table 5)													
	82.5717	79.8761	74.9420	68.4558	64.0284	58.0461	53.4852	59.9454	62.6382	69.3300	76.8066	80.5013	(72)
Total internal gains													
	539.9986	535.3457	514.6408	482.7961	450.2173	420.8337	403.8922	412.3096	430.7731	462.8235	498.4515	525.5474	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	6.5900	12.4885	0.6300	0.7000	0.7700	25.1517	(75)
Southeast	9.5500	39.0225	0.6300	0.7000	0.7700	113.8911	(77)
Northwest	9.5500	12.4885	0.6300	0.7000	0.7700	36.4490	(81)
Horizontal	1.2100	29.0000	0.6300	0.7000	1.0000	13.9272	(82)

Solar gains	189.4191	313.2190	491.0581	729.6488	882.3442	974.9280	921.1492	798.8981	615.6714	396.1611	239.2759	162.8440	(83)
Total gains	729.4177	848.5647	1005.6989	1212.4449	1332.5615	1395.7617	1325.0414	1211.2078	1046.4445	858.9845	737.7274	688.3915	(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	68.0549	68.1727	68.2294	68.2845	68.2845	68.4899	68.3902	68.4899	68.5374	68.4408	68.4899	68.2845	
alpha	5.5370	5.5448	5.5486	5.5523	5.5523	5.5660	5.5593	5.5660	5.5692	5.5627	5.5660	5.5523	
util living area													
	0.9982	0.9953	0.9810	0.9083	0.7103	0.4169	0.2465	0.2916	0.6587	0.9497	0.9945	0.9986	(86)
MIT	20.0109	20.1555	20.4348	20.7628	20.9552	20.9981	20.9999	20.9998	20.9780	20.7262	20.3065	19.9861	(87)
Th 2	19.4444	19.4466	19.4476	19.4487	19.4487	19.4525	19.4506	19.4525	19.4534	19.4516	19.4525	19.4487	(88)
util rest of house													
	0.9969	0.9920	0.9672	0.8500	0.5840	0.2679	0.0874	0.1181	0.4826	0.8997	0.9898	0.9977	(89)
MIT 2	18.2183	18.4298	18.8281	19.2495	19.4285	19.4523	19.4506	19.4525	19.4483	19.2269	18.6543	18.1854	(90)
Living area fraction									fLA = Living area / (4) =			0.3989	(91)
MIT	18.9333	19.1182	19.4690	19.8531	20.0375	20.0689	20.0686	20.0697	20.0585	19.8249	19.3134	18.9037	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9333	19.1182	19.4690	19.8531	20.0375	20.0689	20.0686	20.0697	20.0585	19.8249	19.3134	18.9037	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9962	0.9910	0.9675	0.8679	0.6350	0.3276	0.1509	0.1874	0.5552	0.9152	0.9891	0.9971	(94)
Useful gains	726.6744	840.8908	972.9850	1052.3137	846.1658	457.3213	199.9235	226.9520	581.0130	786.1345	729.7190	686.4185	(95)
Ext temp.	5.6000	6.2000	8.0000	10.5000	13.6000	16.7000	18.6000	18.4000	15.7000	12.2000	8.5000	5.6000	(96)
Heat loss rate W													
	1824.0171	1764.1731	1564.9643	1275.2187	877.7006	457.9443	199.9281	226.9686	592.0521	1037.2198	1469.8900	1813.8481	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	816.4230	620.4457	440.4326	160.4916	23.4619	0.0000	0.0000	0.0000	0.0000	186.8075	532.9231	838.8076	(98)
Space heating												3619.7929	(98)
RHI space heating demand												3620	(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	74.4800 (1b)	x	3.1100 (2b)	=	231.6328	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	74.4800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	231.6328	(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) =	0.1295	(8)
Pressure test		Yes	
Measured/design q50		3.0000	
Infiltration rate		0.2795	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2586	(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	0.3297	0.3232	0.3167	0.2844	0.2779	0.2456	0.2456	0.2392	0.2586	0.2779	0.2909	0.3038	(22b)
Effective ac	0.5543	0.5522	0.5502	0.5404	0.5386	0.5302	0.5302	0.5286	0.5334	0.5386	0.5423	0.5461	(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	
Windows (Uw = 1.40)			25.6900	1.3258	34.0587			(27)
Door			2.0000	1.5000	3.0000			(26)
Roof Light (Uw = 1.40)			1.2100	1.3258	1.6042			(27a)
Heat Loss Floor 1			74.4800	0.1100	8.1928			(28a)
External Wall 1	97.0000	27.6900	69.3100	0.1500	10.3965			(29a)
Sheltered Wall	33.5900		33.5900	0.1322	4.4392			(29a)
External Roof 1	15.2200	1.2100	14.0100	0.1100	1.5411			(30)
Total net area of external elements Aum(A, m2)			220.2900					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	63.2325			(33)
Party Wall 1			5.9400	0.0000	0.0000			(32)
Party Ceilings 1			59.2600					(32b)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							450.0000	(35)
Thermal bridges (Default value 0.150 * total exposed area)							33.0435	(36)
Total fabric heat loss					(33) + (36) =		96.2760	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	42.3728	42.2115	42.0534	41.3109	41.1720	40.5252	40.5252	40.4055	40.7743	41.1720	41.4530	41.7468	(38)
Heat transfer coeff	138.6488	138.4875	138.3294	137.5869	137.4479	136.8012	136.8012	136.6815	137.0503	137.4479	137.7290	138.0228	(39)
Average = Sum(39)m / 12 =												137.5862	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.8616	1.8594	1.8573	1.8473	1.8454	1.8368	1.8368	1.8351	1.8401	1.8454	1.8492	1.8532	(40)
HLP (average)												1.8473	(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		2.3498 (42)
Average daily hot water use (litres/day)		90.0078 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	99.0086	95.4083	91.8080	88.2077	84.6074	81.0070	81.0070	84.6074	88.2077	91.8080	95.4083	99.0086	(44)
Energy conte	146.8269	128.4158	132.5136	115.5285	110.8524	95.6572	88.6404	101.7162	102.9310	119.9562	130.9415	142.1940	(45)
Energy content (annual)										Total = Sum(45)m =		1416.1737	(45)
Distribution loss (46)m = 0.15 x (45)m	22.0240	19.2624	19.8770	17.3293	16.6279	14.3486	13.2961	15.2574	15.4397	17.9934	19.6412	21.3291	(46)

Water storage loss:

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Total storage loss

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)

If cylinder contains dedicated solar storage

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss 50.4537	43.9140	46.7843	43.4997	43.1150	39.9487	41.2803	43.1150	43.4997	46.7843	47.0507	50.4537	(61)

Total heat required for water heating calculated for each month

197.2806	172.3297	179.2979	159.0282	153.9674	135.6059	129.9207	144.8312	146.4307	166.7405	177.9922	192.6477	(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

197.2806	172.3297	179.2979	159.0282	153.9674	135.6059	129.9207	144.8312	146.4307	166.7405	177.9922	192.6477	(64)
							Total per year (kWh/year) = Sum(64)m =				1956.0727	(64)

Heat gains from water heating, kWh/month

61.4334	53.6767	55.7568	49.2882	47.6372	41.7932	39.7930	44.5994	45.0995	51.5815	55.3007	59.8929	(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	140.9882	140.9882	140.9882	140.9882	140.9882	140.9882	140.9882	140.9882	140.9882	140.9882	140.9882	140.9882	(66)

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

46.2513	41.0800	33.4085	25.2924	18.9064	15.9615	17.2470	22.4183	30.0898	38.2059	44.5920	47.5368	(67)

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

309.7308	312.9449	304.8456	287.6032	265.8378	245.3814	231.7152	228.5012	236.6005	253.8429	275.6083	296.0647	(68)

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

51.4486	51.4486	51.4486	51.4486	51.4486	51.4486	51.4486	51.4486	51.4486	51.4486	51.4486	51.4486	(69)
Pumps, fans 3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)

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

-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	(71)

Water heating gains (Table 5)

82.5717	79.8761	74.9420	68.4558	64.0284	58.0461	53.4852	59.9454	62.6382	69.3300	76.8066	80.5013	(72)

Total internal gains

539.9986	535.3457	514.6408	482.7961	450.2173	420.8337	403.8922	412.3096	430.7731	462.8235	498.4515	525.5474	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	6.5900	11.2829	0.6300	0.7000	0.7700	22.7237	(75)
Southeast	9.5500	36.7938	0.6300	0.7000	0.7700	107.3866	(77)
Northwest	9.5500	11.2829	0.6300	0.7000	0.7700	32.9304	(81)
Horizontal	1.2100	26.0000	0.6300	0.7000	1.0000	12.4865	(82)

Solar gains 175.5273	322.1383	500.4866	717.3425	890.1257	921.2414	872.5885	738.3127	574.9316	372.3051	214.5000	147.4358	(83)
Total gains 715.5259	857.4839	1015.1274	1200.1386	1340.3430	1342.0751	1276.4806	1150.6224	1005.7047	835.1286	712.9515	672.9832	(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	67.1481	67.2263	67.3031	67.6663	67.7347	68.0549	68.0549	68.1146	67.9313	67.7347	67.5965	67.4526	
alpha	5.4765	5.4818	5.4869	5.5111	5.5156	5.5370	5.5370	5.5410	5.5288	5.5156	5.5064	5.4968	
util living area	0.9989	0.9967	0.9881	0.9478	0.8258	0.6297	0.4676	0.5376	0.8196	0.9779	0.9973	0.9992	(86)
MIT	19.8545	20.0158	20.2821	20.6221	20.8771	20.9781	20.9964	20.9927	20.9129	20.5607	20.1377	19.8208	(87)
Th 2	19.4272	19.4287	19.4302	19.4371	19.4384	19.4444	19.4444	19.4455	19.4421	19.4384	19.4358	19.4330	(88)
util rest of house	0.9982	0.9946	0.9802	0.9141	0.7348	0.4887	0.3045	0.3609	0.6888	0.9567	0.9951	0.9987	(89)
MIT 2	17.9775	18.2135	18.5980	19.0669	19.3556	19.4372	19.4440	19.4445	19.4007	19.0018	18.3973	17.9325	(90)
Living area fraction									fLA = Living area / (4) =			0.3989	(91)
MIT	18.7262	18.9324	19.2698	19.6873	19.9625	20.0519	20.0633	20.0621	20.0039	19.6236	19.0915	18.6857	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7262	18.9324	19.2698	19.6873	19.9625	20.0519	20.0633	20.0621	20.0039	19.6236	19.0915	18.6857	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9977	0.9937	0.9791	0.9208	0.7687	0.5460	0.3702	0.4326	0.7422	0.9601	0.9944	0.9983	(94)
Useful gains	713.8741	852.0533	993.8785	1105.0577	1030.3682	732.7343	472.5430	497.7161	746.4648	801.8030	708.9656	671.8592	(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	2000.1784	1943.3158	1766.4350	1484.1859	1135.6698	745.8266	473.7773	500.5365	809.1360	1240.2791	1651.5810	1999.3613	(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	957.0104	733.3284	574.7820	272.9723	78.3444	0.0000	0.0000	0.0000	0.0000	326.2263	678.6831	987.6615	(98)
Space heating												4609.0084	(98)
Space heating per m2											(98) / (4) =	61.8825	(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 %)												92.8000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4966.6039	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	957.0104	733.3284	574.7820	272.9723	78.3444	0.0000	0.0000	0.0000	0.0000	326.2263	678.6831	987.6615	(98)
Space heating efficiency (main heating system 1)													
	92.8000	92.8000	92.8000	92.8000	92.8000	0.0000	0.0000	0.0000	0.0000	92.8000	92.8000	92.8000	(210)
Space heating fuel (main heating system)													
	1031.2612	790.2246	619.3772	294.1512	84.4229	0.0000	0.0000	0.0000	0.0000	351.5369	731.3395	1064.2904	(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													
	197.2806	172.3297	179.2979	159.0282	153.9674	135.6059	129.9207	144.8312	146.4307	166.7405	177.9922	192.6477	(64)
Efficiency of water heater												83.5000	(216)
(217)m	91.0665	90.8741	90.4059	89.1450	86.4207	83.5000	83.5000	83.5000	83.5000	89.4309	90.7011	91.1431	(217)
Fuel for water heating, kWh/month													
	216.6336	189.6357	198.3256	178.3927	178.1602	162.4022	155.5937	173.4505	175.3661	186.4461	196.2404	211.3684	(219)
Water heating fuel used												2222.0151	(219)
Annual totals kWh/year													
Space heating fuel - main system												4966.6039	(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)												326.7251	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
Total delivered energy for all uses												7590.3441	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4966.6039	3.4800	172.8378	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2222.0151	3.4800	77.3261	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	326.7251	13.1900	43.0950	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1347.0000	13.1900	-177.6693	(252)
Total energy cost			245.4822	(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] =	0.8629	(257)
SAP value		87.9622	
SAP rating (Section 12)		88	(258)
SAP band		B	

