PRICE&MYERS

64 and 66 Charlotte Street and 32 Tottenham Street, Camden
Option A
Energy Strategy Report

CIBSE LOW CARBON ENERGY ASSESSORS

Date: 01 June 2017

Project number: 26004

Revision: 1

Prepared by: Tom Lodge

Reviewed by: Deepika Singhal

37 Alfred Place London WC1E 7DP 020 7631 5128 mail@pricemyers.com www.pricemyers.com

Contents

Executive Summary

This report details the proposed energy strategy for the Mixed-use development located at 64 and 66 Charlotte Street and 32 Tottenham Street in the London Borough of Camden. The proposals entail the refurbishment and extension of an existing building that will provide A1 shop space, A3 cafe and B1 office space across the basement to first floors. Three residential units shall be provided on the first to fourth floors with the extension of the existing fourth floor to create a mansard roof. Flats 1 and 2 shall be a material change of use, with Flat 3 being a new extension. It should be noted that the whole front façade of the project is being retained.

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)
- Low and zero carbon technologies (Be Green)

The target for the projects is as follows:

- Commercial units (Extension and refurbishment of the existing spaces) – Building Regulations 2013 Part L2A
- Residential units 1 and 2 (Change of use from commercial to residential) – Building Regulations 2013 Part L1B
- Residential unit 3 (new Extension) – Building Regulations 2013 Part L1A

An energy assessment has been carried out based on design information to identify the most effective strategy for the development in order to meet the target. The building fabric performance will meet or exceed the Part L 2013 requirements, as stated above, where applicable and the most appropriate renewable measure will be identified.

1 Introduction

1.1 Site Analysis

Price & Myers have been commissioned to produce an Energy Strategy for the proposed development at 66 64 and 66 Charlotte Street and 32 Tottenham Street.

The proposals entail the refurbishment and extension of an existing building that will provide A1 shop space, A3 cafe and B1 office space across the basement to first floors. Three residential units shall be provided on the first to fourth floors with the extension of the existing fourth floor to create a mansard roof. Flats 1 and 2 shall be a material change of use, with Flat 3 being a new extension.

The flat roof space on the first floor shall be green roof for ecological enhancement. The main roof shall provide space for the inclusion of PV panels to service residential Flat 3. The building occupies most of the site so there is only a small amount of outdoor space in the basement light well.

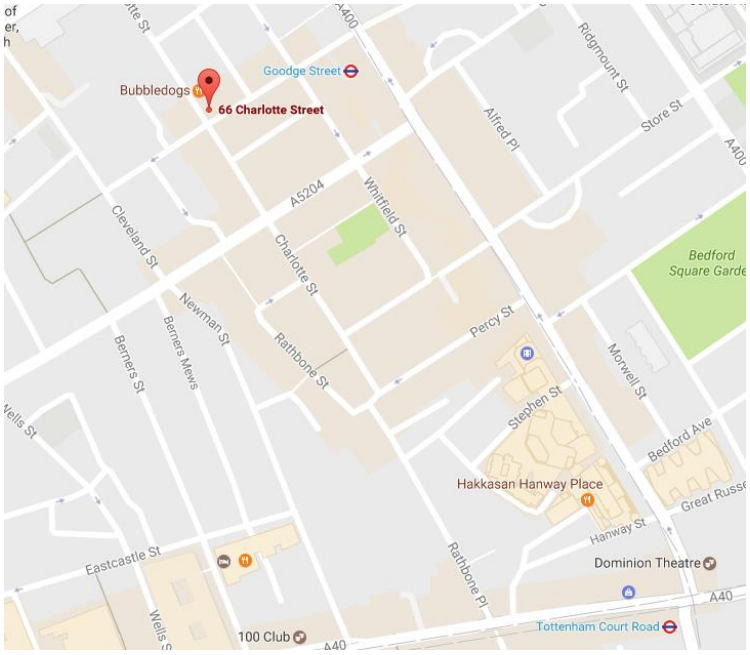


Figure 1-1 - Google Maps extract indicating site location of the proposed development

Our assessment has been based on drawings provided by the architects.

1.2 Objective

This report summarises the work undertaken to support the development of an energy strategy for the scheme. This work has resulted in a strategy that requires design, technical and commercial decisions in order to continue the design development and ultimately select the final solution for ensuring a low carbon development.

This report 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 would allow the scheme to demonstrate compliance with the guidelines set out by the London Borough of Camden in demonstrating a positive commitment to sustainability through providing environmental improvements.

2 Policy

2.1 The London Plan Policies on Energy

The London Plan, March 2016, requires compliance with the following policies relating to climate change:

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:

1. Be Lean: use less energy
2. Be Clean: supply energy efficiently
3. Be Green: use Renewable energy

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

2.2 London Borough of Camden Policies on Energy

Policy DP22 – Promoting sustainable design and construction

The Council will promote and measure sustainable design and construction by:

- Expecting new build housing to meet Code Level 4 by 2013 and encouraging Code Level 6 (zero carbon) by 2016;
- Expecting developments (except new build) of 500 sq m of residential floor space or above or 5 or more dwellings to achieve “very good” in BREEAM for Domestic Refurbishment assessments prior to 2013 and encouraging “excellent” from 2013;

Policy CPG3 Sustainability

Developments are to target a 20% reduction in carbon dioxide emissions from on-site renewable energy technologies.

All residential new build should achieve a Code for Sustainable Homes Level 4 with 50% of the unweighted Energy, Water and Materials credits.

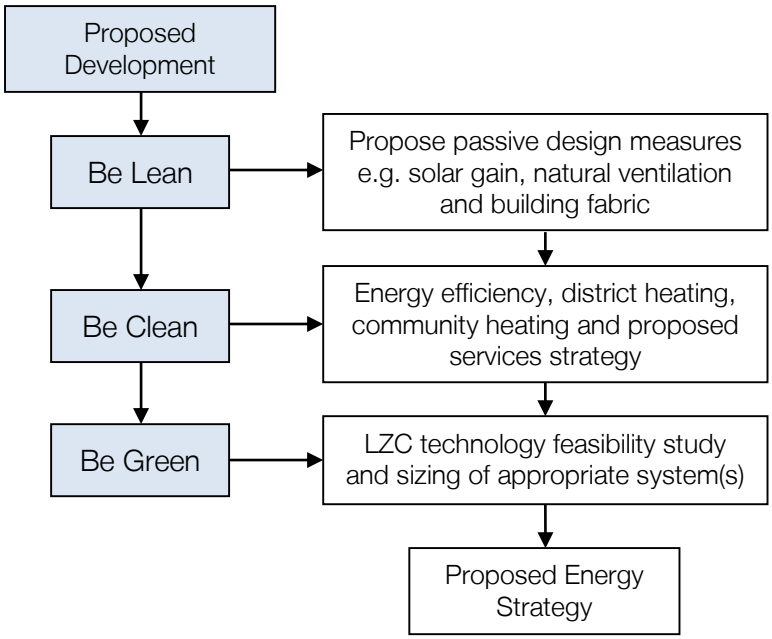
3 Approach

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)
- Utilise renewable energy sources to reduce carbon emissions (Be Green)

This energy strategy examines the energy performance of the proposed 66 Charlotte Street development based on the following methodology:



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 (LCEA). 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), current SAP 2012 version and EDSL Tas Dynamic Simulation Modelling (DSM) software.

4 Energy Targets

The targets for the project are the following Commercial units – Building Regulations 2013 Part L2A, Residential units 1 and 2 – Building Regulations 2013 Part L1B and Residential unit 3 – Building Regulations 2013 Part L1A to meet the London Plan and the London Borough of Camden policy. Table 4-1 details the energy broken down by fuel types and fuel use categories for the site taking into account the regulated energy. These are the target energy and carbon calculations before any passive design, energy efficient measures or renewable technologies.

Building Regulations Target Emission Rate Breakdown													
Regulated Energy & CO2													
Type	Gas Demand				Electricity Demand							Total Energy (kWh/yr)	Total CO_2 (kg/yr)
	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)		
Residential (Flats 1 and 2)	4,216	4,247	8,463	1,828	0	0	0	150	570	720	373	9,182	2,201
Residential (Flat 3)	3,301	2,611	5,912	1,277	0	0	0	75	476	551	286	6,463	1,563
A1, A3, B1	627	0	627	135	0	14,425	11,502	2,448	15,310	43,684	22,672	44,311	22,808
Total	8,144	6,858	15,002	3,240	0	14,425	11,502	2,673	16,355	44,955	23,332	59,957	26,572

Table 4-1: Estimated regulated energy demand and carbon emissions per energy source

6 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.

As a refurbishment, the orientation of the building is fixed. Some external elements will be updated, such as the windows and roof, to provide a more efficient thermal envelope. The building is located in a conservation zone.

All new elements will be specified to meet or exceed Building Regulations standards.

6.1 Solar Gain Control and Daylighting

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.

6.2 Overheating

The impact of solar gains has been incorporated into the SAP analysis for compliance with Part L and the risk of solar overheating has been concluded to be slight for the residential part of the development.

6.3 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 6-1 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	Measure			
	Existing Residential (RDSAP)	Residential Flats 1 & 2	Residential Flat 3	Commercial
Existing External Wall	2.10 W/m^{2}K	0.30 W/m^{2}K		0.30 W/m^{2}K
Sheltered Wall	2.10 W/m^{2}K	0.30 W/m^{2}K		0.30 W/m^{2}K
Lift Wall	N/A	0.50 W/m^{2}K		0.50 W/m^{2}K
Lightwell Wall	N/A	0.28 W/m^{2}K	0.15 W/m^{2}K	0.15 W/m^{2}K
Mansard Wall	N/A	N/A	0.15 W/m^{2}K	
Roof	2.30 W/m^{2}K	0.18 W/m^{2}K		0.14 W/m^{2}K
Ground Floor	1.20 W/m^{2}K	0.25 W/m^{2}K	N/A	0.25 W/m^{2}K
Party Walls	0.00 W/m^{2}K*			-
Windows (Front Elevation)	4.80 W/m^{2}K	1.6 W/m^{2}K		1.6 W/m^{2}K
Windows (Lightwell)	N/A	1.2 W/m^{2}K		1.2 W/m^{2}K

External Doors	3.0 W/m^{2}K	1.2 W/m^{2}K		1.6 W/m^{2}K
Mansard Windows	N/A	N/A	1.2 W/m^{2}K	N/A
Rooflights	N/A		1.2 W/m^{2}K	
Air Tightness	No air pressure test will be carried out to determine air tightness. Worst case scenario assumed: 15 m^3/m^2/h	Pressure testing will be carried out to determine air tightness. This will be an assumed: 5 m^3/m^2/h		Pressure testing will be carried out to determine air tightness. This will be an assumed: 4 m^3/m^2/h
Thermal Bridging	Default (0.150)	Default (0.150)		Default

Table 6-2 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

7 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.

7.1 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.

According to the London Heat Map Study, there is no network or possible network within close enough proximity of the site to consider connecting, see Figure 7-1 below. As no network is yet available, it is not possible to connect at this time.

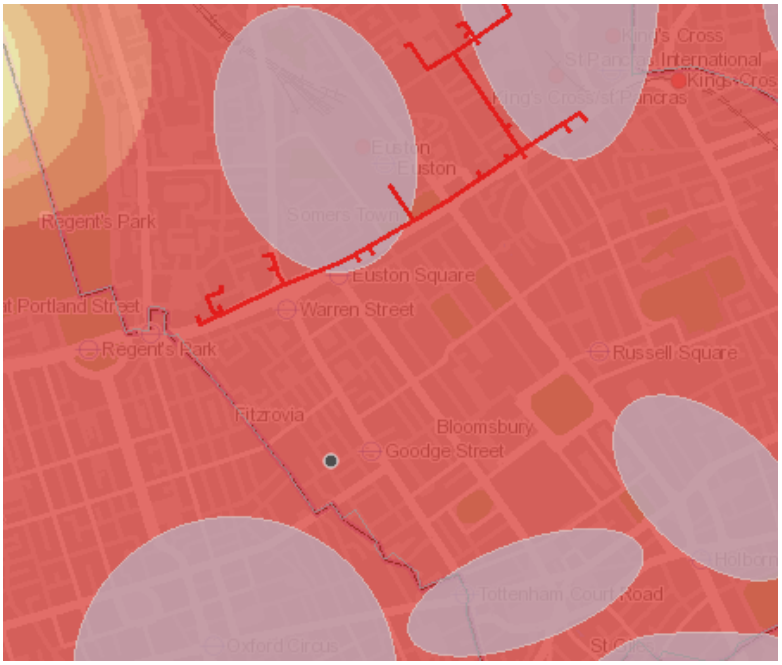


Figure 7-1 London Heat Map

7.2 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 relatively 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.

7.3 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 7-1 shows the proposed services strategy and energy efficiency measures for the development.

Services	Residential	Commercial
Space Heating	Condensing Combi Gas Boiler 90% Efficient Space heating from radiators	Condensing Combi Gas Boiler 92% Efficient
Heating Controls	Time and temperature zone control	
Hot Water Heating	Condensing Combi Gas Boiler 90% Efficient Boiler Interlock Delayed Start Stat	Condensing Combi Gas Boiler 92% Efficient
Hot Water Storage	Flat 3 200lt cylinder 100mm foam insulated Fully insulated primary pipework	N/A
Ventilation	Natural ventilation	Mechanical ventilation
Comfort Cooling	-	VRF Split /Multi Split cooling COP 3.6
Lighting & Controls	100% low energy lighting	90 lumens/circuit-watt Manual On/Auto Off
Electricity power factor	-	<0.9

Table 7-1 Proposed energy efficient design measures

8 Be Green: Low and Zero Carbon (LZC) 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 technologies and their feasibility on this development to contribute to meeting the relevant London Plan and the London Borough of Camden's sustainability requirements.

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 flat roof spaces 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 flat roof space on top of Flat 3 on which Solar PV panels could be installed to contribute to the electricity demand.	✓

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	CHP is not technically viable for a development of this scale.	✗
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 NO_x 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 NO_x emissions	✗

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 limited external space available for installation of boreholes	✗

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. Given that the development is located within a conservation area, ASHP have been excluded due to noise issues and locating the unsightly units	✗

Table 8-1 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 systems should be accurately sized during the detailed design stages and MCS (Microgeneration Certification Scheme) approved equipment and installers used.

9 Summary of CO_2 Emission Savings

The most appropriate LZC technology for the development has been identified as solar PV panels in order to follow the energy hierarchy and the London Borough of Camden's policy for on-site renewables. Table 9-1 shows the proposed system size and the estimated energy and carbon emissions savings for Flat 3. Table 9-2 details the energy broken down by fuel types and fuel use categories for the site taking into account the regulated energy.

	Energy & CO_2				Life Cycle Carbon and Cost Analysis
Proposed LZC Technologies	Energy Generated (kWh/yr)	% energy demand met	CO_2 saved by system ($kgCO_2/yr$)	% reduction in CO_2 emissions	25 year CO_2 saving ($kgCO_2$)
Total Solar PV = 0.5 kWp 2 panels 30 deg, South facing	429	6.11%	223	14.3%	5,569

Table 9-1 Energy, carbon and financial performance of the proposed LZC technologies for Flat 3

Be Green														
Regulated Energy & CO2														
Type	Gas Demand				Electricity Demand								Total Energy (kWh/yr)	Total CO_2 (kg/yr)
	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)		
Residential (Flats 1 and 2)	6,491	3,968	10,459	2,259	0	0	0	150	570	0	720	373	11,179	2,633
Residential (Flat 3)	4,439	2,458	6,898	1,490	0	0	0	75	476	-429	122	63	7,020	1,553
A1, A3, B1	1,475	0	1,475	319	0	15,706	6,887	2,895	11,202	0	36,691	19,043	38,166	19,361
Total	12,405	6,427	18,832	4,068	0	15,706	6,887	3,120	12,248	-429	37,532	19,479	56,365	23,547

Table 9-2 Estimated regulated and unregulated energy demand and carbon emissions per energy source

Table 9-3 details the improvement in DER/TER, DFEE/TFEE and CO_2 emissions for the proposed refurbished dwellings Flats 1 and 2 over the existing case.

Performance Indicator	Existing Case	Proposed Dwelling	Improvement (%)
Flat 1			
DER	94.12	22.69	75.89%
DFEE	165.23	58.14	64.81%
Flat 2			
DER	92.36	20.21	78.12%
DFEE	160.23	46.48	70.99%

Table 9-3 Summary of SAP results for Flats 1 and 2

Figure 9-1 details the improvement in DER/TER for the proposed new dwelling Flat 3 with LZCs.

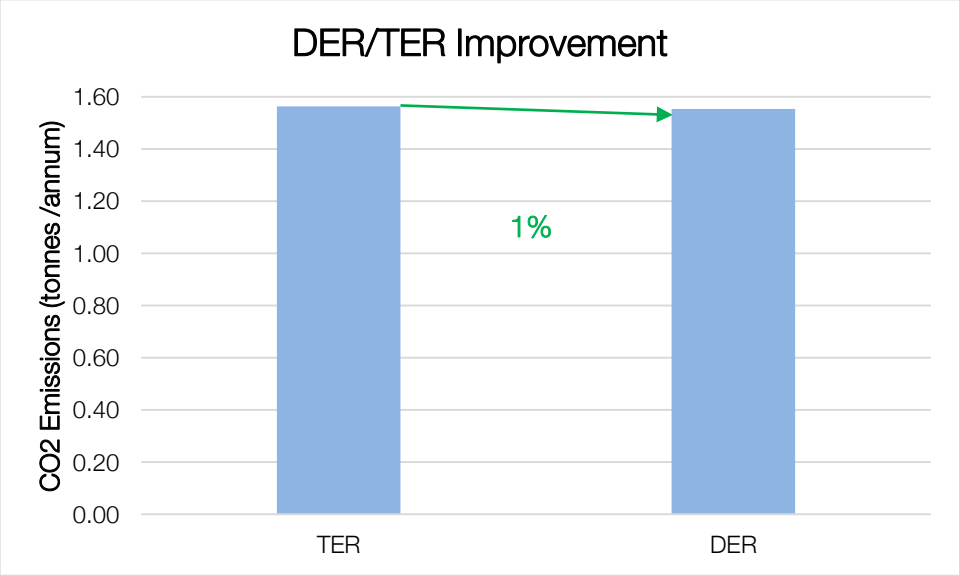


Figure 9-1 Summary of SAP results for Flat 3

Figure 9-2 details the improvement in BER/TER for the proposed commercial units.

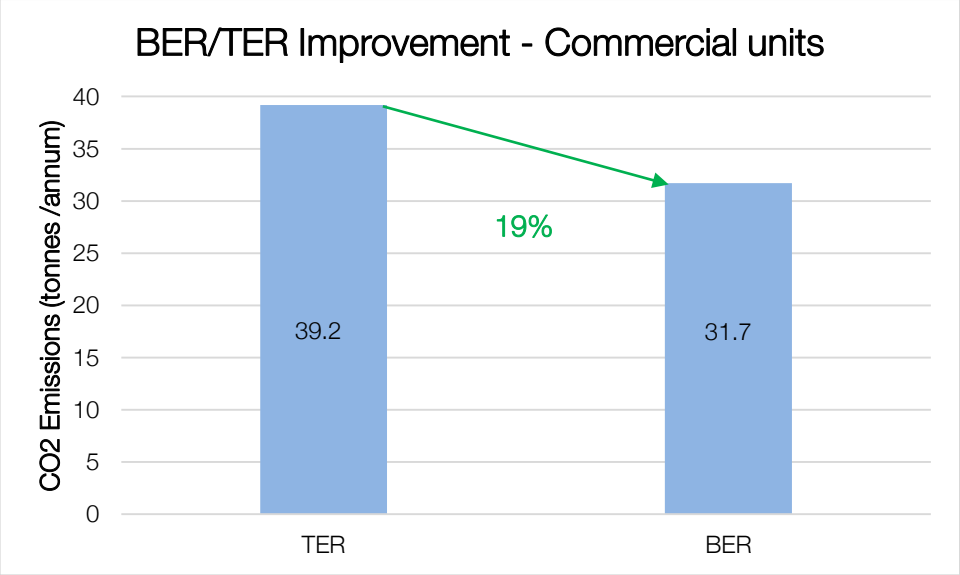


Figure 9-2 Summary of BRUKL results for commercial units

10 Conclusion

The design team have made all reasonable endeavours to achieve the minimum requirements of the London Borough of Camden. 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 been incorporated into the design to reduce carbon emissions from the Flat 3.

Based on the measures mentioned above, the following improvements have been shown in Tables 10-1 and Figures 10-1 and 10-2.

Performance Indicator	Existing Case	Proposed Dwelling	Improvement (%)
Flat 1			
DER	94.12	22.69	75.89%
DFEE	165.23	58.14	64.81%
Flat 2			
DER	92.36	20.21	78.12%
DFEE	160.23	46.48	70.99%

Table 10-1 Summary of SAP results for Flats 1 and 2

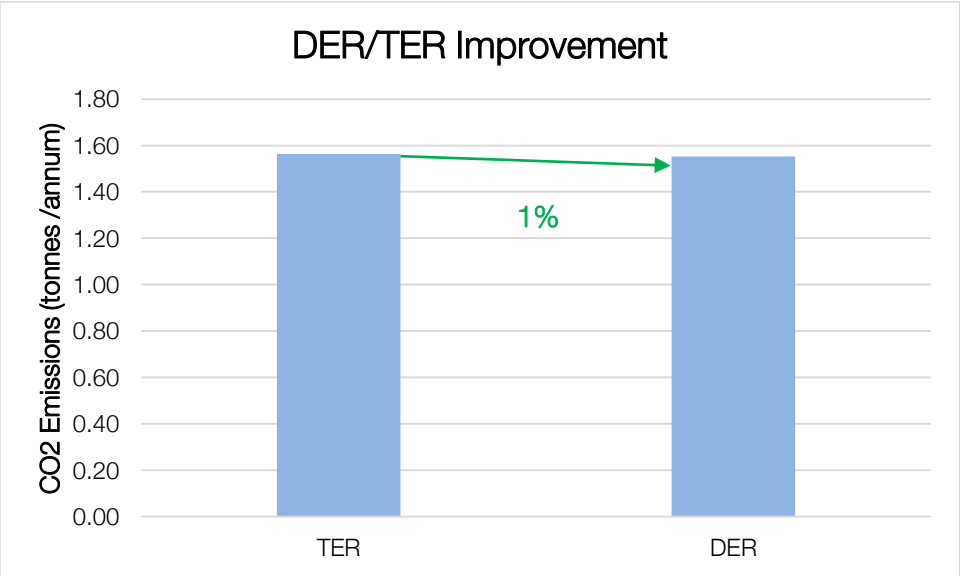


Figure 10-1 Summary of SAP results for Flat 3

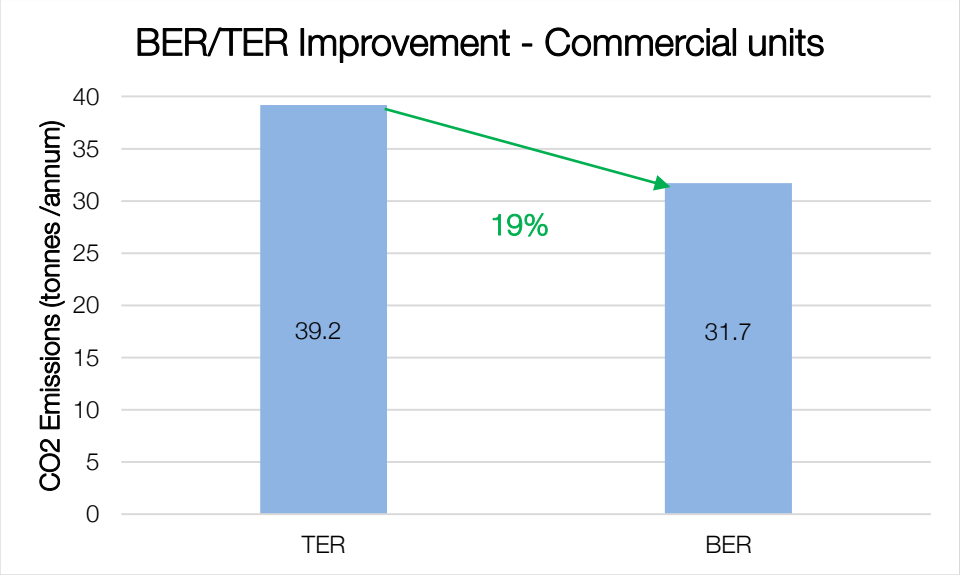


Figure 10-2 Summary of BRUKL results for commercial units

This is in line with the energy hierarchy and the London Borough of Camden policy criteria for London Borough of Camden's policy for on-site renewables.

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

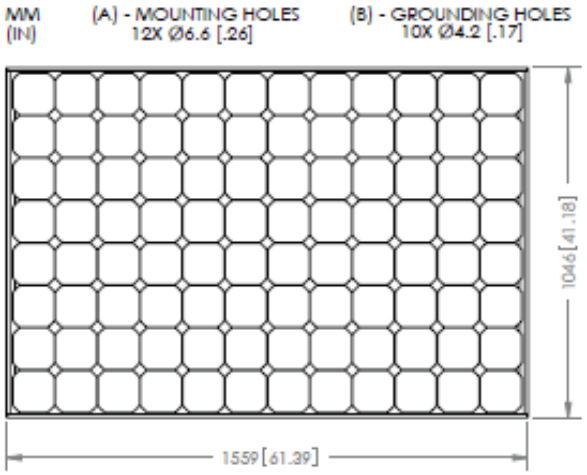
The following tables show figures used in the energy and CO_2 calculations to estimate energy produced and CO_2 savings from LZC technologies. These figures can be used to validate the results.