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4966.6039	0.2160	1072.7864	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2222.0151	0.2160	479.9553	(264)
Space and water heating			1552.7417	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	326.7251	0.5190	169.5703	(268)
Energy saving/generation technologies				
PV Unit	-1347.0000	0.5190	-699.0930	(269)
Total kg/year			1062.1440	(272)
CO2 emissions per m2			14.2600	(273)
EI value			88.0878	
EI rating			88	(274)
EI band			B	

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9280 = 3.750, stars = 5
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9280 = 0.2328, stars = 4
Water heating energy efficiency	3.48 / 0.8777 = 3.965, stars = 4

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Water heating environmental impact 0.216 / 0.8777 = 0.2461, 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	74.4800 (1b)	x	3.1100 (2b)	=	231.6328	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	74.4800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	231.6328	(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) =	0.1295	(8)
Pressure test		Yes	
Measured/design q50		3.0000	
Infiltration rate		0.2795	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2586	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	3.8000	3.6000	3.5000	3.4000	3.4000	3.0000	3.2000	3.0000	2.9000	3.1000	3.0000	3.4000	(22)
Wind factor	0.9500	0.9000	0.8750	0.8500	0.8500	0.7500	0.8000	0.7500	0.7250	0.7750	0.7500	0.8500	(22a)
Adj infilt rate	0.2456	0.2327	0.2262	0.2198	0.2198	0.1939	0.2068	0.1939	0.1874	0.2004	0.1939	0.2198	(22b)
Effective ac	0.5302	0.5271	0.5256	0.5241	0.5241	0.5188	0.5214	0.5188	0.5176	0.5201	0.5188	0.5241	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Windows (Uw = 1.40)			25.6900	1.3258	34.0587			(27)
Door			2.0000	1.5000	3.0000			(26)
Roof Light (Uw = 1.40)			1.2100	1.3258	1.6042			(27a)
Heat Loss Floor 1			74.4800	0.1100	8.1928			(28a)
External Wall 1	97.0000	27.6900	69.3100	0.1500	10.3965			(29a)
Sheltered Wall	33.5900		33.5900	0.1322	4.4392			(29a)
External Roof 1	15.2200	1.2100	14.0100	0.1100	1.5411			(30)
Total net area of external elements Aum(A, m2)			220.2900					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	63.2325			(33)
Party Wall 1			5.9400	0.0000	0.0000			(32)
Party Ceilings 1			59.2600					(32b)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							450.0000	(35)
Thermal bridges (Default value 0.150 * total exposed area)							33.0435	(36)
Total fabric heat loss					(33) + (36) =		96.2760	(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	40.5252	40.2889	40.1755	40.0653	40.0653	39.6566	39.8546	39.6566	39.5623	39.7540	39.6566	40.0653	(38)
Heat transfer coeff	136.8012	136.5649	136.4515	136.3413	136.3413	135.9325	136.1306	135.9325	135.8383	136.0300	135.9325	136.3413	(39)
Average = Sum(39)m / 12 =												136.2198	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.8368	1.8336	1.8321	1.8306	1.8306	1.8251	1.8277	1.8251	1.8238	1.8264	1.8251	1.8306	(40)
HLP (average)												1.8289	(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		2.3498 (42)
Average daily hot water use (litres/day)		90.0078 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	99.0086	95.4083	91.8080	88.2077	84.6074	81.0070	81.0070	84.6074	88.2077	91.8080	95.4083	99.0086	(44)
Energy conte	146.8269	128.4158	132.5136	115.5285	110.8524	95.6572	88.6404	101.7162	102.9310	119.9562	130.9415	142.1940	(45)
Energy content (annual)										Total = Sum(45)m =		1416.1737	(45)
Distribution loss (46)m = 0.15 x (45)m	22.0240	19.2624	19.8770	17.3293	16.6279	14.3486	13.2961	15.2574	15.4397	17.9934	19.6412	21.3291	(46)

Water storage loss:

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

Total storage loss

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.4537	43.9140	46.7843	43.4997	43.1150	39.9487	41.2803	43.1150	43.4997	46.7843	47.0507	50.4537	(61)

Total heat required for water heating calculated for each month

	197.2806	172.3297	179.2979	159.0282	153.9674	135.6059	129.9207	144.8312	146.4307	166.7405	177.9922	192.6477	(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

	197.2806	172.3297	179.2979	159.0282	153.9674	135.6059	129.9207	144.8312	146.4307	166.7405	177.9922	192.6477	(64)
								Total per year (kWh/year) = Sum(64)m =				1956.0727	(64)

Heat gains from water heating, kWh/month

	61.4334	53.6767	55.7568	49.2882	47.6372	41.7932	39.7930	44.5994	45.0995	51.5815	55.3007	59.8929	(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	140.9882	140.9882	140.9882	140.9882	140.9882	140.9882	140.9882	140.9882	140.9882	140.9882	140.9882	140.9882	(66)

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

	46.2513	41.0800	33.4085	25.2924	18.9064	15.9615	17.2470	22.4183	30.0898	38.2059	44.5920	47.5368	(67)

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

	309.7308	312.9449	304.8456	287.6032	265.8378	245.3814	231.7152	228.5012	236.6005	253.8429	275.6083	296.0647	(68)

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

	51.4486	51.4486	51.4486	51.4486	51.4486	51.4486	51.4486	51.4486	51.4486	51.4486	51.4486	51.4486	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)

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

	-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	-93.9921	(71)

Water heating gains (Table 5)

	82.5717	79.8761	74.9420	68.4558	64.0284	58.0461	53.4852	59.9454	62.6382	69.3300	76.8066	80.5013	(72)

Total internal gains

	539.9986	535.3457	514.6408	482.7961	450.2173	420.8337	403.8922	412.3096	430.7731	462.8235	498.4515	525.5474	(73)

---

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	6.5900	12.4885	0.6300	0.7000	0.7700	25.1517	(75)
Southeast	9.5500	39.0225	0.6300	0.7000	0.7700	113.8911	(77)
Northwest	9.5500	12.4885	0.6300	0.7000	0.7700	36.4490	(81)
Horizontal	1.2100	29.0000	0.6300	0.7000	1.0000	13.9272	(82)

Solar gains	189.4191	313.2190	491.0581	729.6488	882.3442	974.9280	921.1492	798.8981	615.6714	396.1611	239.2759	162.8440	(83)
Total gains	729.4177	848.5647	1005.6989	1212.4449	1332.5615	1395.7617	1325.0414	1211.2078	1046.4445	858.9845	737.7274	688.3915	(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	68.0549	68.1727	68.2294	68.2845	68.2845	68.4899	68.3902	68.4899	68.5374	68.4408	68.4899	68.2845	
alpha	5.5370	5.5448	5.5486	5.5523	5.5523	5.5660	5.5593	5.5660	5.5692	5.5627	5.5660	5.5523	
util living area	0.9982	0.9953	0.9810	0.9083	0.7103	0.4169	0.2465	0.2916	0.6587	0.9497	0.9945	0.9986	(86)
MIT	20.0109	20.1555	20.4348	20.7628	20.9552	20.9981	20.9999	20.9998	20.9780	20.7262	20.3065	19.9861	(87)
Th 2	19.4444	19.4466	19.4476	19.4487	19.4487	19.4525	19.4506	19.4525	19.4534	19.4516	19.4525	19.4487	(88)
util rest of house	0.9969	0.9920	0.9672	0.8500	0.5840	0.2679	0.0874	0.1181	0.4826	0.8997	0.9898	0.9977	(89)
MIT 2	18.2183	18.4298	18.8281	19.2495	19.4285	19.4523	19.4506	19.4525	19.4483	19.2269	18.6543	18.1854	(90)
Living area fraction									fLA = Living area / (4) =			0.3989	(91)
MIT	18.9333	19.1182	19.4690	19.8531	20.0375	20.0689	20.0686	20.0697	20.0585	19.8249	19.3134	18.9037	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9333	19.1182	19.4690	19.8531	20.0375	20.0689	20.0686	20.0697	20.0585	19.8249	19.3134	18.9037	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9962	0.9910	0.9675	0.8679	0.6350	0.3276	0.1509	0.1874	0.5552	0.9152	0.9891	0.9971	(94)
Useful gains	726.6744	840.8908	972.9850	1052.3137	846.1658	457.3213	199.9235	226.9520	581.0130	786.1345	729.7190	686.4185	(95)
Ext temp.	5.6000	6.2000	8.0000	10.5000	13.6000	16.7000	18.6000	18.4000	15.7000	12.2000	8.5000	5.6000	(96)
Heat loss rate W	1824.0171	1764.1731	1564.9643	1275.2187	877.7006	457.9443	199.9281	226.9686	592.0521	1037.2198	1469.8900	1813.8481	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	816.4230	620.4457	440.4326	160.4916	23.4619	0.0000	0.0000	0.0000	0.0000	186.8075	532.9231	838.8076	(98)
Space heating												3619.7929	(98)
Space heating per m2											(98) / (4) =	48.6009	(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 %)												92.8000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3900.6389	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	816.4230	620.4457	440.4326	160.4916	23.4619	0.0000	0.0000	0.0000	0.0000	186.8075	532.9231	838.8076	(98)
Space heating efficiency (main heating system 1)													
	92.8000	92.8000	92.8000	92.8000	92.8000	0.0000	0.0000	0.0000	0.0000	92.8000	92.8000	92.8000	(210)
Space heating fuel (main heating system)													
	879.7661	668.5837	474.6041	172.9436	25.2822	0.0000	0.0000	0.0000	0.0000	201.3012	574.2706	903.8875	(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													
	197.2806	172.3297	179.2979	159.0282	153.9674	135.6059	129.9207	144.8312	146.4307	166.7405	177.9922	192.6477	(64)
Efficiency of water heater												83.5000	(216)
(217)m	90.8312	90.6064	89.9030	87.9260	84.6214	83.5000	83.5000	83.5000	83.5000	88.1687	90.2824	90.9089	(217)
Fuel for water heating, kWh/month													
	217.1948	190.1960	199.4348	180.8661	181.9485	162.4022	155.5937	173.4505	175.3661	189.1153	197.1505	211.9130	(219)
Water heating fuel used												2234.6315	(219)
Annual totals kWh/year													
Space heating fuel - main system												3900.6389	(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)												326.7251	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
Total delivered energy for all uses												6536.9955	(238)

10a. Fuel costs - using BEDF prices (410)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3900.6389	4.2000	163.8268	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2234.6315	4.2000	93.8545	(247)
Pumps and fans for heating	75.0000	15.5400	11.6550	(249)
Energy for lighting	326.7251	15.5400	50.7731	(250)
Additional standing charges			90.0000	(251)
Energy saving/generation technologies				
PV Unit	-1347.0000	15.5400	-209.3238	(252)
Total energy cost			200.7856	(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	3900.6389	0.2160	842.5380	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2234.6315	0.2160	482.6804	(264)
Space and water heating			1325.2184	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	326.7251	0.5190	169.5703	(268)
Energy saving/generation technologies				
PV Unit	-1347.0000	0.5190	-699.0930	(269)
Total kg/year			834.6207	(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	3900.6389	1.2200	4758.7795	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2234.6315	1.2200	2726.2504	(264)
Space and water heating			7485.0299	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	326.7251	3.0700	1003.0461	(268)
Energy saving/generation technologies				
PV Unit	-1347.0000	3.0700	-4135.2900	(269)
Primary energy kWh/year			4583.0360	(272)
Primary energy kWh/m2/year			61.5338	(273)