CO_2 Intensity Values	
Gas Intensity	0.216 $kgCO_2/kWh$
Electricity Intensity	0.519 $kgCO_2/kWh$

Fuel Prices (as of March 2016)	
Natural Gas	4.18 p/kWh
Electricity (Grid)	13.86 p/kWh

Appendix B

PV calculation



Energy & Renewable Technology Outputs	
PV panel size	1.046 x 1.56
PV panel area per panel (m2)	1.63
PV panel rated output (kWp)	0.327 kWp
Efficiency of solar thermal collectors	0.20 kWp/m^2

Appendix C

SAP Calculations & TAS BRUKL

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

Design SAP
elmhurst energy

Property Reference	26004 Flat 3	**Issued on Date**	07/04/2017
Survey Reference	Improved u-values	**Prop Type Ref**	66 Charlotte Street
Property	Charlotte Street		

SAP Rating	87 B	**DER**	13.71	**TER**	13.81
Environmental	89 B	**% DER<TER**	0.69		
CO_2 Emissions (t/year)	1.20	**DFEE**	41.99	**TFEE**	37.80
General Requirements Compliance	Fail	**% DFEE<TFEE**	-11.09		

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

SAP2012 - 9.92 input data (DesignData) -

```
SAP2012 Input Data (Flat)      02/05/2017

FullRefNo:                     Improved u-values

Regs Region:                   England
SAP Region:                    Thames Valley
Postcode:
DwellingOrientation:           South East
Property Type:                 Flat, Mid-Terrace
Storeys:                       2
Date Built:                    2017
Sheltered Sides:               2
Sunlight Shade:                Average or unknown
Measurements                   Perimeter, Floor Area, Storey Height
     1st Storey:               20.48, 55.97, 2.27
     2nd Storey:               17.31, 57.24, 2.43
Living Area:                   33.8 m2, fraction: 29.9%
Thermal Mass:                  Simple calculation
Thermal Mass Simple:           Medium
Thermal MassValue:             250
External Walls                 Nett Area, Gross Area, Kappa, Element, Construction, Type, ShelterFactor, UValueFinal
Existing Wall                  9.19, 14.05, 0, Other, Solid, 0, 0.3, Calculate
Sheltered Wall                 5.2, 7.4, 0, Other, Solid, 0.9, 0.236220472440945, Gross
Lift Wall                      22.97, 22.97, 0, Other, Solid, 0.9, 0.344827586206897, Gross
Light Well Wall                11.51, 14.32, 0, Other, Cavity, 0, 0.15, Gross
Mansard Wall                   25.63, 29.81, 0, Other, Cavity, 0, 0.15, Gross
Party Walls                    Area, Kappa, Element, Construction, Type, ShelterFactor, UValueFinal
Party Wall 1                   76.54, 0, Other, Solid, 0, 0
External Roofs                 Nett Area, Gross Area, Kappa, Construction, Element, UValueFinal
     External Roof 1           45.11, 47.26, 0, Other, 0.18
Heat Loss Floors               Area, Kappa, Construction, Element, Type, ShelterFactor, UValueFinal
Party Floors                   Area, Kappa, Construction, Element
     Party Floor 1             55.97, 0
Description                    Data Source, Type, Glazing, Glazing Gap, Argon Filled, Solar Trans, Frame Type, Frame Factor, U Value
     Windows Front Elevation   Manufacturer, Window, Double glazed, , , 0.76, , 0.7,
     Door                      Manufacturer, Solid Door, , , , , , ,
     Windows Light Well        Manufacturer, Window, Double Low-E Soft 0.05, , , 0.63, , 0.7,
     Mansard Window            Manufacturer, Window, Double Low-E Soft 0.1, , , 0.63, , 0.7,
     Roof Lights               Manufacturer, Roof Window, Double Low-E Soft 0.1, , , 0.63, , 0.7,
Openings                       Opening Type, Location, Orientation, Pitch, Curtain Type, Overhang Ratio, Wide Overhang, Width, Height, Count, Area, Curtain Closed
     3rd Floor Front           Window, Existing Wall, South West, , None, 0, , 0, 0, 0, 4.86,
     3rd Floor Rear            Window, Light Well Wall, North East, , None, 0, , 0, 0, 0, 2.81,
     Mansard Front             Window, Mansard Wall, South West, , None, 0, , 0, 0, 0, 2.00,
     Mansard Rear              Window, Mansard Wall, North East, , None, 0, , 0, 0, 0, 2.18,
     Roof Lights               Roof Window, External Roof 1, Horizontal, 0, None, , , 0, 0, 0, 2.15,
     Door                      Solid Door, Sheltered Wall, South East, , , , , 0, 0, 0, 2.20,
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:             4
Passive Vents:                 0
Flueless Gas Fires:            0
Cooling System                 None
Light Fittings:                13
LEL Fittings:                  13
Percentage of LEL Fittings:    100
External Lights Fitted:        No
External LELs Fitted:          No
Electricity Tariff:            Standard
Main Heating 1
     Description               tbc
     Percentage                100
     MHS                       Mains gas BGB Post 98 Regular condens. with auto ign.
     SAP Code                  102
```

SAP2012 - 9.92 input data (DesignData) -

```
     Boiler Efficiency Type   SAP Table
     Efficiency               90
     Model Name               tbc
     Manufacturer             tbc
     Controls by PCDF         0
     MHS Controls             CBI Time and temperature zone control
     Boiler Interlock         Yes
     Compensator              0
     Delayed Start Stat       Yes
     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)
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
     Cylinder Type            HotWaterCylinder
     Cylinder Insulation Type Foam
     Cylinder Volume          200.00
     Cylinder Stat            Yes
     Pipeworks Insulated      Fully insulated primary pipework
     Cylinder in Heated Space Yes
     Separate Time Control    Yes
Flue Gas Heat Recovery System None
Waste Water Heat Recovery     none
PV Unit
Type                          One Dwelling
PVUnit 1                      Cells Peak = 0.5, Orientation = South, Elevation = 30°, Overshading = None Or Little, , Connected to Dwelling = Yes
Wind Turbine                  None
Terrain Type:                 Urban
Small Scale Hydro             None
Special Features              None


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

DWELLING AS DESIGNED

Top-floor flat, total floor area 113 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.
-------------------------------------------------------------------------------------------------------
1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 13.81 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 13.71 kgCO□/m²OK
-------------------------------------------------------------------------------------------------------
1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)37.8 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)42.0 kWh/m²/yrFail
Excess energy =4.2 kWh/m²/yr  (11.1%)
-------------------------------------------------------------------------------------------------------
2 Fabric U-values
Element         Average                 Highest
External wall   0.23 (max. 0.30)        0.34 (max. 0.70)          OK
Party wall      0.00 (max. 0.20)         -                        OK
Floor           (no floor)
Roof            0.18 (max. 0.20)        0.18 (max. 0.35)          OK
Openings        1.32 (max. 2.00)        1.60 (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

Efficiency: 90%
Minimum: 88%                                    OK

Secondary heating system:               None
-------------------------------------------------------------------------------------------------------
5 Cylinder insulation
Hot water storage                       Nominal cylinder loss: 1.74 kWh/day
Permitted by DBSCG 2.24                         OK
Primary pipework insulated:             Yes                                             OK
-------------------------------------------------------------------------------------------------------
6 Controls
Space heating controls:                 Time and temperature zone control               OK
```

SAP2012 - 9.92 input data (DesignData) -

Hot water controls:	Cylinderstat	OK
	Independent timer for DHW	OK
Boiler interlock	Yes	OK

---

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

Minimum	75%	OK

---

8 Mechanical ventilation
Not applicable

---

9 Summertime temperature

Overheating risk (Thames Valley):	Slight	OK
Based on:		
Overshading:	Average	
Windows facing North East:	4.99 m², No overhang	
Windows facing South West:	6.86 m², No overhang	
Air change rate:	3.00 ach	
Blinds/curtains:	None	

---

10 Key features

Party wall U-value	0.00 W/m²K

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	55.9700	(1b)	x 2.2700	(2b) =	127.0519	(1b) - (3b)
First floor	57.2400	(1c)	x 2.4300	(2c) =	139.0932	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	113.2100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		266.1451	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							4 * 10 =	40.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1503	(8)
Pressure test		Yes	
Measured/design q50		5.0000	
Infiltration rate		0.4003	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3402	(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	0.4338	0.4253	0.4168	0.3743	0.3658	0.3232	0.3232	0.3147	0.3402	0.3658	0.3828	0.3998	(22b)
Effective ac	0.5941	0.5904	0.5869	0.5700	0.5669	0.5522	0.5522	0.5495	0.5579	0.5669	0.5733	0.5799	(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 Front Elevation (Uw = 1.60)			4.8600	1.5038	7.3083			(27)
Door			2.2000	1.2000	2.6400			(26)
Windows Light Well (Uw = 1.20)			2.8100	1.1450	3.2176			(27)
Mansard Window (Uw = 1.20)			4.1800	1.1450	4.7863			(27)
Roof Lights (Uw = 1.20)			2.1500	1.1450	2.4618			(27a)
Existing Wall	14.0500	4.8600	9.1900	0.3000	2.7570			(29a)
Sheltered Wall	7.4000	2.2000	5.2000	0.2362	1.2283			(29a)
Lift Wall	22.9700		22.9700	0.3448	7.9207			(29a)
Light Well Wall	14.3200	2.8100	11.5100	0.1500	1.7265			(29a)
Mansard Wall	29.8100	4.1800	25.6300	0.1500	3.8445			(29a)
External Roof 1	47.2600	2.1500	45.1100	0.1800	8.1198			(30)
Total net area of external elements Aum(A, m2)			135.8100					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		46.0108			(33)
Party Wall 1			76.5400	0.0000	0.0000			(32)
Party Floor 1			55.9700					(32d)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Default value 0.150 * total exposed area)	20.3715	(36)
Total fabric heat loss (33) + (36) =	66.3823	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	52.1785	51.8576	51.5430	50.0655	49.7890	48.5022	48.5022	48.2639	48.9979	49.7890	50.3483	50.9329	(38)
Heat transfer coeff	118.5607	118.2398	117.9252	116.4477	116.1713	114.8844	114.8844	114.6461	115.3801	116.1713	116.7305	117.3152	(39)
Average = Sum(39)m / 12 =												116.4464	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0473	1.0444	1.0417	1.0286	1.0262	1.0148	1.0148	1.0127	1.0192	1.0262	1.0311	1.0363	(40)
HLP (average)												1.0286	(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	2.8328	(42)
Average daily hot water use (litres/day)	101.4786	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.6264	107.5673	103.5081	99.4490	95.3899	91.3307	91.3307	95.3899	99.4490	103.5081	107.5673	111.6264	(44)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy conte	165.5388	144.7813	149.4013	130.2517	124.9796	107.8479	99.9369	114.6791	116.0487	135.2436	147.6289	160.3155	(45)
Energy content (annual)										Total = Sum(45)m =		1596.6531	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.8308	21.7172	22.4102	19.5378	18.7469	16.1772	14.9905	17.2019	17.4073	20.2865	22.1443	24.0473	(46)
Water storage loss:													
Store volume												200.0000	(47)
b) If manufacturer declared loss factor is not known :													
Hot water storage loss factor from Table 2 (kWh/litre/day)												0.0103	(51)
Volume factor from Table 2a												0.8434	(52)
Temperature factor from Table 2b												0.5400	(53)
Enter (49) or (54) in (55)												0.9372	(55)
Total storage loss													
	29.0527	26.2411	29.0527	28.1155	29.0527	28.1155	29.0527	29.0527	28.1155	29.0527	28.1155	29.0527	(56)
If cylinder contains dedicated solar storage													
	29.0527	26.2411	29.0527	28.1155	29.0527	28.1155	29.0527	29.0527	28.1155	29.0527	28.1155	29.0527	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	217.8539	192.0336	201.7164	180.8792	177.2947	158.4754	152.2520	166.9942	166.6762	187.5587	198.2564	212.6306	(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													
	217.8539	192.0336	201.7164	180.8792	177.2947	158.4754	152.2520	166.9942	166.6762	187.5587	198.2564	212.6306	(64)
									Total per year (kWh/year) = Sum(64)m =			2212.6211	(64)
Heat gains from water heating, kWh/month													
	96.8937	85.9416	91.5280	83.8107	83.4078	76.3614	75.0811	79.9829	79.0882	86.8206	89.5886	95.1570	(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	141.6391	141.6391	141.6391	141.6391	141.6391	141.6391	141.6391	141.6391	141.6391	141.6391	141.6391	141.6391	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	26.9528	23.9393	19.4687	14.7391	11.0176	9.3016	10.0507	13.0642	17.5348	22.2644	25.9859	27.7019	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	276.0896	278.9545	271.7350	256.3654	236.9640	218.7294	206.5476	203.6827	210.9022	226.2719	245.6732	263.9078	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.1639	37.1639	37.1639	37.1639	37.1639	37.1639	37.1639	37.1639	37.1639	37.1639	37.1639	37.1639	(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)													
	-113.3113	-113.3113	-113.3113	-113.3113	-113.3113	-113.3113	-113.3113	-113.3113	-113.3113	-113.3113	-113.3113	-113.3113	(71)
Water heating gains (Table 5)													
	130.2335	127.8893	123.0215	116.4037	112.1072	106.0575	100.9154	107.5038	109.8447	116.6943	124.4286	127.8991	(72)
Total internal gains													
	501.7677	499.2749	482.7169	455.9999	428.5806	402.5802	386.0055	392.7425	406.7735	433.7223	464.5795	488.0006	(73)

---

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southwest	4.8600	36.7938	0.7600	0.7000	0.7700	65.9259	(79)
Northeast	2.8100	11.2829	0.6300	0.7000	0.7700	9.6895	(75)
Northeast	2.1800	11.2829	0.6300	0.7000	0.7700	7.5171	(75)
Southwest	2.0000	36.7938	0.6300	0.7000	0.7700	22.4893	(79)
Horizontal	2.1500	26.0000	0.6300	0.7000	1.0000	22.1867	(82)

Solar gains	127.8086	231.7085	351.0860	486.9554	589.1255	603.0929	573.9335	495.5797	398.1480	265.5722	155.7115	107.6368	(83)
Total gains	629.5762	730.9834	833.8029	942.9553	1017.7061	1005.6731	959.9390	888.3222	804.9215	699.2945	620.2910	595.6375	(84)