SAP 2012 EPC IMPROVEMENTS

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

Current energy efficiency rating: B 88
Current environmental impact rating: B 88

(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: B 88
Potential environmental impact rating: B 88

Fuel prices for cost data on this page from database revision number 410 TEST (03 Apr 2017)
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	£62	£62	£0
Mains gas	£348	£348	£0
Space heating	£265	£265	£0
Water heating	£94	£94	£0
Lighting	£51	£51	£0
Generated (PV)	-£209	-£209	£0
Total cost of fuels	£201	£201	£0
Total cost of uses	£201	£201	£0
Delivered energy	88 kWh/m²	88 kWh/m²	0 kWh/m²
Carbon dioxide emissions	0.8 tonnes	0.8 tonnes	0.0 tonnes
CO2 emissions per m²	11 kg/m²	11 kg/m²	0 kg/m²
Primary energy	62 kWh/m²	62 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

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

No improvements selected / applicable

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

Overheating Calculation Input Data

Dwelling type	EndTerrace Flat
Number of storeys	1
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	South West
Oversha ding	Average or unknown
Thermal mass parameter	450.0
Night ventilation	No
Ventilation rate during hot weather (ach)	3.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	229.32 (P1)
Transmission heat loss coefficient	96.28 (37)
Summer heat loss coefficient	325.59 (P2)

Overhangs

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

Solar shading

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

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North East	6.5900	98.8453	0.6300	0.7000	0.9000	232.6831
South East	9.5500	119.9223	0.6300	0.7000	0.9000	409.0978
North West	9.5500	98.8453	0.6300	0.7000	0.9000	337.1964
Horizontal	1.2100	203.0000	0.6300	0.7000	1.0000	97.4905
total:						1076.4678

	Jun	Jul	Aug	
Solar gains	1149	1076	931	(P3)
Internal gains	418	401	409	
Total summer gains	1567	1477	1340	(P5)
Summer gain/loss ratio	4.81	4.54	4.12	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 450.0)	0.00	0.00	0.00	
Threshold temperature	20.81	22.44	21.92	(P7)
Likelihood of high internal temperature	Slight	Medium	Slight	
Assessment of likelihood of high internal temperature:	Medium			

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

Design SAP
elmhurst energy

Property Reference	Refurbished Updated	**Issued on Date**	21/09/2017
Survey Reference	Updated Flat 3 - Be Lean/Clean	**Prop Type Ref**	67B Barnes High Street
Property	67b, Barnes High Street, LONDON, SW13 9LD		

SAP Rating	82 B	**DER**	20.70	**TER**	16.11
Environmental	86 B	**% DER<TER**	-28.45		
CO_2 Emissions (t/year)	1.00	**DFEE**	49.00	**TFEE**	32.51
General Requirements Compliance	Fail	**% DFEE<TFEE**	-50.73		

Surveyor	admin Admin, Tel: 4, Fax: s@l.f	**Surveyor ID**	Admin
Client			

SAP2012 - 9.92 input data (DesignData) -

```
SAP2012 Input Data (Flat)      21/09/2017

FullRefNo:                     Updated Flat 3 - Be Lean/Clean

Regs Region:                   England
SAP Region:                    Thames Valley
Postcode:                      SW13 9LD
DwellingOrientation:           North West
Property Type:                 Flat, End-Terrace
Storeys:                       1
Date Built:                    2017
Sheltered Sides:               1
Sunlight Shade:                Average or unknown
Measurements                   Perimeter, Floor Area, Storey Height
     1st Storey:               27.32, 62.35, 2.29
Living Area:                   25.72 m2, fraction: 41.3%
Thermal Mass:                  Simple calculation
Thermal Mass Simple:           High
Thermal MassValue:             450
External Walls                 Nett Area, Gross Area, Kappa, Element, Construction, Type, ShelterFactor, UValueFinal
External Wall 1                43.47, 52.51, 190, CavityWallDensePlasterDenseBlock, Cavity, 0, 0.45, Gross
Sheltered Wall                 10.05, 10.05, 190, CavityWallDensePlasterDenseBlock, Cavity, 0.9, 0.320284697508897, Gross
Party Walls                    Area, Kappa, Element, Construction, Type, ShelterFactor, UValueFinal
Party Wall 1                   28.01, 180, PartyWallDensePlaster, Solid, 0, 0
External Roofs                 Nett Area, Gross Area, Kappa, Construction, Element, UValueFinal
Party Ceilings                 Area, Kappa, Construction, Element
     Party Ceilings 1          62.35, 40, Precast concrete planks floor, screed, carpeted
Heat Loss Floors               Area, Kappa, Construction, Element, Type, ShelterFactor, UValueFinal
     Heat Loss Floor 1         5.57, 110, Other, Exposed Floor - Solid, 2.0, 0.055
Party Floors                   Area, Kappa, Construction, Element
     Party Floor 1             56.78, 0
Description                    Data Source, Type, Glazing, Glazing Gap, Argon Filled, Solar Trans, Frame Type, Frame Factor, U Value
     Windows                   Manufacturer, Window, Double Low-E Soft 0.1, , , 0.63, , 0.7,
     Roof Light                Manufacturer, Roof Window, Double Low-E Soft 0.1, , , 0.63, , 0.7,
     Door                      Manufacturer, Solid Door, , , , , , ,
Openings                       Opening Type, Location, Orientation, Pitch, Curtain Type, Overhang Ratio, Wide Overhang, Width, Height, Count, Area, Curtain Closed
     NE Facing                 Window, External Wall 1, North East, , None, 0, , 0, 0, 0, 0.80,
     Door                      Solid Door, External Wall 1, North West, , , , , 0, 0, 0, 2.00,
     SW Facing                 Window, External Wall 1, South West, , None, 0, , 0, 0, 0, 6.24,
Conservatory:                  None
Draught Proofing:              100
Draught Lobby:                 No
Thermal Bridges
     Bridging:                 Default
     Y                         0.15
Pressure Test:                 True
Designed q50:                  5
AsBuilt q50:                   15
Property Tested:               False
Mechanical Ventilation         None
Chimneys MHS:                  0
Chimneys SHS:                  0
Chimneys Other:                0
Chimneys Total:                0
Open Flues MHS:                0
Open Flues SHS:                0
Open Flues Other:              0
Open Flues Total:              0
Intermittent Fans:             2
Passive Vents:                 0
Flueless Gas Fires:            0
Cooling System                 None
Light Fittings:                15
LEL Fittings:                  15
Percentage of LEL Fittings:    100
External Lights Fitted:        Yes
External LELs Fitted:          No
Electricity Tariff:            Standard
Main Heating 1
     Description               tbc
     Percentage                100
     MHS                       Mains gas BGW Post 98 Combi condens. with auto ign.
     SAP Code                  104
     Boiler Efficiency Type    Sedbuk 2009
     Efficiency                92
     Model Name                tbc
     Manufacturer              tbc
     Controls by PCDF          0
     MHS Controls              CBI Time and temperature zone control
     Boiler Interlock          Yes
```

SAP2012 - 9.92 input data (DesignData) -

Compensator	0
Delayed Start Stat	No
Ctrl SAP Code	2110
Burner Control	OnOff
Flue Type	Balanced
Fan Assisted Flue	Yes
Pumped	Pump in heated space
Heat Pump Age	2013 or later
Heat Emitter	Radiators
Flow Temperature	Normal (> 45°C)
Combi boiler type	Standard Combi
Combi keep hot type	None
Main Heating 2	None
Heating Systems Interaction	Each system heats separate parts of dwelling
Smoke Control Area	Unknown
Community Heating	None
Secondary Heating	None
Water Heating	
Type	MainHeating1
WHS	HWP From main heating 1
Low Water Usage	Yes
SAP Code	901
Showers in Property	Non-electric only
Hot Water Cylinder	None
Flue Gas Heat Recovery System	None
Waste Water Heat Recovery	none
PV Unit	None
Wind Turbine	None
Terrain Type:	Urban
Small Scale Hydro	None
Special Features	None

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

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DWELLING AS DESIGNED

Mid-floor flat, total floor area 62 m²

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

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 16.11 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 20.70 kgCO□/m²Fail
Excess emissions =4.59 kgCO□/m² (28.5%)

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)32.5 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)49.0 kWh/m²/yrFail
Excess energy =16.5 kWh/m²/yr (50.8%)

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2 Fabric U-values

Element	Average	Highest	
External wall	0.43 (max. 0.30)	0.45 (max. 0.70)	Fail
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.06 (max. 0.25)	0.06 (max. 0.70)	OK
Roof	(no roof)		
Openings	1.42 (max. 2.00)	1.50 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated using default y-value of 0.15

---

3 Air permeability
Air permeability at 50 pascals: 5.00 (design value)
Maximum 10.0 OK

---

4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from manufacturer
tbc tbc
Combi boiler
Efficiency: 92.0% 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

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9 Summertime temperature
Overheating risk (Thames Valley): Slight OK

SAP2012 - 9.92 input data (DesignData) -

Based on:	
Overshading:	Average
Windows facing North East:	0.80 m², No overhang
Windows facing South West:	6.24 m², No overhang
Air change rate:	3.00 ach
Blinds/curtains:	None

10 Key features	
Party wall U-value	0.00 W/m²K
Exposed floor U-value	0.11 W/m²K

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	62.3500 (1b)	x	2.2900 (2b)	=	142.7815	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	62.3500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	142.7815	(5)

2. Ventilation rate

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

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1401	(8)
Pressure test		Yes	
Measured/design q50		5.0000	
Infiltration rate		0.3901	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3608	(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	0.4600	0.4510	0.4420	0.3969	0.3879	0.3428	0.3428	0.3338	0.3608	0.3879	0.4059	0.4240	(22b)
Effective ac	0.6058	0.6017	0.5977	0.5788	0.5752	0.5587	0.5587	0.5557	0.5651	0.5752	0.5824	0.5899	(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	
Windows (Uw = 1.40)			7.0400	1.3258	9.3333			(27)
Door			2.0000	1.5000	3.0000			(26)
Heat Loss Floor 1			5.5700	0.0550	0.3064			(28b)
External Wall 1	52.5100	9.0400	43.4700	0.4500	19.5615			(29a)
Sheltered Wall	10.0500		10.0500	0.3203	3.2189			(29a)
Total net area of external elements Aum(A, m2)			68.1300					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	35.4200			(33)
Party Wall 1			28.0100	0.0000	0.0000			(32)
Party Floor 1			56.7800					(32d)
Party Ceilings 1			62.3500					(32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	450.0000	(35)
Thermal bridges (Default value 0.150 * total exposed area)	10.2195	(36)
Total fabric heat loss (33) + (36) =	45.6395	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	28.5450	28.3514	28.1616	27.2702	27.1034	26.3270	26.3270	26.1833	26.6261	27.1034	27.4408	27.7935	(38)
Heat transfer coeff	74.1845	73.9909	73.8011	72.9097	72.7430	71.9666	71.9666	71.8228	72.2656	72.7430	73.0803	73.4331	(39)
Average = Sum(39)m / 12 =												72.9089	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1898	1.1867	1.1837	1.1694	1.1667	1.1542	1.1542	1.1519	1.1590	1.1667	1.1721	1.1778	(40)
HLP (average)												1.1693	(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	2.0472 (42)
Average daily hot water use (litres/day)	82.8219 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	91.1041	87.7912	84.4784	81.1655	77.8526	74.5397	74.5397	77.8526	81.1655	84.4784	87.7912	91.1041	(44)
Energy conte	135.1048	118.1635	121.9341	106.3051	102.0023	88.0202	81.5637	93.5955	94.7134	110.3793	120.4876	130.8417	(45)
Energy content (annual)										Total = Sum(45)m =		1303.1113	(45)
Distribution loss (46)m = 0.15 x (45)m	20.2657	17.7245	18.2901	15.9458	15.3003	13.2030	12.2346	14.0393	14.2070	16.5569	18.0731	19.6263	(46)
Water storage loss:													
Total storage loss													