---

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	66.3104	66.4903	66.6677	67.5136	67.6743	68.4323	68.4323	68.5745	68.1383	67.6743	67.3500	67.0144	
alpha	5.4207	5.4327	5.4445	5.5009	5.5116	5.5622	5.5622	5.5716	5.5426	5.5116	5.4900	5.4676	
util living area													
	0.9986	0.9966	0.9896	0.9608	0.8706	0.6916	0.5194	0.5800	0.8425	0.9787	0.9968	0.9990	(86)
MIT	19.8577	20.0060	20.2513	20.5733	20.8350	20.9662	20.9942	20.9897	20.8997	20.5555	20.1485	19.8345	(87)
Th 2	20.0441	20.0465	20.0488	20.0596	20.0616	20.0710	20.0710	20.0728	20.0674	20.0616	20.0575	20.0532	(88)
util rest of house													
	0.9982	0.9954	0.9859	0.9463	0.8260	0.6070	0.4136	0.4701	0.7741	0.9682	0.9956	0.9987	(89)
MIT 2	18.5110	18.7292	19.0873	19.5537	19.8991	20.0485	20.0688	20.0684	19.9859	19.5369	18.9460	18.4837	(90)
Living area fraction									fLA = Living area / (4) =			0.2986	(91)
MIT	18.9130	19.1104	19.4348	19.8581	20.1785	20.3225	20.3451	20.3435	20.2588	19.8410	19.3050	18.8870	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.7630	18.9604	19.2848	19.7081	20.0285	20.1725	20.1951	20.1935	20.1088	19.6910	19.1550	18.7370	(93)

---

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9972	0.9935	0.9818	0.9395	0.8242	0.6168	0.4280	0.4849	0.7776	0.9626	0.9937	0.9979	(94)
Useful gains	627.8295	726.2425	818.6518	885.9159	838.8410	620.2977	410.8524	430.7187	625.8753	673.1587	616.4077	594.4043	(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													
	1714.7490	1662.5025	1507.6541	1258.5762	967.5355	640.1926	413.0206	434.9080	693.2903	1056.1151	1407.1864	1705.4103	(97)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	808.6681	629.1667	512.6177	268.3154	95.7487	0.0000	0.0000	0.0000	0.0000	284.9196	569.3607	826.5884	(98)
Space heating												3995.3854	(98)
Space heating per m2											(98) / (4) =	35.2918	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.0000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4439.3171	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	808.6681	629.1667	512.6177	268.3154	95.7487	0.0000	0.0000	0.0000	0.0000	284.9196	569.3607	826.5884	(98)
Space heating efficiency (main heating system 1)													
	90.0000	90.0000	90.0000	90.0000	90.0000	0.0000	0.0000	0.0000	0.0000	90.0000	90.0000	90.0000	(210)
Space heating fuel (main heating system)													
	898.5201	699.0741	569.5752	298.1283	106.3875	0.0000	0.0000	0.0000	0.0000	316.5773	632.6230	918.4316	(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													
	217.8539	192.0336	201.7164	180.8792	177.2947	158.4754	152.2520	166.9942	166.6762	187.5587	198.2564	212.6306	(64)
Efficiency of water heater												90.0000	(216)
(217)m	90.0000	90.0000	90.0000	90.0000	90.0000	90.0000	90.0000	90.0000	90.0000	90.0000	90.0000	90.0000	(217)
Fuel for water heating, kWh/month													
	242.0598	213.3707	224.1293	200.9769	196.9941	176.0838	169.1689	185.5491	185.1958	208.3985	220.2849	236.2562	(219)
Water heating fuel used												2458.4679	(219)
Annual totals kWh/year													
Space heating fuel - main system												4439.3171	(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)												475.9956	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 0.50 * 1080 * 1.00) =										-431.8098		-431.8098	(233)
Total delivered energy for all uses												7016.9708	(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	4439.3171	0.2160	958.8925	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2458.4679	0.2160	531.0291	(264)
Space and water heating			1489.9216	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	475.9956	0.5190	247.0417	(268)
Energy saving/generation technologies				
PV Unit	-431.8098	0.5190	-224.1093	(269)
Total CO2, kg/year			1551.7790	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			13.7100	(273)

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

DER		13.7100	ZC1
Total Floor Area	TFA	113.2100	
Assumed number of occupants	N	2.8328	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		14.4515	ZC2
CO2 emissions from cooking, equation (L16)		1.6517	ZC3
Total CO2 emissions		29.8131	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		29.8131	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	55.9700	(1b)	x 2.2700	(2b) =	127.0519	(1b) - (3b)
First floor	57.2400	(1c)	x 2.4300	(2c) =	139.0932	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	113.2100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		266.1451	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							4 * 10 =		40.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1503	(8)
Pressure test		Yes	
Measured/design q50		5.0000	
Infiltration rate		0.4003	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3402	(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	0.4338	0.4253	0.4168	0.3743	0.3658	0.3232	0.3232	0.3147	0.3402	0.3658	0.3828	0.3998	(22b)
Effective ac	0.5941	0.5904	0.5869	0.5700	0.5669	0.5522	0.5522	0.5495	0.5579	0.5669	0.5733	0.5799	(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			2.2000	1.0000	2.2000			(26)
TER Opening Type (Uw = 1.40)			11.8500	1.3258	15.7102			(27)
TER Room Window (Uw = 1.70)			2.1500	1.5918	3.4223			(27a)
Existing Wall	14.0500	4.8600	9.1900	0.1800	1.6542			(29a)
Sheltered Wall	7.4000	2.2000	5.2000	0.1800	0.9360			(29a)
Lift Wall	22.9700		22.9700	0.1800	4.1346			(29a)
Light Well Wall	14.3200	2.8100	11.5100	0.1800	2.0718			(29a)
Mansard Wall	29.8100	4.1800	25.6300	0.1800	4.6134			(29a)
External Roof 1	47.2600	2.1500	45.1100	0.1300	5.8643			(30)
Total net area of external elements Aum(A, m2)			135.8100					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	40.6068			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (User defined value 0.050 * total exposed area)	6.7905	(36)
Total fabric heat loss	(33) + (36) = 47.3973	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	52.1785	51.8576	51.5430	50.0655	49.7890	48.5022	48.5022	48.2639	48.9979	49.7890	50.3483	50.9329	(38)
Heat transfer coeff	99.5758	99.2549	98.9403	97.4628	97.1864	95.8995	95.8995	95.6612	96.3952	97.1864	97.7456	98.3302	(39)
Average = Sum(39)m / 12 =												97.4615	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.8796	0.8767	0.8740	0.8609	0.8585	0.8471	0.8471	0.8450	0.8515	0.8585	0.8634	0.8686	(40)
HLP (average)												0.8609	(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	2.8328 (42)
Average daily hot water use (litres/day)	101.4786 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.6264	107.5673	103.5081	99.4490	95.3899	91.3307	91.3307	95.3899	99.4490	103.5081	107.5673	111.6264	(44)
Energy conte	165.5388	144.7813	149.4013	130.2517	124.9796	107.8479	99.9369	114.6791	116.0487	135.2436	147.6289	160.3155	(45)
Energy content (annual)										Total = Sum(45)m =		1596.6531	(45)
Distribution loss (46)m = 0.15 x (45)m	24.8308	21.7172	22.4102	19.5378	18.7469	16.1772	14.9905	17.2019	17.4073	20.2865	22.1443	24.0473	(46)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Water storage loss:
Store volume 200.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): 1.6525 (48)
Temperature factor from Table 2b 0.5400 (49)
Enter (49) or (54) in (55) 0.8924 (55)
Total storage loss

	27.6637	24.9865	27.6637	26.7713	27.6637	26.7713	27.6637	27.6637	26.7713	27.6637	26.7713	27.6637 (56)

If cylinder contains dedicated solar storage

	27.6637	24.9865	27.6637	26.7713	27.6637	26.7713	27.6637	27.6637	26.7713	27.6637	26.7713	27.6637 (57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624 (59)

Total heat required for water heating calculated for each month

	216.4648	190.7790	200.3274	179.5350	175.9057	157.1312	150.8630	165.6051	165.3320	186.1696	196.9122	211.2415 (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

	216.4648	190.7790	200.3274	179.5350	175.9057	157.1312	150.8630	165.6051	165.3320	186.1696	196.9122	211.2415 (64)

Total per year (kWh/year) = Sum(64)m = 2196.2666 (64)
Heat gains from water heating, kWh/month

	95.7825	84.9380	90.4168	82.7353	82.2966	75.2861	73.9699	78.8716	78.0128	85.7093	88.5133	94.0458 (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	141.6391	141.6391	141.6391	141.6391	141.6391	141.6391	141.6391	141.6391	141.6391	141.6391	141.6391	141.6391	(66)

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

	26.9528	23.9393	19.4687	14.7391	11.0176	9.3016	10.0507	13.0642	17.5348	22.2644	25.9859	27.7019 (67)

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

	276.0896	278.9545	271.7350	256.3654	236.9640	218.7294	206.5476	203.6827	210.9022	226.2719	245.6732	263.9078 (68)

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

	37.1639	37.1639	37.1639	37.1639	37.1639	37.1639	37.1639	37.1639	37.1639	37.1639	37.1639	37.1639 (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)

	-113.3113	-113.3113	-113.3113	-113.3113	-113.3113	-113.3113	-113.3113	-113.3113	-113.3113	-113.3113	-113.3113	-113.3113 (71)

Water heating gains (Table 5)

	128.7399	126.3958	121.5279	114.9102	110.6137	104.5640	99.4219	106.0103	108.3512	115.2007	122.9351	126.4056 (72)

Total internal gains

	500.2741	497.7813	481.2234	454.5063	427.0870	401.0867	384.5119	391.2489	405.2799	432.2287	463.0859	486.5071 (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	4.9900	11.2829	0.6300	0.7000	0.7700	17.2066	(75)
Southwest	6.8600	36.7938	0.6300	0.7000	0.7700	77.1385	(79)
Horizontal	2.1500	26.0000	0.6300	0.7000	1.0000	22.1867	(82)

Solar gains	116.5318	212.4999	324.8040	454.3907	552.6504	566.8815	539.0219	463.5855	369.6902	244.3427	142.2045	97.9862 (83)
Total gains	616.8059	710.2813	806.0274	908.8970	979.7374	967.9682	923.5338	854.8344	774.9701	676.5714	605.2904	584.4933 (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	78.9530	79.2083	79.4601	80.6647	80.8941	81.9796	81.9796	82.1839	81.5581	80.8941	80.4313	79.9531	
alpha	6.2635	6.2806	6.2973	6.3776	6.3929	6.4653	6.4653	6.4789	6.4372	6.3929	6.3621	6.3302	
util living area	0.9987	0.9966	0.9882	0.9490	0.8275	0.6214	0.4553	0.5114	0.7913	0.9732	0.9968	0.9991	(86)
MIT	20.0865	20.2229	20.4426	20.7226	20.9184	20.9893	20.9987	20.9974	20.9545	20.6914	20.3389	20.0662	(87)
Th 2	20.1849	20.1873	20.1897	20.2009	20.2030	20.2127	20.2127	20.2145	20.2089	20.2030	20.1987	20.1943	(88)
util rest of house	0.9983	0.9955	0.9842	0.9322	0.7814	0.5504	0.3747	0.4259	0.7241	0.9612	0.9955	0.9988	(89)
MIT 2	18.9504	19.1512	19.4718	19.8750	20.1249	20.2057	20.2122	20.2134	20.1733	19.8399	19.3298	18.9278	(90)
Living area fraction									fLA = Living area / (4) =			0.2986	(91)
MIT	19.2896	19.4712	19.7616	20.1280	20.3618	20.4396	20.4470	20.4475	20.4065	20.0941	19.6311	19.2677	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.2896	19.4712	19.7616	20.1280	20.3618	20.4396	20.4470	20.4475	20.4065	20.0941	19.6311	19.2677	(93)

---

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9977	0.9941	0.9815	0.9305	0.7912	0.5713	0.3988	0.4515	0.7420	0.9592	0.9943	0.9983	(94)
Useful gains	615.3756	706.1032	791.1496	845.7025	775.1827	553.0403	368.3404	385.9339	575.0593	648.9545	601.8165	583.5110	(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	1492.6017	1446.2606	1312.1109	1094.3157	841.8082	560.0191	368.9285	387.1889	607.9190	922.6975	1224.8597	1481.6075	(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	652.6562	497.3858	387.5952	179.0016	49.5693	0.0000	0.0000	0.0000	0.0000	203.6648	448.5911	668.1839	(98)
Space heating												3086.6479	(98)
Space heating per m2											(98) / (4) =	27.2648	(99)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3301.2277	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	652.6562	497.3858	387.5952	179.0016	49.5693	0.0000	0.0000	0.0000	0.0000	203.6648	448.5911	668.1839	(98)
Space heating efficiency (main heating system 1)													
	93.5000	93.5000	93.5000	93.5000	93.5000	0.0000	0.0000	0.0000	0.0000	93.5000	93.5000	93.5000	(210)
Space heating fuel (main heating system)													
	698.0280	531.9634	414.5403	191.4455	53.0153	0.0000	0.0000	0.0000	0.0000	217.8234	479.7766	714.6351	(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													
	216.4648	190.7790	200.3274	179.5350	175.9057	157.1312	150.8630	165.6051	165.3320	186.1696	196.9122	211.2415	(64)
Efficiency of water heater												79.8000	(216)
(217)m	87.5754	87.2565	86.5459	84.8059	81.9296	79.8000	79.8000	79.8000	79.8000	85.0537	86.9437	87.6761	(217)
Fuel for water heating, kWh/month													
	247.1755	218.6417	231.4695	211.7010	214.7035	196.9062	189.0514	207.5252	207.1830	218.8849	226.4824	240.9339	(219)
Water heating fuel used												2610.6580	(219)
Annual totals kWh/year													
Space heating fuel - main system												3301.2277	(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)												475.9956	(232)
Total delivered energy for all uses												6462.8813	(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	3301.2277	0.2160	713.0652	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2610.6580	0.2160	563.9021	(264)
Space and water heating			1276.9673	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	475.9956	0.5190	247.0417	(268)
Total CO2, kg/m2/year			1562.9341	(272)
Emissions per m2 for space and water heating			11.2796	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.1822	(272b)
Emissions per m2 for pumps and fans			0.3438	(272c)
Target Carbon Dioxide Emission Rate (TER) = (11.2796 * 1.00) + 2.1822 + 0.3438, rounded to 2 d.p.			13.8100	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	55.9700	(1b)	x 2.2700	(2b) =	127.0519	(1b) - (3b)
First floor	57.2400	(1c)	x 2.4300	(2c) =	139.0932	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	113.2100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		266.1451	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							4 * 10 =	40.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1503	(8)
Pressure test		Yes	
Measured/design q50		5.0000	
Infiltration rate		0.4003	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3402	(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	0.4338	0.4253	0.4168	0.3743	0.3658	0.3232	0.3232	0.3147	0.3402	0.3658	0.3828	0.3998	(22b)
Effective ac	0.5941	0.5904	0.5869	0.5700	0.5669	0.5522	0.5522	0.5495	0.5579	0.5669	0.5733	0.5799	(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 Front Elevation (Uw = 1.60)			4.8600	1.5038	7.3083			(27)
Door			2.2000	1.2000	2.6400			(26)
Windows Light Well (Uw = 1.20)			2.8100	1.1450	3.2176			(27)
Mansard Window (Uw = 1.20)			4.1800	1.1450	4.7863			(27)
Roof Lights (Uw = 1.20)			2.1500	1.1450	2.4618			(27a)
Existing Wall	14.0500	4.8600	9.1900	0.3000	2.7570			(29a)
Sheltered Wall	7.4000	2.2000	5.2000	0.2362	1.2283			(29a)
Lift Wall	22.9700		22.9700	0.3448	7.9207			(29a)
Light Well Wall	14.3200	2.8100	11.5100	0.1500	1.7265			(29a)
Mansard Wall	29.8100	4.1800	25.6300	0.1500	3.8445			(29a)
External Roof 1	47.2600	2.1500	45.1100	0.1800	8.1198			(30)
Total net area of external elements Aum(A, m2)			135.8100					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	46.0108			(33)
Party Wall 1			76.5400	0.0000	0.0000			(32)
Party Floor 1			55.9700					(32d)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Default value 0.150 * total exposed area)	20.3715	(36)
Total fabric heat loss	(33) + (36) = 66.3823	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	52.1785	51.8576	51.5430	50.0655	49.7890	48.5022	48.5022	48.2639	48.9979	49.7890	50.3483	50.9329	(38)
Heat transfer coeff	118.5607	118.2398	117.9252	116.4477	116.1713	114.8844	114.8844	114.6461	115.3801	116.1713	116.7305	117.3152	(39)
Average = Sum(39)m / 12 =												116.4464	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0473	1.0444	1.0417	1.0286	1.0262	1.0148	1.0148	1.0127	1.0192	1.0262	1.0311	1.0363	(40)
HLP (average)												1.0286	(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	2.8328	(42)
Average daily hot water use (litres/day)	101.4786	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.6264	107.5673	103.5081	99.4490	95.3899	91.3307	91.3307	95.3899	99.4490	103.5081	107.5673	111.6264	(44)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy conte	165.5388	144.7813	149.4013	130.2517	124.9796	107.8479	99.9369	114.6791	116.0487	135.2436	147.6289	160.3155	(45)
Energy content (annual)										Total = Sum(45)m =		1596.6531	(45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	35.1770	30.7660	31.7478	27.6785	26.5582	22.9177	21.2366	24.3693	24.6603	28.7393	31.3711	34.0670	(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	141.6391	141.6391	141.6391	141.6391	141.6391	141.6391	141.6391	141.6391	141.6391	141.6391	141.6391	141.6391	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	26.9528	23.9393	19.4687	14.7391	11.0176	9.3016	10.0507	13.0642	17.5348	22.2644	25.9859	27.7019	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	276.0896	278.9545	271.7350	256.3654	236.9640	218.7294	206.5476	203.6827	210.9022	226.2719	245.6732	263.9078	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.1639	37.1639	37.1639	37.1639	37.1639	37.1639	37.1639	37.1639	37.1639	37.1639	37.1639	37.1639	(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)													
	-113.3113	-113.3113	-113.3113	-113.3113	-113.3113	-113.3113	-113.3113	-113.3113	-113.3113	-113.3113	-113.3113	-113.3113	(71)
Water heating gains (Table 5)													
	47.2809	45.7828	42.6717	38.4423	35.6965	31.8301	28.5438	32.7544	34.2505	38.6280	43.5710	45.7890	(72)
Total internal gains													
	415.8151	414.1683	399.3672	375.0385	349.1698	325.3528	310.6338	314.9931	328.1792	352.6561	380.7219	402.8905	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southwest	4.8600	36.7938	0.7600	0.7000	0.7700	65.9259	(79)
Northeast	2.8100	11.2829	0.6300	0.7000	0.7700	9.6895	(75)
Northeast	2.1800	11.2829	0.6300	0.7000	0.7700	7.5171	(75)
Southwest	2.0000	36.7938	0.6300	0.7000	0.7700	22.4893	(79)
Horizontal	2.1500	26.0000	0.6300	0.7000	1.0000	22.1867	(82)

Solar gains	127.8086	231.7085	351.0860	486.9554	589.1255	603.0929	573.9335	495.5797	398.1480	265.5722	155.7115	107.6368	(83)
Total gains	543.6236	645.8768	750.4532	861.9939	938.2953	928.4457	884.5673	810.5728	726.3272	618.2283	536.4334	510.5273	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	66.3104	66.4903	66.6677	67.5136	67.6743	68.4323	68.4323	68.5745	68.1383	67.6743	67.3500	67.0144	
alpha	5.4207	5.4327	5.4445	5.5009	5.5116	5.5622	5.5622	5.5716	5.5426	5.5116	5.4900	5.4676	
util living area													
	0.9993	0.9981	0.9936	0.9729	0.8994	0.7345	0.5603	0.6286	0.8832	0.9877	0.9985	0.9995	(86)
MIT	19.7854	19.9351	20.1840	20.5161	20.7993	20.9546	20.9916	20.9848	20.8686	20.4928	20.0783	19.7627	(87)
Th 2	20.0441	20.0465	20.0488	20.0596	20.0616	20.0710	20.0710	20.0728	20.0674	20.0616	20.0575	20.0532	(88)
util rest of house													
	0.9991	0.9975	0.9913	0.9622	0.8607	0.6499	0.4478	0.5129	0.8236	0.9812	0.9978	0.9994	(89)
MIT 2	18.9253	19.0766	19.3262	19.6608	19.9226	20.0497	20.0688	20.0682	19.9907	19.6436	19.2288	18.9099	(90)
Living area fraction										fLA = Living area / (4) =		0.2986	(91)
MIT	19.1821	19.3329	19.5823	19.9161	20.1843	20.3198	20.3443	20.3419	20.2528	19.8971	19.4825	19.1645	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.1821	19.3329	19.5823	19.9161	20.1843	20.3198	20.3443	20.3419	20.2528	19.8971	19.4825	19.1645	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9988	0.9968	0.9897	0.9602	0.8665	0.6740	0.4817	0.5478	0.8373	0.9797	0.9973	0.9992	(94)
Useful gains	542.9869	643.8255	742.7591	827.6595	813.0022	625.7966	426.1197	444.0388	608.1564	605.6863	534.9696	510.1046	(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													
	1764.4295	1706.5437	1542.7324	1282.8033	985.6352	657.1214	430.1625	451.9220	709.9073	1080.0578	1445.4113	1755.5672	(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													
	908.7533	714.1466	595.1801	327.7036	128.4389	0.0000	0.0000	0.0000	0.0000	352.9324	655.5180	926.6242	(98)
Space heating												4609.2971	(98)
Space heating per m2											(98) / (4) =	40.7146	(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

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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	1079.9137	850.1448	871.3105	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8791	0.9372	0.9113	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	949.3920	796.7597	794.0006	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1169.1308	1117.0378	1037.5342	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	158.2120	238.2870	181.1890	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												577.6879	(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	39.5530	59.5717	45.2973	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												144.4220	(107)
Space cooling per m2												1.2757	(108)
Energy for space heating												40.7146	(99)
Energy for space cooling												1.2757	(108)
Total												41.9903	(109)
Dwelling Fabric Energy Efficiency (DFEE)												42.0	(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	55.9700	(1b)	x 2.2700	(2b) =	127.0519	(1b) - (3b)
First floor	57.2400	(1c)	x 2.4300	(2c) =	139.0932	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	113.2100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		266.1451	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							4 * 10 =		40.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1503	(8)
Pressure test		Yes	
Measured/design q50		5.0000	
Infiltration rate		0.4003	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3402	(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	0.4338	0.4253	0.4168	0.3743	0.3658	0.3232	0.3232	0.3147	0.3402	0.3658	0.3828	0.3998	(22b)
Effective ac	0.5941	0.5904	0.5869	0.5700	0.5669	0.5522	0.5522	0.5495	0.5579	0.5669	0.5733	0.5799	(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			2.2000	1.0000	2.2000			(26)
TER Opening Type (Uw = 1.40)			11.8500	1.3258	15.7102			(27)
TER Room Window (Uw = 1.70)			2.1500	1.5918	3.4223			(27a)
Existing Wall	14.0500	4.8600	9.1900	0.1800	1.6542			(29a)
Sheltered Wall	7.4000	2.2000	5.2000	0.1800	0.9360			(29a)
Lift Wall	22.9700		22.9700	0.1800	4.1346			(29a)
Light Well Wall	14.3200	2.8100	11.5100	0.1800	2.0718			(29a)
Mansard Wall	29.8100	4.1800	25.6300	0.1800	4.6134			(29a)
External Roof 1	47.2600	2.1500	45.1100	0.1300	5.8643			(30)
Total net area of external elements Aum(A, m2)			135.8100					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	40.6068			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (User defined value 0.050 * total exposed area)	6.7905	(36)
Total fabric heat loss	(33) + (36) = 47.3973	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	52.1785	51.8576	51.5430	50.0655	49.7890	48.5022	48.5022	48.2639	48.9979	49.7890	50.3483	50.9329	(38)
Heat transfer coeff	99.5758	99.2549	98.9403	97.4628	97.1864	95.8995	95.8995	95.6612	96.3952	97.1864	97.7456	98.3302	(39)
Average = Sum(39)m / 12 =												97.4615	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.8796	0.8767	0.8740	0.8609	0.8585	0.8471	0.8471	0.8450	0.8515	0.8585	0.8634	0.8686	(40)
HLP (average)												0.8609	(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	2.8328 (42)
Average daily hot water use (litres/day)	101.4786 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.6264	107.5673	103.5081	99.4490	95.3899	91.3307	91.3307	95.3899	99.4490	103.5081	107.5673	111.6264	(44)
Energy conte	165.5388	144.7813	149.4013	130.2517	124.9796	107.8479	99.9369	114.6791	116.0487	135.2436	147.6289	160.3155	(45)
Energy content (annual)										Total = Sum(45)m =		1596.6531	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Water storage loss:
Total storage loss

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

If cylinder contains dedicated solar storage

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

Heat gains from water heating, kWh/month

	35.1770	30.7660	31.7478	27.6785	26.5582	22.9177	21.2366	24.3693	24.6603	28.7393	31.3711	34.0670 (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	141.6391	141.6391	141.6391	141.6391	141.6391	141.6391	141.6391	141.6391	141.6391	141.6391	141.6391	141.6391	(66)

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

	26.9528	23.9393	19.4687	14.7391	11.0176	9.3016	10.0507	13.0642	17.5348	22.2644	25.9859	27.7019	(67)

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

	276.0896	278.9545	271.7350	256.3654	236.9640	218.7294	206.5476	203.6827	210.9022	226.2719	245.6732	263.9078	(68)

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

	37.1639	37.1639	37.1639	37.1639	37.1639	37.1639	37.1639	37.1639	37.1639	37.1639	37.1639	37.1639	(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)

	-113.3113	-113.3113	-113.3113	-113.3113	-113.3113	-113.3113	-113.3113	-113.3113	-113.3113	-113.3113	-113.3113	-113.3113	(71)

Water heating gains (Table 5)

	47.2809	45.7828	42.6717	38.4423	35.6965	31.8301	28.5438	32.7544	34.2505	38.6280	43.5710	45.7890	(72)