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	46.4257	40.4080	43.0492	40.0268	39.6728	36.7593	37.9846	39.6728	40.0268	43.0492	43.2943	46.4257	(61)
Total heat required for water heating calculated for each month													
	181.5304	158.5715	164.9834	146.3319	141.6751	124.7796	119.5483	133.2684	134.7402	153.4285	163.7819	177.2674	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	181.5304	158.5715	164.9834	146.3319	141.6751	124.7796	119.5483	133.2684	134.7402	153.4285	163.7819	177.2674	(64)
								Total per year (kWh/year) = Sum(64)m =				1799.9066	(64)
Heat gains from water heating, kWh/month													
	56.5287	49.3914	51.3054	45.3532	43.8340	38.4566	36.6161	41.0387	41.4989	47.4634	50.8857	55.1113	(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	102.3619	102.3619	102.3619	102.3619	102.3619	102.3619	102.3619	102.3619	102.3619	102.3619	102.3619	102.3619	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	17.9353	15.9299	12.9551	9.8078	7.3315	6.1895	6.6880	8.6933	11.6682	14.8154	17.2918	18.4337	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	178.8324	180.6881	176.0118	166.0564	153.4894	141.6783	133.7877	131.9320	136.6084	146.5638	159.1307	170.9418	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	33.2362	33.2362	33.2362	33.2362	33.2362	33.2362	33.2362	33.2362	33.2362	33.2362	33.2362	33.2362	(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)													
	-81.8895	-81.8895	-81.8895	-81.8895	-81.8895	-81.8895	-81.8895	-81.8895	-81.8895	-81.8895	-81.8895	-81.8895	(71)
Water heating gains (Table 5)													
	75.9795	73.4991	68.9589	62.9905	58.9166	53.4119	49.2152	55.1596	57.6373	63.7949	70.6746	74.0743	(72)
Total internal gains													
	329.4557	326.8257	314.6343	295.5633	276.4461	257.9883	246.3995	252.4935	262.6225	281.8827	303.8057	320.1585	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	0.8000	11.2829	0.6300	0.7000	0.7700	2.7586	(75)
Southwest	6.2400	36.7938	0.6300	0.7000	0.7700	70.1668	(79)

Solar gains	72.9253	125.1351	173.6491	219.2391	249.2896	249.1248	239.5013	216.8318	189.3984	138.9572	87.5146	62.3009	(83)
Total gains	402.3811	451.9608	488.2835	514.8024	525.7358	507.1131	485.9008	469.3254	452.0209	420.8399	391.3203	382.4594	(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	105.0590	105.3339	105.6048	106.8959	107.1410	108.2968	108.2968	108.5136	107.8486	107.1410	106.6463	106.1341	
alpha	8.0039	8.0223	8.0403	8.1264	8.1427	8.2198	8.2198	8.2342	8.1899	8.1427	8.1098	8.0756	
util living area													
	0.9999	0.9997	0.9990	0.9947	0.9682	0.8440	0.6448	0.6919	0.9296	0.9962	0.9997	0.9999	(86)
MIT	20.2315	20.3205	20.4647	20.6592	20.8458	20.9700	20.9969	20.9948	20.9277	20.6894	20.4251	20.2170	(87)
Th 2	19.9282	19.9307	19.9331	19.9446	19.9467	19.9568	19.9568	19.9586	19.9529	19.9467	19.9424	19.9378	(88)
util rest of house													
	0.9999	0.9996	0.9983	0.9903	0.9398	0.7394	0.4964	0.5429	0.8593	0.9922	0.9995	0.9999	(89)
MIT 2	18.9096	19.0418	19.2546	19.5462	19.8040	19.9425	19.9563	19.9576	19.9063	19.5929	19.2044	18.8960	(90)
Living area fraction									fLA = Living area / (4) =			0.4125	(91)
MIT	19.4549	19.5693	19.7538	20.0053	20.2337	20.3664	20.3855	20.3854	20.3276	20.0452	19.7080	19.4409	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.4549	19.5693	19.7538	20.0053	20.2337	20.3664	20.3855	20.3854	20.3276	20.0452	19.7080	19.4409	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9998	0.9995	0.9981	0.9907	0.9493	0.7844	0.5585	0.6058	0.8892	0.9928	0.9994	0.9999	(94)
Useful gains	402.3118	451.7269	487.3648	509.9970	499.1036	397.7656	271.3986	284.3214	401.9467	417.7930	391.1033	382.4162	(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													
	1124.2587	1085.3951	978.1439	809.6860	620.7685	414.9851	272.4328	286.2457	450.0438	687.0708	921.3941	1119.1892	(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													
	537.1285	425.8250	365.1396	215.7761	90.5187	0.0000	0.0000	0.0000	0.0000	200.3427	381.8094	548.1591	(98)
Space heating												2764.6991	(98)
Space heating per m2											(98) / (4) =	44.3416	(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 %)												92.8000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												2979.2016	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	537.1285	425.8250	365.1396	215.7761	90.5187	0.0000	0.0000	0.0000	0.0000	200.3427	381.8094	548.1591	(98)
Space heating efficiency (main heating system 1)													
	92.8000	92.8000	92.8000	92.8000	0.0000	0.0000	0.0000	0.0000	92.8000	92.8000	92.8000		(210)
Space heating fuel (main heating system)													
	578.8023	458.8632	393.4694	232.5173	97.5417	0.0000	0.0000	0.0000	0.0000	215.8865	411.4326	590.6887	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	181.5304	158.5715	164.9834	146.3319	141.6751	124.7796	119.5483	133.2684	134.7402	153.4285	163.7819	177.2674	(64)
Efficiency of water heater												83.5000	(216)
(217)m	90.2607	90.0777	89.6911	88.8031	86.8948	83.5000	83.5000	83.5000	83.5000	88.5240	89.7977	90.3412	(217)
Fuel for water heating, kWh/month													
	201.1180	176.0385	183.9462	164.7825	163.0421	149.4366	143.1716	159.6028	161.3655	173.3186	182.3900	196.2198	(219)
Water heating fuel used												2054.4323	(219)
Annual totals kWh/year													
Space heating fuel - main system												2979.2016	(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)												316.7423	(232)
Total delivered energy for all uses												5425.3762	(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	2979.2016	0.2160	643.5075	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2054.4323	0.2160	443.7574	(264)
Space and water heating			1087.2649	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	316.7423	0.5190	164.3892	(268)
Total CO2, kg/year			1290.5792	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			20.7000	(273)

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

DER		20.7000	ZC1
Total Floor Area	TFA	62.3500	
Assumed number of occupants	N	2.0472	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		16.9964	ZC2
CO2 emissions from cooking, equation (L16)		2.6966	ZC3
Total CO2 emissions		40.3930	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		40.3930	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	62.3500 (1b)	x	2.2900 (2b)	=	142.7815	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	62.3500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	142.7815	(5)

2. Ventilation rate

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

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1401	(8)
Pressure test		Yes	
Measured/design q50		5.0000	
Infiltration rate		0.3901	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3608	(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	0.4600	0.4510	0.4420	0.3969	0.3879	0.3428	0.3428	0.3338	0.3608	0.3879	0.4059	0.4240	(22b)
Effective ac	0.6058	0.6017	0.5977	0.5788	0.5752	0.5587	0.5587	0.5557	0.5651	0.5752	0.5824	0.5899	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.0000	1.0000	2.0000			(26)
TER Opening Type (Uw = 1.40)			7.0400	1.3258	9.3333			(27)
Heat Loss Floor 1			5.5700	0.1300	0.7241			(28b)
External Wall 1	52.5100	9.0400	43.4700	0.1800	7.8246			(29a)
Sheltered Wall	10.0500		10.0500	0.1800	1.8090			(29a)
Total net area of external elements Aum(A, m2)			68.1300					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	21.6910			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (User defined value 0.050 * total exposed area)	3.4065	(36)
Total fabric heat loss (33) + (36) =	25.0975	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	28.5450	28.3514	28.1616	27.2702	27.1034	26.3270	26.3270	26.1833	26.6261	27.1034	27.4408	27.7935	(38)
Heat transfer coeff	53.6425	53.4489	53.2591	52.3677	52.2009	51.4246	51.4246	51.2808	51.7236	52.2009	52.5383	52.8911	(39)
Average = Sum(39)m / 12 =												52.3669	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.8603	0.8572	0.8542	0.8399	0.8372	0.8248	0.8248	0.8225	0.8296	0.8372	0.8426	0.8483	(40)
HLP (average)												0.8399	(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	2.0472 (42)
Average daily hot water use (litres/day)	82.8219 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	91.1041	87.7912	84.4784	81.1655	77.8526	74.5397	74.5397	77.8526	81.1655	84.4784	87.7912	91.1041	(44)
Energy conte	135.1048	118.1635	121.9341	106.3051	102.0023	88.0202	81.5637	93.5955	94.7134	110.3793	120.4876	130.8417	(45)
Energy content (annual)										Total = Sum(45)m =		1303.1113	(45)
Distribution loss (46)m = 0.15 x (45)m	20.2657	17.7245	18.2901	15.9458	15.3003	13.2030	12.2346	14.0393	14.2070	16.5569	18.0731	19.6263	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Combi loss	46.4257	40.4080	43.0492	40.0268	39.6728	36.7593	37.9846	39.6728	40.0268	43.0492	43.2943	46.4257	(61)
Total heat required for water heating calculated for each month													
	181.5304	158.5715	164.9834	146.3319	141.6751	124.7796	119.5483	133.2684	134.7402	153.4285	163.7819	177.2674	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	181.5304	158.5715	164.9834	146.3319	141.6751	124.7796	119.5483	133.2684	134.7402	153.4285	163.7819	177.2674	(64)
									Total per year (kWh/year) = Sum(64)m =			1799.9066	(64)
Heat gains from water heating, kWh/month													
	56.5287	49.3914	51.3054	45.3532	43.8340	38.4566	36.6161	41.0387	41.4989	47.4634	50.8857	55.1113	(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	102.3619	102.3619	102.3619	102.3619	102.3619	102.3619	102.3619	102.3619	102.3619	102.3619	102.3619	102.3619	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	17.9353	15.9299	12.9551	9.8078	7.3315	6.1895	6.6880	8.6933	11.6682	14.8154	17.2918	18.4337	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	178.8324	180.6881	176.0118	166.0564	153.4894	141.6783	133.7877	131.9320	136.6084	146.5638	159.1307	170.9418	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	33.2362	33.2362	33.2362	33.2362	33.2362	33.2362	33.2362	33.2362	33.2362	33.2362	33.2362	33.2362	(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)													
	-81.8895	-81.8895	-81.8895	-81.8895	-81.8895	-81.8895	-81.8895	-81.8895	-81.8895	-81.8895	-81.8895	-81.8895	(71)
Water heating gains (Table 5)													
	75.9795	73.4991	68.9589	62.9905	58.9166	53.4119	49.2152	55.1596	57.6373	63.7949	70.6746	74.0743	(72)
Total internal gains													
	329.4557	326.8257	314.6343	295.5633	276.4461	257.9883	246.3995	252.4935	262.6225	281.8827	303.8057	320.1585	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	0.8000	11.2829	0.6300	0.7000	0.7700	2.7586	(75)
Southwest	6.2400	36.7938	0.6300	0.7000	0.7700	70.1668	(79)