Total internal gains

	415.8151	414.1683	399.3672	375.0385	349.1698	325.3528	310.6338	314.9931	328.1792	352.6561	380.7219	402.8905	(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	4.9900	11.2829	0.6300	0.7000	0.7700	17.2066	(75)
Southwest	6.8600	36.7938	0.6300	0.7000	0.7700	77.1385	(79)
Horizontal	2.1500	26.0000	0.6300	0.7000	1.0000	22.1867	(82)

Solar gains	116.5318	212.4999	324.8040	454.3907	552.6504	566.8815	539.0219	463.5855	369.6902	244.3427	142.2045	97.9862	(83)
Total gains	532.3468	626.6683	724.1712	829.4292	901.8202	892.2343	849.6557	778.5786	697.8694	596.9987	522.9264	500.8768	(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	78.9530	79.2083	79.4601	80.6647	80.8941	81.9796	81.9796	82.1839	81.5581	80.8941	80.4313	79.9531	
alpha	6.2635	6.2806	6.2973	6.3776	6.3929	6.4653	6.4653	6.4789	6.4372	6.3929	6.3621	6.3302	
util living area	0.9995	0.9983	0.9933	0.9660	0.8657	0.6675	0.4939	0.5590	0.8439	0.9856	0.9986	0.9996	(86)
MIT	20.0133	20.1511	20.3752	20.6689	20.8921	20.9841	20.9980	20.9958	20.9331	20.6300	20.2679	19.9933	(87)
Th 2	20.1849	20.1873	20.1897	20.2009	20.2030	20.2127	20.2127	20.2145	20.2089	20.2030	20.1987	20.1943	(88)
util rest of house	0.9993	0.9977	0.9909	0.9538	0.8242	0.5939	0.4070	0.4668	0.7822	0.9785	0.9980	0.9995	(89)
MIT 2	19.2689	19.4085	19.6334	19.9292	20.1301	20.2054	20.2122	20.2133	20.1712	19.8971	19.5349	19.2569	(90)
Living area fraction									fLA = Living area / (4) =			0.2986	(91)
MIT	19.4911	19.6302	19.8548	20.1500	20.3576	20.4379	20.4468	20.4469	20.3987	20.1159	19.7537	19.4768	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.4911	19.6302	19.8548	20.1500	20.3576	20.4379	20.4468	20.4469	20.3987	20.1159	19.7537	19.4768	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9991	0.9972	0.9896	0.9529	0.8330	0.6156	0.4331	0.4945	0.7985	0.9775	0.9976	0.9994	(94)
Useful gains	531.8488	624.9139	716.6607	790.3848	751.1917	549.2755	367.9529	385.0132	557.2314	583.5775	521.6619	500.5574	(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	1512.6701	1462.0439	1321.3320	1096.4597	841.4040	559.8486	368.9032	387.1294	607.1654	924.8161	1236.8447	1502.1668	(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	729.7310	562.5514	449.8755	220.3739	67.1180	0.0000	0.0000	0.0000	0.0000	253.8815	514.9316	745.1974	(98)
Space heating												3543.6603	(98)
Space heating per m2											(98) / (4) =	31.3017	(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	901.4552	709.6562	727.0250	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9417	0.9759	0.9619	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	848.9214	692.5229	699.3316	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1126.8058	1076.2321	1000.1384	0.0000	0.0000	0.0000	0.0000	(103)

CALCULATION OF TARGET 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	200.0768	285.4796	223.8002	0.0000	0.0000	0.0000	0.0000 (104)
Space cooling												709.3567 (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	50.0192	71.3699	55.9501	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												177.3392 (107)
Space cooling per m2												1.5665 (108)
Energy for space heating												31.3017 (99)
Energy for space cooling												1.5665 (108)
Total												32.8681 (109)
Target Fabric Energy Efficiency (TFEE)												37.8 (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	55.9700 (1b)	x	2.2700 (2b)	=	127.0519	(1b) - (3b)
First floor	57.2400 (1c)	x	2.4300 (2c)	=	139.0932	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	113.2100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	266.1451	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							4 * 10 =	40.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1503	(8)
Pressure test		Yes	
Measured/design q50		5.0000	
Infiltration rate		0.4003	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3402	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.3573	0.3402	0.3402	0.3147	0.3147	0.2807	0.2892	0.2722	0.2807	0.2977	0.2977	0.3232	(22b)
Effective ac	0.5638	0.5579	0.5579	0.5495	0.5495	0.5394	0.5418	0.5370	0.5394	0.5443	0.5443	0.5522	(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 Front Elevation (Uw = 1.60)			4.8600	1.5038	7.3083			(27)
Door			2.2000	1.2000	2.6400			(26)
Windows Light Well (Uw = 1.20)			2.8100	1.1450	3.2176			(27)
Mansard Window (Uw = 1.20)			4.1800	1.1450	4.7863			(27)
Roof Lights (Uw = 1.20)			2.1500	1.1450	2.4618			(27a)
Existing Wall	14.0500	4.8600	9.1900	0.3000	2.7570			(29a)
Sheltered Wall	7.4000	2.2000	5.2000	0.2362	1.2283			(29a)
Lift Wall	22.9700		22.9700	0.3448	7.9207			(29a)
Light Well Wall	14.3200	2.8100	11.5100	0.1500	1.7265			(29a)
Mansard Wall	29.8100	4.1800	25.6300	0.1500	3.8445			(29a)
External Roof 1	47.2600	2.1500	45.1100	0.1800	8.1198			(30)
Total net area of external elements Aum(A, m2)			135.8100					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		46.0108			(33)
Party Wall 1			76.5400	0.0000	0.0000			(32)
Party Floor 1			55.9700					(32d)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Default value 0.150 * total exposed area)	20.3715	(36)
Total fabric heat loss	(33) + (36) = 66.3823	(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	49.5190	48.9979	48.9979	48.2639	48.2639	47.3742	47.5871	47.1676	47.3742	47.8063	47.8063	48.5022	(38)
Heat transfer coeff	115.9012	115.3801	115.3801	114.6461	114.6461	113.7564	113.9693	113.5499	113.7564	114.1886	114.1886	114.8844	(39)
Average = Sum(39)m / 12 =												114.5206	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0238	1.0192	1.0192	1.0127	1.0127	1.0048	1.0067	1.0030	1.0048	1.0086	1.0086	1.0148	(40)
HLP (average)												1.0116	(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	2.8328 (42)
Average daily hot water use (litres/day)	101.4786 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.6264	107.5673	103.5081	99.4490	95.3899	91.3307	91.3307	95.3899	99.4490	103.5081	107.5673	111.6264	(44)

CALCULATION OF HEAT DEMAND 09 Jan 2014

```
Energy conte   165.5388   144.7813   149.4013   130.2517   124.9796   107.8479    99.9369   114.6791   116.0487   135.2436   147.6289   160.3155 (45)
Energy content (annual)                                                                                  Total = Sum(45)m =   1596.6531 (45)
Distribution loss  (46)m = 0.15 x (45)m
               24.8308    21.7172    22.4102    19.5378    18.7469    16.1772    14.9905    17.2019    17.4073    20.2865    22.1443    24.0473 (46)
Water storage loss:
Store volume                                                                                                                          200.0000 (47)
  b) If manufacturer declared loss factor is not known :
  Hot water storage loss factor from Table 2 (kWh/litre/day)                                                                            0.0103 (51)
  Volume factor from Table 2a                                                                                                           0.8434 (52)
  Temperature factor from Table 2b                                                                                                      0.5400 (53)
Enter (49) or (54) in (55)                                                                                                              0.9372 (55)
Total storage loss
               29.0527    26.2411    29.0527    28.1155    29.0527    28.1155    29.0527    29.0527    28.1155    29.0527    28.1155    29.0527 (56)
If cylinder contains dedicated solar storage
               29.0527    26.2411    29.0527    28.1155    29.0527    28.1155    29.0527    29.0527    28.1155    29.0527    28.1155    29.0527 (57)
Primary loss   23.2624    21.0112    23.2624    22.5120    23.2624    22.5120    23.2624    23.2624    22.5120    23.2624    22.5120    23.2624 (59)
Total heat required for water heating calculated for each month
              217.8539   192.0336   201.7164   180.8792   177.2947   158.4754   152.2520   166.9942   166.6762   187.5587   198.2564   212.6306 (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
              217.8539   192.0336   201.7164   180.8792   177.2947   158.4754   152.2520   166.9942   166.6762   187.5587   198.2564   212.6306 (64)
                                                                                                  Total per year (kWh/year) = Sum(64)m =   2212.6211 (64)
RHI water heating demand                                                                                                                2213 (64)
Heat gains from water heating, kWh/month
               96.8937    85.9416    91.5280    83.8107    83.4078    76.3614    75.0811    79.9829    79.0882    86.8206    89.5886    95.1570 (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         169.9669   169.9669   169.9669   169.9669   169.9669   169.9669   169.9669   169.9669   169.9669   169.9669   169.9669   169.9669 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
               67.3821    59.8482    48.6718    36.8477    27.5441    23.2539    25.1266    32.6606    43.8369    55.6610    64.9647    69.2549 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
              412.0740   416.3501   405.5746   382.6349   353.6776   326.4618   308.2800   304.0040   314.7795   337.7192   366.6765   393.8922 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
               54.8295    54.8295    54.8295    54.8295    54.8295    54.8295    54.8295    54.8295    54.8295    54.8295    54.8295    54.8295 (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)
             -113.3113  -113.3113  -113.3113  -113.3113  -113.3113  -113.3113  -113.3113  -113.3113  -113.3113  -113.3113  -113.3113  -113.3113 (71)
Water heating gains (Table 5)
              130.2335   127.8893   123.0215   116.4037   112.1072   106.0575   100.9154   107.5038   109.8447   116.6943   124.4286   127.8991 (72)
Total internal gains
              724.1747   718.5727   691.7530   650.3714   607.8140   570.2584   548.8072   558.6535   582.9462   624.5597   670.5549   705.5314 (73)
```

---

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southwest	4.8600	40.4699	0.7600	0.7000	0.7700	72.5126	(79)
Northeast	2.8100	12.9236	0.6300	0.7000	0.7700	11.0984	(75)
Northeast	2.1800	12.9236	0.6300	0.7000	0.7700	8.6101	(75)
Southwest	2.0000	40.4699	0.6300	0.7000	0.7700	24.7363	(79)
Horizontal	2.1500	30.0000	0.6300	0.7000	1.0000	25.6001	(82)

```
Solar gains    142.5574   233.0943   350.1803   502.3965   593.3496   650.4162   612.1393   539.7791   431.1434   285.6320   178.0410   118.8312 (83)
Total gains    866.7322   951.6670  1041.9334  1152.7679  1201.1636  1220.6745  1160.9465  1098.4326  1014.0896   910.1917   848.5959   824.3625 (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           67.8320    68.1383    68.1383    68.5745    68.5745    69.1109    68.9818    69.2366    69.1109    68.8493    68.8493    68.4323
alpha          5.5221     5.5426     5.5426     5.5716     5.5716     5.6074     5.5988     5.6158     5.6074     5.5900     5.5900     5.5622
util living area
               0.9917     0.9852     0.9627     0.8864     0.7152     0.4625     0.3041     0.3304     0.6289     0.9087     0.9807     0.9934 (86)

MIT           20.1651    20.2867    20.5189    20.7867    20.9506    20.9964    20.9997    20.9996    20.9813    20.7903    20.4446    20.1429 (87)
Th 2           20.0636    20.0674    20.0674    20.0728    20.0728    20.0793    20.0777    20.0808    20.0793    20.0761    20.0761    20.0710 (88)
util rest of house
               0.9890     0.9804     0.9506     0.8527     0.6485     0.3791     0.2138     0.2357     0.5387     0.8731     0.9734     0.9912 (89)
MIT 2          18.9728    19.1510    19.4810    19.8444    20.0330    20.0777    20.0777    20.0808    20.0684    19.8601    19.3866    18.9464 (90)
Living area fraction                                                                                  fLA = Living area / (4) =      0.2986 (91)
MIT            19.3288    19.4901    19.7909    20.1257    20.3069    20.3520    20.3530    20.3551    20.3410    20.1378    19.7025    19.3036 (92)
Temperature adjustment                                                                                                                -0.1500
adjusted MIT   19.1788    19.3401    19.6409    19.9757    20.1569    20.2020    20.2030    20.2051    20.1910    19.9878    19.5525    19.1536 (93)
```

---

8. Space heating requirement

```
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation    0.9855     0.9755     0.9437     0.8487     0.6549     0.3903     0.2260     0.2485     0.5501     0.8690     0.9680     0.9882 (94)
Useful gains  854.1816   928.3601   983.2891   978.3555   786.6438   476.4869   262.4204   273.0142   557.8766   790.9633   821.4064   814.6499 (95)
Ext temp.       5.1000     5.6000     7.4000     9.9000    13.0000    16.0000    17.9000    17.8000    15.2000    11.6000     8.0000     5.1000 (96)
Heat loss rate W
```