Solar gains	72.9253	125.1351	173.6491	219.2391	249.2896	249.1248	239.5013	216.8318	189.3984	138.9572	87.5146	62.3009	(83)
Total gains	402.3811	451.9608	488.2835	514.8024	525.7358	507.1131	485.9008	469.3254	452.0209	420.8399	391.3203	382.4594	(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	80.7170	81.0094	81.2980	82.6819	82.9460	84.1983	84.1983	84.4343	83.7115	82.9460	82.4134	81.8638	
alpha	6.3811	6.4006	6.4199	6.5121	6.5297	6.6132	6.6132	6.6290	6.5808	6.5297	6.4942	6.4576	
util living area													
	0.9967	0.9922	0.9800	0.9386	0.8302	0.6354	0.4641	0.5000	0.7474	0.9500	0.9919	0.9975	(86)
MIT	20.2132	20.3443	20.5323	20.7598	20.9218	20.9890	20.9988	20.9980	20.9695	20.7715	20.4541	20.1918	(87)
Th 2	20.2013	20.2040	20.2066	20.2189	20.2212	20.2319	20.2319	20.2339	20.2278	20.2212	20.2165	20.2117	(88)
util rest of house													
	0.9956	0.9898	0.9736	0.9196	0.7850	0.5650	0.3840	0.4181	0.6794	0.9306	0.9889	0.9968	(89)
MIT 2	19.1477	19.3403	19.6129	19.9399	20.1461	20.2246	20.2314	20.2331	20.2048	19.9624	19.5104	19.1246	(90)
Living area fraction									fLA = Living area / (4) =			0.4125	(91)
MIT	19.5873	19.7545	19.9922	20.2781	20.4661	20.5399	20.5480	20.5486	20.5202	20.2962	19.8997	19.5649	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.5873	19.7545	19.9922	20.2781	20.4661	20.5399	20.5480	20.5486	20.5202	20.2962	19.8997	19.5649	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9946	0.9881	0.9716	0.9212	0.8001	0.5938	0.4171	0.4520	0.7063	0.9327	0.9874	0.9959	(94)
Useful gains	400.1890	446.5919	474.3956	474.2596	420.6444	301.1160	202.6535	212.1295	319.2587	392.5371	386.3737	380.8955	(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													
	820.0467	793.9556	718.5820	595.8461	457.5963	305.4590	203.0223	212.7445	332.0782	506.1489	672.4738	812.6636	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	312.3741	233.4284	181.6747	87.5423	27.4922	0.0000	0.0000	0.0000	0.0000	84.5272	205.9920	321.2354	(98)
Space heating												1454.2663	(98)
Space heating per m2											(98) / (4) =	23.3242	(99)

8c. Space cooling requirement

Not applicable

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

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												1557.0303	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	312.3741	233.4284	181.6747	87.5423	27.4922	0.0000	0.0000	0.0000	0.0000	84.5272	205.9920	321.2354	(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)													
	334.4476	249.9233	194.5125	93.7284	29.4349	0.0000	0.0000	0.0000	0.0000	90.5002	220.5482	343.9352	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	181.5304	158.5715	164.9834	146.3319	141.6751	124.7796	119.5483	133.2684	134.7402	153.4285	163.7819	177.2674	(64)
Efficiency of water heater												80.3000	(216)
(217)m	86.4056	86.0232	85.2942	83.8048	81.7850	80.3000	80.3000	80.3000	80.3000	83.6186	85.6296	86.5298	(217)
Fuel for water heating, kWh/month													
	210.0911	184.3358	193.4286	174.6106	173.2288	155.3917	148.8771	165.9631	167.7960	183.4861	191.2680	204.8628	(219)
Water heating fuel used												2153.3397	(219)
Annual totals kWh/year													
Space heating fuel - main system												1557.0303	(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)												316.7423	(232)
Total delivered energy for all uses												4102.1122	(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	1557.0303	0.2160	336.3185	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2153.3397	0.2160	465.1214	(264)
Space and water heating			801.4399	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	316.7423	0.5190	164.3892	(268)
Total CO2, kg/m2/year			1004.7542	(272)
Emissions per m2 for space and water heating			12.8539	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.6366	(272b)
Emissions per m2 for pumps and fans			0.6243	(272c)
Target Carbon Dioxide Emission Rate (TER) = (12.8539 * 1.00) + 2.6366 + 0.6243, rounded to 2 d.p.			16.1100	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	62.3500 (1b)	x	2.2900 (2b)	=	142.7815	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	62.3500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	142.7815	(5)

2. Ventilation rate

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

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1401	(8)
Pressure test		Yes	
Measured/design q50		5.0000	
Infiltration rate		0.3901	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3608	(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	0.4600	0.4510	0.4420	0.3969	0.3879	0.3428	0.3428	0.3338	0.3608	0.3879	0.4059	0.4240	(22b)
Effective ac	0.6058	0.6017	0.5977	0.5788	0.5752	0.5587	0.5587	0.5557	0.5651	0.5752	0.5824	0.5899	(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	
Windows (Uw = 1.40)			7.0400	1.3258	9.3333			(27)
Door			2.0000	1.5000	3.0000			(26)
Heat Loss Floor 1			5.5700	0.0550	0.3064			(28b)
External Wall 1	52.5100	9.0400	43.4700	0.4500	19.5615			(29a)
Sheltered Wall	10.0500		10.0500	0.3203	3.2189			(29a)
Total net area of external elements Aum(A, m2)			68.1300					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	35.4200			(33)
Party Wall 1			28.0100	0.0000	0.0000			(32)
Party Floor 1			56.7800					(32d)
Party Ceilings 1			62.3500					(32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	450.0000	(35)
Thermal bridges (Default value 0.150 * total exposed area)	10.2195	(36)
Total fabric heat loss (33) + (36) =	45.6395	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	28.5450	28.3514	28.1616	27.2702	27.1034	26.3270	26.3270	26.1833	26.6261	27.1034	27.4408	27.7935	(38)
Heat transfer coeff	74.1845	73.9909	73.8011	72.9097	72.7430	71.9666	71.9666	71.8228	72.2656	72.7430	73.0803	73.4331	(39)
Average = Sum(39)m / 12 =												72.9089	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1898	1.1867	1.1837	1.1694	1.1667	1.1542	1.1542	1.1519	1.1590	1.1667	1.1721	1.1778	(40)
HLP (average)												1.1693	(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	2.0472	(42)
Average daily hot water use (litres/day)	82.8219	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	91.1041	87.7912	84.4784	81.1655	77.8526	74.5397	74.5397	77.8526	81.1655	84.4784	87.7912	91.1041	(44)
Energy conte	135.1048	118.1635	121.9341	106.3051	102.0023	88.0202	81.5637	93.5955	94.7134	110.3793	120.4876	130.8417	(45)
Energy content (annual)										Total = Sum(45)m =		1303.1113	(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													

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(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													
	28.7098	25.1097	25.9110	22.5898	21.6755	18.7043	17.3323	19.8890	20.1266	23.4556	25.6036	27.8039	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	102.3619	102.3619	102.3619	102.3619	102.3619	102.3619	102.3619	102.3619	102.3619	102.3619	102.3619	102.3619	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	17.9353	15.9299	12.9551	9.8078	7.3315	6.1895	6.6880	8.6933	11.6682	14.8154	17.2918	18.4337	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	178.8324	180.6881	176.0118	166.0564	153.4894	141.6783	133.7877	131.9320	136.6084	146.5638	159.1307	170.9418	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	33.2362	33.2362	33.2362	33.2362	33.2362	33.2362	33.2362	33.2362	33.2362	33.2362	33.2362	33.2362	(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)													
	-81.8895	-81.8895	-81.8895	-81.8895	-81.8895	-81.8895	-81.8895	-81.8895	-81.8895	-81.8895	-81.8895	-81.8895	(71)
Water heating gains (Table 5)													
	38.5884	37.3657	34.8266	31.3748	29.1337	25.9782	23.2961	26.7326	27.9536	31.5263	35.5606	37.3708	(72)
Total internal gains													
	289.0646	287.6923	277.5021	260.9476	243.6632	227.5546	217.4804	221.0665	229.9387	246.6141	265.6917	280.4549	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	0.8000	11.2829	0.6300	0.7000	0.7700	2.7586	(75)
Southwest	6.2400	36.7938	0.6300	0.7000	0.7700	70.1668	(79)

Solar gains	72.9253	125.1351	173.6491	219.2391	249.2896	249.1248	239.5013	216.8318	189.3984	138.9572	87.5146	62.3009	(83)
Total gains	361.9900	412.8274	451.1512	480.1867	492.9529	476.6794	456.9817	437.8984	419.3371	385.5713	353.2063	342.7559	(84)

7. Mean internal temperature (heating season)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
tau	105.0590	105.3339	105.6048	106.8959	107.1410	108.2968	108.2968	108.5136	107.8486	107.1410	106.6463	106.1341	
alpha	8.0039	8.0223	8.0403	8.1264	8.1427	8.2198	8.2198	8.2342	8.1899	8.1427	8.1098	8.0756	
util living area													
	1.0000	0.9999	0.9994	0.9967	0.9782	0.8756	0.6821	0.7348	0.9517	0.9980	0.9999	1.0000	(86)
MIT	20.1944	20.2846	20.4308	20.6284	20.8210	20.9602	20.9954	20.9921	20.9082	20.6576	20.3901	20.1805	(87)
Th 2	19.9282	19.9307	19.9331	19.9446	19.9467	19.9568	19.9568	19.9586	19.9529	19.9467	19.9424	19.9378	(88)
util rest of house													
	0.9999	0.9998	0.9990	0.9939	0.9568	0.7773	0.5273	0.5808	0.8950	0.9957	0.9998	1.0000	(89)
MIT 2	19.1956	19.2879	19.4361	19.6426	19.8286	19.9430	19.9562	19.9575	19.9090	19.6741	19.4036	19.1900	(90)
Living area fraction									fLA = Living area / (4) =			0.4125	(91)
MIT	19.6077	19.6991	19.8464	20.0492	20.2380	20.3626	20.3849	20.3842	20.3212	20.0798	19.8105	19.5986	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.6077	19.6991	19.8464	20.0492	20.2380	20.3626	20.3849	20.3842	20.3212	20.0798	19.8105	19.5986	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9999	0.9998	0.9990	0.9943	0.9642	0.8202	0.5926	0.6465	0.9195	0.9961	0.9998	1.0000	(94)
Useful gains	361.9638	412.7247	450.6918	477.4379	475.3240	390.9774	270.8095	283.1152	385.5991	384.0695	353.1202	342.7403	(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													
	1135.5911	1094.9971	984.9795	812.8887	621.0800	414.7118	272.3875	286.1600	449.5772	689.5911	928.8877	1130.7665	(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													
	575.5787	458.4870	397.5100	241.5246	108.4425	0.0000	0.0000	0.0000	0.0000	227.3081	414.5526	586.2915	(98)
Space heating												3009.6951	(98)
Space heating per m2											(98) / (4) =	48.2710	(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	676.4859	532.5527	545.8534	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8608	0.9417	0.9225	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	582.2966	501.5108	503.5345	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	634.3725	609.9113	589.0947	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	37.4946	80.6500	63.6568	0.0000	0.0000	0.0000	0.0000	(104)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Space cooling												181.8014 (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	9.3737	20.1625	15.9142	0.0000	0.0000	0.0000		0.0000 (107)
Space cooling												45.4503 (107)
Space cooling per m2												0.7290 (108)
Energy for space heating												48.2710 (99)
Energy for space cooling												0.7290 (108)
Total												48.9999 (109)
Dwelling Fabric Energy Efficiency (DFEE)												49.0 (109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	62.3500 (1b)	x	2.2900 (2b)	=	142.7815	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	62.3500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	142.7815	(5)

2. Ventilation rate

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

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1401	(8)
Pressure test		Yes	
Measured/design q50		5.0000	
Infiltration rate		0.3901	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3608	(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	0.4600	0.4510	0.4420	0.3969	0.3879	0.3428	0.3428	0.3338	0.3608	0.3879	0.4059	0.4240	(22b)
Effective ac	0.6058	0.6017	0.5977	0.5788	0.5752	0.5587	0.5587	0.5557	0.5651	0.5752	0.5824	0.5899	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.0000	1.0000	2.0000			(26)
TER Opening Type (Uw = 1.40)			7.0400	1.3258	9.3333			(27)
Heat Loss Floor 1			5.5700	0.1300	0.7241			(28b)
External Wall 1	52.5100	9.0400	43.4700	0.1800	7.8246			(29a)
Sheltered Wall	10.0500		10.0500	0.1800	1.8090			(29a)
Total net area of external elements Aum(A, m2)			68.1300					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	21.6910			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (User defined value 0.050 * total exposed area)							3.4065	(36)
Total fabric heat loss						(33) + (36) =	25.0975	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	28.5450	28.3514	28.1616	27.2702	27.1034	26.3270	26.3270	26.1833	26.6261	27.1034	27.4408	27.7935	(38)
Heat transfer coeff	53.6425	53.4489	53.2591	52.3677	52.2009	51.4246	51.4246	51.2808	51.7236	52.2009	52.5383	52.8911	(39)
Average = Sum(39)m / 12 =												52.3669	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.8603	0.8572	0.8542	0.8399	0.8372	0.8248	0.8248	0.8225	0.8296	0.8372	0.8426	0.8483	(40)
HLP (average)												0.8399	(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	2.0472	(42)
Average daily hot water use (litres/day)	82.8219	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	91.1041	87.7912	84.4784	81.1655	77.8526	74.5397	74.5397	77.8526	81.1655	84.4784	87.7912	91.1041	(44)
Energy conte	135.1048	118.1635	121.9341	106.3051	102.0023	88.0202	81.5637	93.5955	94.7134	110.3793	120.4876	130.8417	(45)
Energy content (annual)										Total = Sum(45)m =		1303.1113	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	28.7098	25.1097	25.9110	22.5898	21.6755	18.7043	17.3323	19.8890	20.1266	23.4556	25.6036	27.8039	(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	102.3619	102.3619	102.3619	102.3619	102.3619	102.3619	102.3619	102.3619	102.3619	102.3619	102.3619	102.3619	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	17.9353	15.9299	12.9551	9.8078	7.3315	6.1895	6.6880	8.6933	11.6682	14.8154	17.2918	18.4337	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	178.8324	180.6881	176.0118	166.0564	153.4894	141.6783	133.7877	131.9320	136.6084	146.5638	159.1307	170.9418	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	33.2362	33.2362	33.2362	33.2362	33.2362	33.2362	33.2362	33.2362	33.2362	33.2362	33.2362	33.2362	(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)													
	-81.8895	-81.8895	-81.8895	-81.8895	-81.8895	-81.8895	-81.8895	-81.8895	-81.8895	-81.8895	-81.8895	-81.8895	(71)
Water heating gains (Table 5)													
	38.5884	37.3657	34.8266	31.3748	29.1337	25.9782	23.2961	26.7326	27.9536	31.5263	35.5606	37.3708	(72)
Total internal gains													
	289.0646	287.6923	277.5021	260.9476	243.6632	227.5546	217.4804	221.0665	229.9387	246.6141	265.6917	280.4549	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	0.8000	11.2829	0.6300	0.7000	0.7700	2.7586	(75)
Southwest	6.2400	36.7938	0.6300	0.7000	0.7700	70.1668	(79)

Solar gains	72.9253	125.1351	173.6491	219.2391	249.2896	249.1248	239.5013	216.8318	189.3984	138.9572	87.5146	62.3009	(83)
Total gains	361.9900	412.8274	451.1512	480.1867	492.9529	476.6794	456.9817	437.8984	419.3371	385.5713	353.2063	342.7559	(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	80.7170	81.0094	81.2980	82.6819	82.9460	84.1983	84.1983	84.4343	83.7115	82.9460	82.4134	81.8638	
alpha	6.3811	6.4006	6.4199	6.5121	6.5297	6.6132	6.6132	6.6290	6.5808	6.5297	6.4942	6.4576	
util living area													
	0.9982	0.9953	0.9866	0.9545	0.8605	0.6708	0.4927	0.5345	0.7889	0.9664	0.9954	0.9987	(86)
MIT	20.1500	20.2845	20.4791	20.7202	20.9021	20.9850	20.9982	20.9971	20.9583	20.7280	20.3957	20.1293	(87)
Th 2	20.2013	20.2040	20.2066	20.2189	20.2212	20.2319	20.2319	20.2339	20.2278	20.2212	20.2165	20.2117	(88)
util rest of house													
	0.9976	0.9937	0.9821	0.9393	0.8187	0.5985	0.4081	0.4477	0.7226	0.9521	0.9936	0.9983	(89)
MIT 2	19.4192	19.5552	19.7498	19.9927	20.1553	20.2250	20.2314	20.2330	20.2055	20.0054	19.6769	19.4072	(90)
Living area fraction										fLA = Living area / (4) =		0.4125	(91)
MIT	19.7207	19.8561	20.0507	20.2928	20.4634	20.5385	20.5478	20.5482	20.5160	20.3035	19.9734	19.7051	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.7207	19.8561	20.0507	20.2928	20.4634	20.5385	20.5478	20.5482	20.5160	20.3035	19.9734	19.7051	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9971	0.9929	0.9811	0.9410	0.8327	0.6281	0.4431	0.4837	0.7488	0.9539	0.9929	0.9979	(94)
Useful gains	360.9442	409.8992	442.6034	451.8465	410.4681	299.4103	202.4831	211.8074	313.9789	367.7919	350.7042	342.0414	(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													
	827.2031	799.3860	721.6963	596.6141	457.4570	305.3863	203.0115	212.7240	331.8603	506.5303	676.3495	820.0815	(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													
	346.8966	261.7351	207.6452	104.2326	34.9598	0.0000	0.0000	0.0000	0.0000	103.2214	234.4647	355.6618	(98)
Space heating												1648.8171	(98)
Space heating per m2											(98) / (4) =	26.4445	(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	483.3910	380.5419	389.7341	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9549	0.9829	0.9771	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	461.5719	374.0406	380.8244	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	634.3725	609.9113	589.0947	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	124.4164	175.4878	154.9531	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												454.8573	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)													

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000 (106)
Space cooling kWh												
	0.0000	0.0000	0.0000	0.0000	0.0000	31.1041	43.8720	38.7383	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												113.7143 (107)
Space cooling per m2												1.8238 (108)
Energy for space heating												26.4445 (99)
Energy for space cooling												1.8238 (108)
Total												28.2683 (109)
Target Fabric Energy Efficiency (TFEE)												32.5 (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	62.3500 (1b)	x	2.2900 (2b)	=	142.7815	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	62.3500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	142.7815	(5)

2. Ventilation rate

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

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1401	(8)
Pressure test		Yes	
Measured/design q50		5.0000	
Infiltration rate		0.3901	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3608	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	3.8000	3.6000	3.5000	3.4000	3.4000	3.0000	3.2000	3.0000	2.9000	3.1000	3.0000	3.4000	(22)
Wind factor	0.9500	0.9000	0.8750	0.8500	0.8500	0.7500	0.8000	0.7500	0.7250	0.7750	0.7500	0.8500	(22a)
Adj infilt rate	0.3428	0.3247	0.3157	0.3067	0.3067	0.2706	0.2887	0.2706	0.2616	0.2796	0.2706	0.3067	(22b)
Effective ac	0.5587	0.5527	0.5498	0.5470	0.5470	0.5366	0.5417	0.5366	0.5342	0.5391	0.5366	0.5470	(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	
Windows (Uw = 1.40)			7.0400	1.3258	9.3333			(27)
Door			2.0000	1.5000	3.0000			(26)
Heat Loss Floor 1			5.5700	0.0550	0.3064			(28b)
External Wall 1	52.5100	9.0400	43.4700	0.4500	19.5615			(29a)
Sheltered Wall	10.0500		10.0500	0.3203	3.2189			(29a)
Total net area of external elements Aum(A, m2)			68.1300					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	35.4200			(33)
Party Wall 1			28.0100	0.0000	0.0000			(32)
Party Floor 1			56.7800					(32d)
Party Ceilings 1			62.3500					(32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	450.0000	(35)
Thermal bridges (Default value 0.150 * total exposed area)	10.2195	(36)
Total fabric heat loss (33) + (36) =	45.6395	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	26.3270	26.0433	25.9072	25.7750	25.7750	25.2842	25.5219	25.2842	25.1711	25.4011	25.2842	25.7750	(38)
Heat transfer coeff	71.9666	71.6829	71.5468	71.4145	71.4145	70.9238	71.1615	70.9238	70.8107	71.0407	70.9238	71.4145	(39)
Average = Sum(39)m / 12 =												71.2687	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1542	1.1497	1.1475	1.1454	1.1454	1.1375	1.1413	1.1375	1.1357	1.1394	1.1375	1.1454	(40)
HLP (average)												1.1430	(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	2.0472 (42)
Average daily hot water use (litres/day)	82.8219 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	91.1041	87.7912	84.4784	81.1655	77.8526	74.5397	74.5397	77.8526	81.1655	84.4784	87.7912	91.1041	(44)
Energy conte	135.1048	118.1635	121.9341	106.3051	102.0023	88.0202	81.5637	93.5955	94.7134	110.3793	120.4876	130.8417	(45)
Energy content (annual)										Total = Sum(45)m =		1303.1113	(45)
Distribution loss (46)m = 0.15 x (45)m	20.2657	17.7245	18.2901	15.9458	15.3003	13.2030	12.2346	14.0393	14.2070	16.5569	18.0731	19.6263	(46)
Water storage loss:													
Total storage loss													

CALCULATION OF HEAT DEMAND 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	46.4257	40.4080	43.0492	40.0268	39.6728	36.7593	37.9846	39.6728	40.0268	43.0492	43.2943	46.4257	(61)
Total heat required for water heating calculated for each month													
	181.5304	158.5715	164.9834	146.3319	141.6751	124.7796	119.5483	133.2684	134.7402	153.4285	163.7819	177.2674	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	181.5304	158.5715	164.9834	146.3319	141.6751	124.7796	119.5483	133.2684	134.7402	153.4285	163.7819	177.2674	(64)
								Total per year (kWh/year) = Sum(64)m =				1799.9066	(64)
RHI water heating demand												1800	(64)
Heat gains from water heating, kWh/month													
	56.5287	49.3914	51.3054	45.3532	43.8340	38.4566	36.6161	41.0387	41.4989	47.4634	50.8857	55.1113	(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	122.8343	122.8343	122.8343	122.8343	122.8343	122.8343	122.8343	122.8343	122.8343	122.8343	122.8343	122.8343	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	44.8381	39.8248	32.3877	24.5196	18.3287	15.4739	16.7200	21.7333	29.1704	37.0386	43.2295	46.0843	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	266.9140	269.6838	262.7041	247.8453	229.0887	211.4602	199.6832	196.9135	203.8931	218.7519	237.5085	255.1371	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	49.3307	49.3307	49.3307	49.3307	49.3307	49.3307	49.3307	49.3307	49.3307	49.3307	49.3307	49.3307	(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)													
	-81.8895	-81.8895	-81.8895	-81.8895	-81.8895	-81.8895	-81.8895	-81.8895	-81.8895	-81.8895	-81.8895	-81.8895	(71)
Water heating gains (Table 5)													
	75.9795	73.4991	68.9589	62.9905	58.9166	53.4119	49.2152	55.1596	57.6373	63.7949	70.6746	74.0743	(72)
Total internal gains													
	481.0071	476.2831	457.3262	428.6308	399.6095	373.6213	358.8939	367.0818	383.9764	412.8609	444.6881	468.5712	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	0.8000	12.4885	0.6300	0.7000	0.7700	3.0533	(75)
Southwest	6.2400	39.0225	0.6300	0.7000	0.7700	74.4168	(79)