CALCULATION OF HEAT DEMAND 09 Jan 2014

	1631.7484	1585.3345	1412.3562	1155.1407	820.5157	478.0053	262.4697	273.0969	567.7545	957.7931	1319.1602	1614.5413 (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												
	578.5097	441.4868	319.2259	127.2854	25.2007	0.0000	0.0000	0.0000	0.0000	124.1214	358.3827	595.1192 (98)
Space heating												2569.3318 (98)
RHI space heating demand												2569 (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	55.9700	(1b)	x 2.2700	(2b) =	127.0519	(1b) - (3b)
First floor	57.2400	(1c)	x 2.4300	(2c) =	139.0932	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	113.2100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		266.1451	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							4 * 10 =	40.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1503	(8)
Pressure test		Yes	
Measured/design q50		5.0000	
Infiltration rate		0.4003	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3402	(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	0.4338	0.4253	0.4168	0.3743	0.3658	0.3232	0.3232	0.3147	0.3402	0.3658	0.3828	0.3998	(22b)
Effective ac	0.5941	0.5904	0.5869	0.5700	0.5669	0.5522	0.5522	0.5495	0.5579	0.5669	0.5733	0.5799	(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 Front Elevation (Uw = 1.60)			4.8600	1.5038	7.3083			(27)
Door			2.2000	1.2000	2.6400			(26)
Windows Light Well (Uw = 1.20)			2.8100	1.1450	3.2176			(27)
Mansard Window (Uw = 1.20)			4.1800	1.1450	4.7863			(27)
Roof Lights (Uw = 1.20)			2.1500	1.1450	2.4618			(27a)
Existing Wall	14.0500	4.8600	9.1900	0.3000	2.7570			(29a)
Sheltered Wall	7.4000	2.2000	5.2000	0.2362	1.2283			(29a)
Lift Wall	22.9700		22.9700	0.3448	7.9207			(29a)
Light Well Wall	14.3200	2.8100	11.5100	0.1500	1.7265			(29a)
Mansard Wall	29.8100	4.1800	25.6300	0.1500	3.8445			(29a)
External Roof 1	47.2600	2.1500	45.1100	0.1800	8.1198			(30)
Total net area of external elements Aum(A, m2)			135.8100					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		46.0108			(33)
Party Wall 1			76.5400	0.0000	0.0000			(32)
Party Floor 1			55.9700					(32d)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Default value 0.150 * total exposed area)	20.3715	(36)
Total fabric heat loss (33) + (36) =	66.3823	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	52.1785	51.8576	51.5430	50.0655	49.7890	48.5022	48.5022	48.2639	48.9979	49.7890	50.3483	50.9329	(38)
Heat transfer coeff	118.5607	118.2398	117.9252	116.4477	116.1713	114.8844	114.8844	114.6461	115.3801	116.1713	116.7305	117.3152	(39)
Average = Sum(39)m / 12 =												116.4464	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0473	1.0444	1.0417	1.0286	1.0262	1.0148	1.0148	1.0127	1.0192	1.0262	1.0311	1.0363	(40)
HLP (average)												1.0286	(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	2.8328	(42)
Average daily hot water use (litres/day)	101.4786	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.6264	107.5673	103.5081	99.4490	95.3899	91.3307	91.3307	95.3899	99.4490	103.5081	107.5673	111.6264	(44)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Energy conte	165.5388	144.7813	149.4013	130.2517	124.9796	107.8479	99.9369	114.6791	116.0487	135.2436	147.6289	160.3155	(45)
Energy content (annual)										Total = Sum(45)m =		1596.6531	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.8308	21.7172	22.4102	19.5378	18.7469	16.1772	14.9905	17.2019	17.4073	20.2865	22.1443	24.0473	(46)
Water storage loss:													
Store volume												200.0000	(47)
b) If manufacturer declared loss factor is not known :													
Hot water storage loss factor from Table 2 (kWh/litre/day)												0.0103	(51)
Volume factor from Table 2a												0.8434	(52)
Temperature factor from Table 2b												0.5400	(53)
Enter (49) or (54) in (55)												0.9372	(55)
Total storage loss													
	29.0527	26.2411	29.0527	28.1155	29.0527	28.1155	29.0527	29.0527	28.1155	29.0527	28.1155	29.0527	(56)
If cylinder contains dedicated solar storage													
	29.0527	26.2411	29.0527	28.1155	29.0527	28.1155	29.0527	29.0527	28.1155	29.0527	28.1155	29.0527	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	217.8539	192.0336	201.7164	180.8792	177.2947	158.4754	152.2520	166.9942	166.6762	187.5587	198.2564	212.6306	(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													
	217.8539	192.0336	201.7164	180.8792	177.2947	158.4754	152.2520	166.9942	166.6762	187.5587	198.2564	212.6306	(64)
									Total per year (kWh/year) = Sum(64)m =			2212.6211	(64)
Heat gains from water heating, kWh/month													
	96.8937	85.9416	91.5280	83.8107	83.4078	76.3614	75.0811	79.9829	79.0882	86.8206	89.5886	95.1570	(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	169.9669	169.9669	169.9669	169.9669	169.9669	169.9669	169.9669	169.9669	169.9669	169.9669	169.9669	169.9669	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	67.3821	59.8482	48.6718	36.8477	27.5441	23.2539	25.1266	32.6606	43.8369	55.6610	64.9647	69.2549	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	412.0740	416.3501	405.5746	382.6349	353.6776	326.4618	308.2800	304.0040	314.7795	337.7192	366.6765	393.8922	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.8295	54.8295	54.8295	54.8295	54.8295	54.8295	54.8295	54.8295	54.8295	54.8295	54.8295	54.8295	(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)													
	-113.3113	-113.3113	-113.3113	-113.3113	-113.3113	-113.3113	-113.3113	-113.3113	-113.3113	-113.3113	-113.3113	-113.3113	(71)
Water heating gains (Table 5)													
	130.2335	127.8893	123.0215	116.4037	112.1072	106.0575	100.9154	107.5038	109.8447	116.6943	124.4286	127.8991	(72)
Total internal gains													
	724.1747	718.5727	691.7530	650.3714	607.8140	570.2584	548.8072	558.6535	582.9462	624.5597	670.5549	705.5314	(73)

---

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southwest	4.8600	36.7938	0.7600	0.7000	0.7700	65.9259	(79)
Northeast	2.8100	11.2829	0.6300	0.7000	0.7700	9.6895	(75)
Northeast	2.1800	11.2829	0.6300	0.7000	0.7700	7.5171	(75)
Southwest	2.0000	36.7938	0.6300	0.7000	0.7700	22.4893	(79)
Horizontal	2.1500	26.0000	0.6300	0.7000	1.0000	22.1867	(82)

Solar gains	127.8086	231.7085	351.0860	486.9554	589.1255	603.0929	573.9335	495.5797	398.1480	265.5722	155.7115	107.6368	(83)
Total gains	851.9833	950.2812	1042.8390	1137.3268	1196.9395	1173.3513	1122.7408	1054.2332	981.0942	890.1319	826.2664	813.1682	(84)

---

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	66.3104	66.4903	66.6677	67.5136	67.6743	68.4323	68.4323	68.5745	68.1383	67.6743	67.3500	67.0144	
alpha	5.4207	5.4327	5.4445	5.5009	5.5116	5.5622	5.5622	5.5716	5.5426	5.5116	5.4900	5.4676	
util living area													
	0.9941	0.9884	0.9724	0.9210	0.8000	0.6084	0.4473	0.4949	0.7470	0.9434	0.9878	0.9953	(86)
MIT	20.0421	20.1843	20.4111	20.6933	20.8957	20.9818	20.9972	20.9952	20.9462	20.6873	20.3162	20.0161	(87)
Th 2	20.0441	20.0465	20.0488	20.0596	20.0616	20.0710	20.0710	20.0728	20.0674	20.0616	20.0575	20.0532	(88)
util rest of house													
	0.9922	0.9847	0.9636	0.8966	0.7465	0.5278	0.3544	0.3980	0.6692	0.9204	0.9833	0.9939	(89)
MIT 2	18.7796	18.9871	19.3140	19.7119	19.9647	20.0595	20.0700	20.0709	20.0276	19.7136	19.1880	18.7484	(90)
Living area fraction									fLA = Living area / (4) =			0.2986	(91)
MIT	19.1565	19.3445	19.6415	20.0049	20.2427	20.3349	20.3468	20.3468	20.3018	20.0043	19.5249	19.1269	(92)
Temperature adjustment												-0.1500	
adjusted MIT	19.0065	19.1945	19.4915	19.8549	20.0927	20.1849	20.1968	20.1968	20.1518	19.8543	19.3749	18.9769	(93)

---

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9894	0.9803	0.9571	0.8903	0.7484	0.5380	0.3671	0.4111	0.6768	0.9141	0.9788	0.9915	(94)
Useful gains	842.9131	931.6042	998.0730	1012.5901	895.7765	631.2956	412.2132	433.4386	663.9918	813.6688	808.7428	806.2347	(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													
	1743.6164	1690.1796	1532.0314	1275.6760	974.9898	641.6176	413.2200	435.2939	698.2618	1075.0883	1432.8508	1733.5522	(97)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	670.1233	509.7627	397.2650	189.4218	58.9347	0.0000	0.0000	0.0000	0.0000	194.4962	449.3578	689.9242	(98)
Space heating												3159.2856	(98)
Space heating per m2											(98) / (4) =	27.9064	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.0000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3510.3174	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	670.1233	509.7627	397.2650	189.4218	58.9347	0.0000	0.0000	0.0000	0.0000	194.4962	449.3578	689.9242	(98)
Space heating efficiency (main heating system 1)	90.0000	90.0000	90.0000	90.0000	90.0000	0.0000	0.0000	0.0000	0.0000	90.0000	90.0000	90.0000	(210)
Space heating fuel (main heating system)	744.5814	566.4030	441.4056	210.4687	65.4830	0.0000	0.0000	0.0000	0.0000	216.1068	499.2864	766.5825	(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	217.8539	192.0336	201.7164	180.8792	177.2947	158.4754	152.2520	166.9942	166.6762	187.5587	198.2564	212.6306	(64)
Efficiency of water heater												90.0000	(216)
(217)m	90.0000	90.0000	90.0000	90.0000	90.0000	90.0000	90.0000	90.0000	90.0000	90.0000	90.0000	90.0000	(217)
Fuel for water heating, kWh/month	242.0598	213.3707	224.1293	200.9769	196.9941	176.0838	169.1689	185.5491	185.1958	208.3985	220.2849	236.2562	(219)
Water heating fuel used												2458.4679	(219)
Annual totals kWh/year													
Space heating fuel - main system												3510.3174	(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)												475.9956	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 0.50 * 1080 * 1.00) =										-431.8098		-431.8098	(233)
Total delivered energy for all uses												6087.9711	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3510.3174	3.4800	122.1590	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2458.4679	3.4800	85.5547	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	475.9956	13.1900	62.7838	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-431.8098	13.1900	-56.9557	(252)
Total energy cost			343.4343	(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] =	0.9117	(257)
SAP value		87.2816	
SAP rating (Section 12)		87	(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	3510.3174	0.2160	758.2286	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2458.4679	0.2160	531.0291	(264)
Space and water heating			1289.2576	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	475.9956	0.5190	247.0417	(268)
Energy saving/generation technologies				
PV Unit	-431.8098	0.5190	-224.1093	(269)
Total kg/year			1351.1150	(272)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

CO2 emissions per m2	11.9300 (273)
EI value	88.5564
EI rating	89 (274)
EI band	B

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9000 = 3.867, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9000 = 0.2400, stars = 4
Water heating energy efficiency	3.48 / 0.9000 = 3.867, stars = 4
Water heating environmental impact	0.216 / 0.9000 = 0.2400, 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	55.9700	(1b)	x 2.2700	(2b) =	127.0519	(1b) - (3b)
First floor	57.2400	(1c)	x 2.4300	(2c) =	139.0932	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	113.2100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		266.1451	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							4 * 10 =		40.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1503	(8)
Pressure test			Yes	
Measured/design q50			5.0000	
Infiltration rate			0.4003	(18)
Number of sides sheltered			2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3402	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.3573	0.3402	0.3402	0.3147	0.3147	0.2807	0.2892	0.2722	0.2807	0.2977	0.2977	0.3232	(22b)
Effective ac	0.5638	0.5579	0.5579	0.5495	0.5495	0.5394	0.5418	0.5370	0.5394	0.5443	0.5443	0.5522	(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 Front Elevation (Uw = 1.60)			4.8600	1.5038	7.3083			(27)
Door			2.2000	1.2000	2.6400			(26)
Windows Light Well (Uw = 1.20)			2.8100	1.1450	3.2176			(27)
Mansard Window (Uw = 1.20)			4.1800	1.1450	4.7863			(27)
Roof Lights (Uw = 1.20)			2.1500	1.1450	2.4618			(27a)
Existing Wall	14.0500	4.8600	9.1900	0.3000	2.7570			(29a)
Sheltered Wall	7.4000	2.2000	5.2000	0.2362	1.2283			(29a)
Lift Wall	22.9700		22.9700	0.3448	7.9207			(29a)
Light Well Wall	14.3200	2.8100	11.5100	0.1500	1.7265			(29a)
Mansard Wall	29.8100	4.1800	25.6300	0.1500	3.8445			(29a)
External Roof 1	47.2600	2.1500	45.1100	0.1800	8.1198			(30)
Total net area of external elements Aum(A, m2)			135.8100					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		46.0108			(33)
Party Wall 1			76.5400	0.0000	0.0000			(32)
Party Floor 1			55.9700					(32d)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Default value 0.150 * total exposed area)	20.3715	(36)
Total fabric heat loss (33) + (36) =	66.3823	(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	49.5190	48.9979	48.9979	48.2639	48.2639	47.3742	47.5871	47.1676	47.3742	47.8063	47.8063	48.5022	(38)
Heat transfer coeff	115.9012	115.3801	115.3801	114.6461	114.6461	113.7564	113.9693	113.5499	113.7564	114.1886	114.1886	114.8844	(39)
Average = Sum(39)m / 12 =												114.5206	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0238	1.0192	1.0192	1.0127	1.0127	1.0048	1.0067	1.0030	1.0048	1.0086	1.0086	1.0148	(40)
HLP (average)												1.0116	(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	2.8328	(42)
Average daily hot water use (litres/day)	101.4786	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.6264	107.5673	103.5081	99.4490	95.3899	91.3307	91.3307	95.3899	99.4490	103.5081	107.5673	111.6264	(44)