Solar gains	77.4702	119.3679	166.6728	218.4184	242.9683	259.8318	248.9119	230.1334	198.3910	144.8555	96.0017	67.8102	(83)
Total gains	558.4773	595.6510	623.9990	647.0493	642.5778	633.4532	607.8058	597.2152	582.3674	557.7164	540.6897	536.3814	(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	108.2968	108.7254	108.9322	109.1340	109.1340	109.8891	109.5221	109.8891	110.0646	109.7082	109.8891	109.1340	
alpha	8.2198	8.2484	8.2621	8.2756	8.2756	8.3259	8.3015	8.3259	8.3376	8.3139	8.3259	8.2756	
util living area													
	0.9982	0.9962	0.9875	0.9457	0.7878	0.4809	0.2810	0.3088	0.6385	0.9362	0.9936	0.9987	(86)
MIT	20.4920	20.5686	20.7103	20.8727	20.9795	20.9997	21.0000	21.0000	20.9968	20.9048	20.6772	20.4792	(87)
Th 2	19.9568	19.9605	19.9622	19.9639	19.9639	19.9703	19.9672	19.9703	19.9718	19.9688	19.9703	19.9639	(88)
util rest of house													
	0.9971	0.9938	0.9790	0.9106	0.6950	0.3661	0.1601	0.1865	0.5183	0.8879	0.9886	0.9978	(89)
MIT 2	19.3133	19.4274	19.6310	19.8467	19.9533	19.9703	19.9672	19.9703	19.9710	19.8921	19.5927	19.3006	(90)
Living area fraction										fLA = Living area / (4) =		0.4125	(91)
MIT	19.7995	19.8981	20.0762	20.2699	20.3766	20.3949	20.3933	20.3951	20.3941	20.3098	20.0401	19.7868	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.7995	19.8981	20.0762	20.2699	20.3766	20.3949	20.3933	20.3951	20.3941	20.3098	20.0401	19.7868	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9968	0.9936	0.9801	0.9226	0.7340	0.4135	0.2100	0.2369	0.5685	0.9065	0.9890	0.9976	(94)
Useful gains	556.7057	591.8183	611.6109	596.9988	471.6216	261.9578	127.6105	141.4971	331.0567	505.5960	534.7506	535.0704	(95)
Ext temp.	5.6000	6.2000	8.0000	10.5000	13.6000	16.7000	18.6000	18.4000	15.7000	12.2000	8.5000	5.6000	(96)
Heat loss rate W													
	1021.8915	981.9218	864.0162	697.7159	483.9469	262.0567	127.6107	141.4978	332.3935	576.1289	818.4665	1013.1407	(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													
	346.0982	262.1496	187.7895	72.5163	9.1701	0.0000	0.0000	0.0000	0.0000	52.4765	204.2754	355.6843	(98)
Space heating												1490.1600	(98)
RHI space heating demand												1490	(98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
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1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	62.3500 (1b)	x	2.2900 (2b)	=	142.7815	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	62.3500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	142.7815	(5)

2. Ventilation rate

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

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1401	(8)
Pressure test		Yes	
Measured/design q50		5.0000	
Infiltration rate		0.3901	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3608	(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	0.4600	0.4510	0.4420	0.3969	0.3879	0.3428	0.3428	0.3338	0.3608	0.3879	0.4059	0.4240	(22b)
Effective ac	0.6058	0.6017	0.5977	0.5788	0.5752	0.5587	0.5587	0.5557	0.5651	0.5752	0.5824	0.5899	(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	
Windows (Uw = 1.40)			7.0400	1.3258	9.3333			(27)
Door			2.0000	1.5000	3.0000			(26)
Heat Loss Floor 1			5.5700	0.0550	0.3064			(28b)
External Wall 1	52.5100	9.0400	43.4700	0.4500	19.5615			(29a)
Sheltered Wall	10.0500		10.0500	0.3203	3.2189			(29a)
Total net area of external elements Aum(A, m2)			68.1300					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	35.4200			(33)
Party Wall 1			28.0100	0.0000	0.0000			(32)
Party Floor 1			56.7800					(32d)
Party Ceilings 1			62.3500					(32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	450.0000	(35)
Thermal bridges (Default value 0.150 * total exposed area)	10.2195	(36)
Total fabric heat loss (33) + (36) =	45.6395	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	28.5450	28.3514	28.1616	27.2702	27.1034	26.3270	26.3270	26.1833	26.6261	27.1034	27.4408	27.7935	(38)
Heat transfer coeff	74.1845	73.9909	73.8011	72.9097	72.7430	71.9666	71.9666	71.8228	72.2656	72.7430	73.0803	73.4331	(39)
Average = Sum(39)m / 12 =												72.9089	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1898	1.1867	1.1837	1.1694	1.1667	1.1542	1.1542	1.1519	1.1590	1.1667	1.1721	1.1778	(40)
HLP (average)												1.1693	(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	2.0472 (42)
Average daily hot water use (litres/day)	82.8219 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	91.1041	87.7912	84.4784	81.1655	77.8526	74.5397	74.5397	77.8526	81.1655	84.4784	87.7912	91.1041	(44)
Energy conte	135.1048	118.1635	121.9341	106.3051	102.0023	88.0202	81.5637	93.5955	94.7134	110.3793	120.4876	130.8417	(45)
Energy content (annual)										Total = Sum(45)m =		1303.1113	(45)
Distribution loss (46)m = 0.15 x (45)m	20.2657	17.7245	18.2901	15.9458	15.3003	13.2030	12.2346	14.0393	14.2070	16.5569	18.0731	19.6263	(46)
Water storage loss:													
Total storage loss													

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	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	46.4257	40.4080	43.0492	40.0268	39.6728	36.7593	37.9846	39.6728	40.0268	43.0492	43.2943	46.4257	(61)
Total heat required for water heating calculated for each month													
	181.5304	158.5715	164.9834	146.3319	141.6751	124.7796	119.5483	133.2684	134.7402	153.4285	163.7819	177.2674	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	181.5304	158.5715	164.9834	146.3319	141.6751	124.7796	119.5483	133.2684	134.7402	153.4285	163.7819	177.2674	(64)
								Total per year (kWh/year) = Sum(64)m =				1799.9066	(64)
Heat gains from water heating, kWh/month													
	56.5287	49.3914	51.3054	45.3532	43.8340	38.4566	36.6161	41.0387	41.4989	47.4634	50.8857	55.1113	(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	122.8343	122.8343	122.8343	122.8343	122.8343	122.8343	122.8343	122.8343	122.8343	122.8343	122.8343	122.8343	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	44.8381	39.8248	32.3877	24.5196	18.3287	15.4739	16.7200	21.7333	29.1704	37.0386	43.2295	46.0843	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	266.9140	269.6838	262.7041	247.8453	229.0887	211.4602	199.6832	196.9135	203.8931	218.7519	237.5085	255.1371	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	49.3307	49.3307	49.3307	49.3307	49.3307	49.3307	49.3307	49.3307	49.3307	49.3307	49.3307	49.3307	(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)													
	-81.8895	-81.8895	-81.8895	-81.8895	-81.8895	-81.8895	-81.8895	-81.8895	-81.8895	-81.8895	-81.8895	-81.8895	(71)
Water heating gains (Table 5)													
	75.9795	73.4991	68.9589	62.9905	58.9166	53.4119	49.2152	55.1596	57.6373	63.7949	70.6746	74.0743	(72)
Total internal gains													
	481.0071	476.2831	457.3262	428.6308	399.6095	373.6213	358.8939	367.0818	383.9764	412.8609	444.6881	468.5712	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	0.8000	11.2829	0.6300	0.7000	0.7700	2.7586	(75)
Southwest	6.2400	36.7938	0.6300	0.7000	0.7700	70.1668	(79)

Solar gains	72.9253	125.1351	173.6491	219.2391	249.2896	249.1248	239.5013	216.8318	189.3984	138.9572	87.5146	62.3009	(83)
Total gains	553.9324	601.4182	630.9753	647.8700	648.8991	622.7461	598.3951	583.9137	573.3748	551.8181	532.2027	530.8721	(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	105.0590	105.3339	105.6048	106.8959	107.1410	108.2968	108.2968	108.5136	107.8486	107.1410	106.6463	106.1341	
alpha	8.0039	8.0223	8.0403	8.1264	8.1427	8.2198	8.2198	8.2342	8.1899	8.1427	8.1098	8.0756	
util living area													
	0.9991	0.9979	0.9941	0.9770	0.9082	0.7224	0.5278	0.5635	0.8197	0.9780	0.9975	0.9994	(86)
MIT	20.3703	20.4568	20.5929	20.7705	20.9197	20.9901	20.9993	20.9988	20.9736	20.8003	20.5536	20.3532	(87)
Th 2	19.9282	19.9307	19.9331	19.9446	19.9467	19.9568	19.9568	19.9586	19.9529	19.9467	19.9424	19.9378	(88)
util rest of house													
	0.9986	0.9967	0.9902	0.9613	0.8526	0.6144	0.4036	0.4374	0.7206	0.9596	0.9956	0.9990	(89)
MIT 2	19.1125	19.2406	19.4395	19.6985	19.8838	19.9529	19.9567	19.9584	19.9397	19.7439	19.3915	19.0953	(90)
Living area fraction									fLA = Living area / (4) =			0.4125	(91)
MIT	19.6314	19.7423	19.9153	20.1407	20.3111	20.3808	20.3868	20.3876	20.3662	20.1797	19.8709	19.6142	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.6314	19.7423	19.9153	20.1407	20.3111	20.3808	20.3868	20.3876	20.3662	20.1797	19.8709	19.6142	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9984	0.9964	0.9901	0.9649	0.8743	0.6598	0.4550	0.4898	0.7626	0.9647	0.9955	0.9988	(94)
Useful gains	553.0340	599.2369	624.7536	625.1161	567.3086	410.8834	272.2884	285.9854	437.2760	532.3358	529.7839	530.2482	(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													
	1137.3505	1098.1943	990.0647	819.5595	626.3991	416.0213	272.5196	286.3996	452.8309	696.8527	933.2996	1131.9129	(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													
	434.7314	335.2994	271.7915	139.9992	43.9633	0.0000	0.0000	0.0000	0.0000	122.4006	290.5313	447.6385	(98)
Space heating												2086.3552	(98)
Space heating per m2											(98) / (4) =	33.4620	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	92.8000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2248.2276	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	434.7314	335.2994	271.7915	139.9992	43.9633	0.0000	0.0000	0.0000	0.0000	122.4006	290.5313	447.6385	(98)
Space heating efficiency (main heating system 1)													
	92.8000	92.8000	92.8000	92.8000	0.0000	0.0000	0.0000	0.0000	0.0000	92.8000	92.8000	92.8000	(210)
Space heating fuel (main heating system)													
	468.4606	361.3140	292.8788	150.8612	47.3743	0.0000	0.0000	0.0000	0.0000	131.8972	313.0725	482.3691	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	181.5304	158.5715	164.9834	146.3319	141.6751	124.7796	119.5483	133.2684	134.7402	153.4285	163.7819	177.2674	(64)
Efficiency of water heater												83.5000	(216)
(217)m	89.8521	89.5960	89.0535	87.8023	85.5299	83.5000	83.5000	83.5000	83.5000	87.3862	89.2177	89.9578	(217)
Fuel for water heating, kWh/month													
	202.0324	176.9851	185.2633	166.6608	165.6440	149.4366	143.1716	159.6028	161.3655	175.5753	183.5755	197.0561	(219)
Water heating fuel used												2066.3690	(219)
Annual totals kWh/year													
Space heating fuel - main system												2248.2276	(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)												316.7423	(232)
Total delivered energy for all uses												4706.3389	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2248.2276	3.4800	78.2383	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2066.3690	3.4800	71.9096	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	316.7423	13.1900	41.7783	(250)
Additional standing charges			120.0000	(251)
Total energy cost			321.8188	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	1.2591	(257)
SAP value		82.4356	
SAP rating (Section 12)		82	(258)
SAP band		B	

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2248.2276	0.2160	485.6172	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2066.3690	0.2160	446.3357	(264)
Space and water heating			931.9529	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	316.7423	0.5190	164.3892	(268)
Total kg/year			1135.2671	(272)
CO2 emissions per m2			18.2100	(273)
EI value			85.8290	
EI rating			86	(274)
EI band			B	

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9280 = 3.750, stars = 5
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9280 = 0.2328, stars = 4
Water heating energy efficiency	3.48 / 0.8687 = 4.006, stars = 4
Water heating environmental impact	0.216 / 0.8687 = 0.2487, 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	62.3500 (1b)	x	2.2900 (2b)	=	142.7815	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	62.3500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	142.7815	(5)