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

Energy conte	165.5388	144.7813	149.4013	130.2517	124.9796	107.8479	99.9369	114.6791	116.0487	135.2436	147.6289	160.3155	(45)
Energy content (annual)										Total = Sum(45)m =		1596.6531	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.8308	21.7172	22.4102	19.5378	18.7469	16.1772	14.9905	17.2019	17.4073	20.2865	22.1443	24.0473	(46)
Water storage loss:													
Store volume												200.0000	(47)
b) If manufacturer declared loss factor is not known :													
Hot water storage loss factor from Table 2 (kWh/litre/day)												0.0103	(51)
Volume factor from Table 2a												0.8434	(52)
Temperature factor from Table 2b												0.5400	(53)
Enter (49) or (54) in (55)												0.9372	(55)
Total storage loss													
	29.0527	26.2411	29.0527	28.1155	29.0527	28.1155	29.0527	29.0527	28.1155	29.0527	28.1155	29.0527	(56)
If cylinder contains dedicated solar storage													
	29.0527	26.2411	29.0527	28.1155	29.0527	28.1155	29.0527	29.0527	28.1155	29.0527	28.1155	29.0527	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	217.8539	192.0336	201.7164	180.8792	177.2947	158.4754	152.2520	166.9942	166.6762	187.5587	198.2564	212.6306	(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													
	217.8539	192.0336	201.7164	180.8792	177.2947	158.4754	152.2520	166.9942	166.6762	187.5587	198.2564	212.6306	(64)
								Total per year (kWh/year) = Sum(64)m =				2212.6211	(64)
Heat gains from water heating, kWh/month													
	96.8937	85.9416	91.5280	83.8107	83.4078	76.3614	75.0811	79.9829	79.0882	86.8206	89.5886	95.1570	(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	169.9669	169.9669	169.9669	169.9669	169.9669	169.9669	169.9669	169.9669	169.9669	169.9669	169.9669	169.9669	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	67.3821	59.8482	48.6718	36.8477	27.5441	23.2539	25.1266	32.6606	43.8369	55.6610	64.9647	69.2549	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	412.0740	416.3501	405.5746	382.6349	353.6776	326.4618	308.2800	304.0040	314.7795	337.7192	366.6765	393.8922	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.8295	54.8295	54.8295	54.8295	54.8295	54.8295	54.8295	54.8295	54.8295	54.8295	54.8295	54.8295	(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)													
	-113.3113	-113.3113	-113.3113	-113.3113	-113.3113	-113.3113	-113.3113	-113.3113	-113.3113	-113.3113	-113.3113	-113.3113	(71)
Water heating gains (Table 5)													
	130.2335	127.8893	123.0215	116.4037	112.1072	106.0575	100.9154	107.5038	109.8447	116.6943	124.4286	127.8991	(72)
Total internal gains													
	724.1747	718.5727	691.7530	650.3714	607.8140	570.2584	548.8072	558.6535	582.9462	624.5597	670.5549	705.5314	(73)

---

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southwest	4.8600	40.4699	0.7600	0.7000	0.7700	72.5126	(79)
Northeast	2.8100	12.9236	0.6300	0.7000	0.7700	11.0984	(75)
Northeast	2.1800	12.9236	0.6300	0.7000	0.7700	8.6101	(75)
Southwest	2.0000	40.4699	0.6300	0.7000	0.7700	24.7363	(79)
Horizontal	2.1500	30.0000	0.6300	0.7000	1.0000	25.6001	(82)

Solar gains	142.5574	233.0943	350.1803	502.3965	593.3496	650.4162	612.1393	539.7791	431.1434	285.6320	178.0410	118.8312	(83)
Total gains	866.7322	951.6670	1041.9334	1152.7679	1201.1636	1220.6745	1160.9465	1098.4326	1014.0896	910.1917	848.5959	824.3625	(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	67.8320	68.1383	68.1383	68.5745	68.5745	69.1109	68.9818	69.2366	69.1109	68.8493	68.8493	68.4323	
alpha	5.5221	5.5426	5.5426	5.5716	5.5716	5.6074	5.5988	5.6158	5.6074	5.5900	5.5900	5.5622	
util living area													
	0.9917	0.9852	0.9627	0.8864	0.7152	0.4625	0.3041	0.3304	0.6289	0.9087	0.9807	0.9934	(86)
MIT	20.1651	20.2867	20.5189	20.7867	20.9506	20.9964	20.9997	20.9996	20.9813	20.7903	20.4446	20.1429	(87)
Th 2	20.0636	20.0674	20.0674	20.0728	20.0728	20.0793	20.0777	20.0808	20.0793	20.0761	20.0761	20.0710	(88)
util rest of house													
	0.9890	0.9804	0.9506	0.8527	0.6485	0.3791	0.2138	0.2357	0.5387	0.8731	0.9734	0.9912	(89)
MIT 2	18.9728	19.1510	19.4810	19.8444	20.0330	20.0777	20.0777	20.0808	20.0684	19.8601	19.3866	18.9464	(90)
Living area fraction									fLA = Living area / (4) =			0.2986	(91)
MIT	19.3288	19.4901	19.7909	20.1257	20.3069	20.3520	20.3530	20.3551	20.3410	20.1378	19.7025	19.3036	(92)
Temperature adjustment												-0.1500	
adjusted MIT	19.1788	19.3401	19.6409	19.9757	20.1569	20.2020	20.2030	20.2051	20.1910	19.9878	19.5525	19.1536	(93)

---

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9855	0.9755	0.9437	0.8487	0.6549	0.3903	0.2260	0.2485	0.5501	0.8690	0.9680	0.9882	(94)
Useful gains	854.1816	928.3601	983.2891	978.3555	786.6438	476.4869	262.4204	273.0142	557.8766	790.9633	821.4064	814.6499	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W													
	1631.7484	1585.3345	1412.3562	1155.1407	820.5157	478.0053	262.4697	273.0969	567.7545	957.7931	1319.1602	1614.5413	(97)

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

Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	578.5097	441.4868	319.2259	127.2854	25.2007	0.0000	0.0000	0.0000	0.0000	124.1214	358.3827	595.1192	(98)
Space heating												2569.3318	(98)
Space heating per m2											(98) / (4) =	22.6953	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.0000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												2854.8131	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	578.5097	441.4868	319.2259	127.2854	25.2007	0.0000	0.0000	0.0000	0.0000	124.1214	358.3827	595.1192	(98)
Space heating efficiency (main heating system 1)	90.0000	90.0000	90.0000	90.0000	90.0000	0.0000	0.0000	0.0000	0.0000	90.0000	90.0000	90.0000	(210)
Space heating fuel (main heating system)	642.7886	490.5409	354.6955	141.4282	28.0007	0.0000	0.0000	0.0000	0.0000	137.9127	398.2030	661.2435	(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	217.8539	192.0336	201.7164	180.8792	177.2947	158.4754	152.2520	166.9942	166.6762	187.5587	198.2564	212.6306	(64)
Efficiency of water heater												90.0000	(216)
(217)m	90.0000	90.0000	90.0000	90.0000	90.0000	90.0000	90.0000	90.0000	90.0000	90.0000	90.0000	90.0000	(217)
Fuel for water heating, kWh/month	242.0598	213.3707	224.1293	200.9769	196.9941	176.0838	169.1689	185.5491	185.1958	208.3985	220.2849	236.2562	(219)
Water heating fuel used												2458.4679	(219)
Annual totals kWh/year													
Space heating fuel - main system												2854.8131	(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)												475.9956	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 0.50 * 1140 * 1.00) =										-456.0399		-456.0399	(233)
Total delivered energy for all uses												5408.2367	(238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2854.8131	4.2000	119.9021	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2458.4679	4.2000	103.2557	(247)
Pumps and fans for heating	75.0000	15.5400	11.6550	(249)
Energy for lighting	475.9956	15.5400	73.9697	(250)
Additional standing charges			90.0000	(251)
Energy saving/generation technologies				
PV Unit	-456.0399	15.5400	-70.8686	(252)
Total energy cost			327.9139	(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	2854.8131	0.2160	616.6396	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2458.4679	0.2160	531.0291	(264)
Space and water heating			1147.6687	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	475.9956	0.5190	247.0417	(268)
Energy saving/generation technologies				
PV Unit	-456.0399	0.5190	-236.6847	(269)
Total kg/year			1196.9507	(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	2854.8131	1.2200	3482.8720	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2458.4679	1.2200	2999.3308	(264)

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

Space and water heating			6482.2028 (265)
Pumps and fans	75.0000	3.0700	230.2500 (267)
Energy for lighting	475.9956	3.0700	1461.3066 (268)
Energy saving/generation technologies			
PV Unit	-456.0399	3.0700	-1400.0425 (269)
Primary energy kWh/year			6773.7169 (272)
Primary energy kWh/m2/year			59.8332 (273)

SAP 2012 EPC IMPROVEMENTS

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

(For testing purposes):

A	Not considered
B	Not considered
C	Not considered
D	Not considered
E Low energy lighting	Already installed
F	Not considered
G	Not considered
H	Not considered
I	Not considered
J	Not considered
K	Not considered
M	Not considered
N Solar water heating	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 87
Potential environmental impact rating: B 89

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	£86	£86	£0
Mains gas	£313	£313	£0
Space heating	£222	£222	£0
Water heating	£103	£103	£0
Lighting	£74	£74	£0
Generated (PV)	-£71	-£71	£0
Total cost of fuels	£328	£328	£0
Total cost of uses	£328	£328	£0
Delivered energy	48 kWh/m²	48 kWh/m²	0 kWh/m²
Carbon dioxide emissions	1.2 tonnes	1.2 tonnes	0.0 tonnes
CO2 emissions per m²	11 kg/m²	11 kg/m²	0 kg/m²
Primary energy	60 kWh/m²	60 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	MidTerrace Flat
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	South East
Oversha ding	Average or unknown
Thermal mass parameter	250.0
Night ventilation	Yes
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	351.31 (P1)
Transmission heat loss coefficient	66.38 (37)
Summer heat loss coefficient	417.69 (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)
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
South West	4.8600	119.9223	0.7600	0.7000	0.9000	251.1499
North East	2.8100	98.8453	0.6300	0.7000	0.9000	99.2169
North East	2.1800	98.8453	0.6300	0.7000	0.9000	76.9726
South West	2.0000	119.9223	0.6300	0.7000	0.9000	85.6749
Horizontal	2.1500	203.0000	0.6300	0.7000	1.0000	173.2270
total:						686.2414

	Jun	Jul	Aug	
Solar gains	729	686	606	(P3)
Internal gains	567	546	556	
Total summer gains	1296	1232	1162	(P5)
Summer gain/loss ratio	3.10	2.95	2.78	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 250.0)	0.25	0.25	0.25	
Threshold temperature	19.35	21.10	20.83	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

66 Charlotte Street

As designed

Date: Tue May 02 14:52:57 2017

Administrative information

Building Details

Address: ,

Certification tool

Calculation engine: TAS

Calculation engine version: "v9.4.0"

Interface to calculation engine: TAS

Interface to calculation engine version: v9.4.0

BRUKL compliance check version: v5.2.g.3

Owner Details

Name:

Telephone number:

Address: , ,

Certifier details

Name:

Telephone number:

Address: , ,

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

CO_2 emission rate from the notional building, $kgCO_2/m^2.annum$	39.2
Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	39.2
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	31.7
Are emissions from the building less than or equal to the target?	BER =< TER
Are as built details the same as used in the BER calculations?	Separate submission

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

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

Building fabric

Element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	Surface where the maximum value occurs*
Wall**	0.35	0.31	1.53	Lift Shaft Wall
Floor	0.25	0.22	0.25	Ground Floor
Roof	0.25	0.14	0.14	Roof
Windows***, roof windows, and rooflights	2.2	1.61	1.61	1st Floor
Personnel doors	2.2	1.6	1.61	Bin Store Door
Vehicle access & similar large doors	1.5	-	-	No vehicle doors in project
High usage entrance doors	3.5	-	-	No high usage entrance doors in project

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [W/(m²K)]
$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [W/(m²K)]
$U_{i\text{-}Calc}$ = Calculated maximum individual element U-values [W/(m²K)]

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

Air Permeability	Worst acceptable standard	This building
$m^3/(h.m^2)$ at 50 Pa	10	4

Building services

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

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	NO
Whole building electric power factor achieved by power factor correction	<0.9

1- VRF with Mechanical Ventilation (11 Zones)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.92	3.6	-	1.1	0.8
Standard value	0.91*	2.6	N/A	1.6^	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.

^ Allowed SFP may be increased by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide.

1- New HWS Circuit

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	0.92	0
Standard value	0.9*	N/A

* Standard shown is for gas boilers >30 kW output. For boilers <=30 kW output, limiting efficiency is 0.73.

"No zones in project where local mechanical ventilation, exhaust, or terminal unit is applicable"

General lighting and display