2. Ventilation rate

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

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1401	(8)
Pressure test		Yes	
Measured/design q50		5.0000	
Infiltration rate		0.3901	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3608	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	3.8000	3.6000	3.5000	3.4000	3.4000	3.0000	3.2000	3.0000	2.9000	3.1000	3.0000	3.4000	(22)
Wind factor	0.9500	0.9000	0.8750	0.8500	0.8500	0.7500	0.8000	0.7500	0.7250	0.7750	0.7500	0.8500	(22a)
Adj infilt rate	0.3428	0.3247	0.3157	0.3067	0.3067	0.2706	0.2887	0.2706	0.2616	0.2796	0.2706	0.3067	(22b)
Effective ac	0.5587	0.5527	0.5498	0.5470	0.5470	0.5366	0.5417	0.5366	0.5342	0.5391	0.5366	0.5470	(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	
Windows (Uw = 1.40)			7.0400	1.3258	9.3333			(27)
Door			2.0000	1.5000	3.0000			(26)
Heat Loss Floor 1			5.5700	0.0550	0.3064			(28b)
External Wall 1	52.5100	9.0400	43.4700	0.4500	19.5615			(29a)
Sheltered Wall	10.0500		10.0500	0.3203	3.2189			(29a)
Total net area of external elements Aum(A, m2)			68.1300					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	35.4200			(33)
Party Wall 1			28.0100	0.0000	0.0000			(32)
Party Floor 1			56.7800					(32d)
Party Ceilings 1			62.3500					(32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	450.0000	(35)
Thermal bridges (Default value 0.150 * total exposed area)	10.2195	(36)
Total fabric heat loss (33) + (36) =	45.6395	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	26.3270	26.0433	25.9072	25.7750	25.7750	25.2842	25.5219	25.2842	25.1711	25.4011	25.2842	25.7750	(38)
Heat transfer coeff	71.9666	71.6829	71.5468	71.4145	71.4145	70.9238	71.1615	70.9238	70.8107	71.0407	70.9238	71.4145	(39)
Average = Sum(39)m / 12 =												71.2687	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1542	1.1497	1.1475	1.1454	1.1454	1.1375	1.1413	1.1375	1.1357	1.1394	1.1375	1.1454	(40)
HLP (average)												1.1430	(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	2.0472 (42)
Average daily hot water use (litres/day)	82.8219 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	91.1041	87.7912	84.4784	81.1655	77.8526	74.5397	74.5397	77.8526	81.1655	84.4784	87.7912	91.1041	(44)
Energy conte	135.1048	118.1635	121.9341	106.3051	102.0023	88.0202	81.5637	93.5955	94.7134	110.3793	120.4876	130.8417	(45)
Energy content (annual)										Total = Sum(45)m =		1303.1113	(45)
Distribution loss (46)m = 0.15 x (45)m	20.2657	17.7245	18.2901	15.9458	15.3003	13.2030	12.2346	14.0393	14.2070	16.5569	18.0731	19.6263	(46)
Water storage loss:													
Total storage loss													

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

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	46.4257	40.4080	43.0492	40.0268	39.6728	36.7593	37.9846	39.6728	40.0268	43.0492	43.2943	46.4257	(61)
Total heat required for water heating calculated for each month													
	181.5304	158.5715	164.9834	146.3319	141.6751	124.7796	119.5483	133.2684	134.7402	153.4285	163.7819	177.2674	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	181.5304	158.5715	164.9834	146.3319	141.6751	124.7796	119.5483	133.2684	134.7402	153.4285	163.7819	177.2674	(64)
								Total per year (kWh/year) = Sum(64)m =				1799.9066	(64)
Heat gains from water heating, kWh/month													
	56.5287	49.3914	51.3054	45.3532	43.8340	38.4566	36.6161	41.0387	41.4989	47.4634	50.8857	55.1113	(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	122.8343	122.8343	122.8343	122.8343	122.8343	122.8343	122.8343	122.8343	122.8343	122.8343	122.8343	122.8343	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	44.8381	39.8248	32.3877	24.5196	18.3287	15.4739	16.7200	21.7333	29.1704	37.0386	43.2295	46.0843	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	266.9140	269.6838	262.7041	247.8453	229.0887	211.4602	199.6832	196.9135	203.8931	218.7519	237.5085	255.1371	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	49.3307	49.3307	49.3307	49.3307	49.3307	49.3307	49.3307	49.3307	49.3307	49.3307	49.3307	49.3307	(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)													
	-81.8895	-81.8895	-81.8895	-81.8895	-81.8895	-81.8895	-81.8895	-81.8895	-81.8895	-81.8895	-81.8895	-81.8895	(71)
Water heating gains (Table 5)													
	75.9795	73.4991	68.9589	62.9905	58.9166	53.4119	49.2152	55.1596	57.6373	63.7949	70.6746	74.0743	(72)
Total internal gains													
	481.0071	476.2831	457.3262	428.6308	399.6095	373.6213	358.8939	367.0818	383.9764	412.8609	444.6881	468.5712	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	0.8000	12.4885	0.6300	0.7000	0.7700	3.0533	(75)
Southwest	6.2400	39.0225	0.6300	0.7000	0.7700	74.4168	(79)

Solar gains	77.4702	119.3679	166.6728	218.4184	242.9683	259.8318	248.9119	230.1334	198.3910	144.8555	96.0017	67.8102	(83)
Total gains	558.4773	595.6510	623.9990	647.0493	642.5778	633.4532	607.8058	597.2152	582.3674	557.7164	540.6897	536.3814	(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	108.2968	108.7254	108.9322	109.1340	109.1340	109.8891	109.5221	109.8891	110.0646	109.7082	109.8891	109.1340	
alpha	8.2198	8.2484	8.2621	8.2756	8.2756	8.3259	8.3015	8.3259	8.3376	8.3139	8.3259	8.2756	
util living area													
	0.9982	0.9962	0.9875	0.9457	0.7878	0.4809	0.2810	0.3088	0.6385	0.9362	0.9936	0.9987	(86)
MIT	20.4920	20.5686	20.7103	20.8727	20.9795	20.9997	21.0000	21.0000	20.9968	20.9048	20.6772	20.4792	(87)
Th 2	19.9568	19.9605	19.9622	19.9639	19.9639	19.9703	19.9672	19.9703	19.9718	19.9688	19.9703	19.9639	(88)
util rest of house													
	0.9971	0.9938	0.9790	0.9106	0.6950	0.3661	0.1601	0.1865	0.5183	0.8879	0.9886	0.9978	(89)
MIT 2	19.3133	19.4274	19.6310	19.8467	19.9533	19.9703	19.9672	19.9703	19.9710	19.8921	19.5927	19.3006	(90)
Living area fraction										fLA = Living area / (4) =		0.4125	(91)
MIT	19.7995	19.8981	20.0762	20.2699	20.3766	20.3949	20.3933	20.3951	20.3941	20.3098	20.0401	19.7868	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.7995	19.8981	20.0762	20.2699	20.3766	20.3949	20.3933	20.3951	20.3941	20.3098	20.0401	19.7868	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9968	0.9936	0.9801	0.9226	0.7340	0.4135	0.2100	0.2369	0.5685	0.9065	0.9890	0.9976	(94)
Useful gains	556.7057	591.8183	611.6109	596.9988	471.6216	261.9578	127.6105	141.4971	331.0567	505.5960	534.7506	535.0704	(95)
Ext temp.	5.6000	6.2000	8.0000	10.5000	13.6000	16.7000	18.6000	18.4000	15.7000	12.2000	8.5000	5.6000	(96)
Heat loss rate W													
	1021.8915	981.9218	864.0162	697.7159	483.9469	262.0567	127.6107	141.4978	332.3935	576.1289	818.4665	1013.1407	(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													
	346.0982	262.1496	187.7895	72.5163	9.1701	0.0000	0.0000	0.0000	0.0000	52.4765	204.2754	355.6843	(98)
Space heating												1490.1600	(98)
Space heating per m2											(98) / (4) =	23.8999	(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 %)	92.8000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	1605.7759	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	346.0982	262.1496	187.7895	72.5163	9.1701	0.0000	0.0000	0.0000	0.0000	52.4765	204.2754	355.6843	(98)
Space heating efficiency (main heating system 1)													
	92.8000	92.8000	92.8000	92.8000	0.0000	0.0000	0.0000	0.0000	0.0000	92.8000	92.8000	92.8000	(210)
Space heating fuel (main heating system)													
	372.9507	282.4888	202.3594	78.1426	9.8815	0.0000	0.0000	0.0000	0.0000	56.5480	220.1244	383.2805	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	181.5304	158.5715	164.9834	146.3319	141.6751	124.7796	119.5483	133.2684	134.7402	153.4285	163.7819	177.2674	(64)
Efficiency of water heater												83.5000	(216)
(217)m	89.3752	89.0613	88.2055	86.3680	84.0118	83.5000	83.5000	83.5000	83.5000	85.6885	88.4179	89.4850	(217)
Fuel for water heating, kWh/month													
	203.1105	178.0475	187.0443	169.4284	168.6372	149.4366	143.1716	159.6028	161.3655	179.0537	185.2363	198.0974	(219)
Water heating fuel used												2082.2318	(219)
Annual totals kWh/year													
Space heating fuel - main system												1605.7759	(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)												316.7423	(232)
Total delivered energy for all uses												4079.7499	(238)

10a. Fuel costs - using BEDF prices (410)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1605.7759	4.2000	67.4426	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2082.2318	4.2000	87.4537	(247)
Pumps and fans for heating	75.0000	15.5400	11.6550	(249)
Energy for lighting	316.7423	15.5400	49.2217	(250)
Additional standing charges			90.0000	(251)
Total energy cost			305.7731	(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	1605.7759	0.2160	346.8476	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2082.2318	0.2160	449.7621	(264)
Space and water heating			796.6097	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	316.7423	0.5190	164.3892	(268)
Total kg/year			999.9239	(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	1605.7759	1.2200	1959.0466	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2082.2318	1.2200	2540.3228	(264)
Space and water heating			4499.3694	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	316.7423	3.0700	972.3988	(268)
Primary energy kWh/year			5702.0181	(272)
Primary energy kWh/m2/year			91.4518	(273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating:	B 82
Current environmental impact rating:	B 86

(For testing purposes):

A	Not considered
B	Not considered
C	Not considered

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

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: B 82
Potential environmental impact rating: B 86

Fuel prices for cost data on this page from database revision number 410 TEST (03 Apr 2017)
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	£61	£61	£0
Mains gas	£245	£245	£0
Space heating	£169	£169	£0
Water heating	£87	£87	£0
Lighting	£49	£49	£0
Total cost of fuels	£306	£306	£0
Total cost of uses	£305	£305	£0
Delivered energy	65 kWh/m²	65 kWh/m²	0 kWh/m²
Carbon dioxide emissions	1.0 tonnes	1.0 tonnes	0.0 tonnes
CO2 emissions per m²	16 kg/m²	16 kg/m²	0 kg/m²
Primary energy	91 kWh/m²	91 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

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

No improvements selected / applicable

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

Overheating Calculation Input Data

Dwelling type	EndTerrace Flat
Number of storeys	1
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	North West
Overshading	Average or unknown
Thermal mass parameter	450.0
Night ventilation	No
Ventilation rate during hot weather (ach)	3.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	141.35 (P1)
Transmission heat loss coefficient	45.64 (37)
Summer heat loss coefficient	186.99 (P2)

Overhangs

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

Solar shading

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

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North East	0.8000	98.8453	0.6300	0.7000	0.9000	28.2468
South West	6.2400	119.9223	0.6300	0.7000	0.9000	267.3058
total:						295.5526

	Jun	Jul	Aug	
Solar gains	311	296	272	(P3)
Internal gains	371	356	364	
Total summer gains	682	651	637	(P5)
Summer gain/loss ratio	3.65	3.48	3.40	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 450.0)	0.00	0.00	0.00	
Threshold temperature	19.65	21.38	21.20	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight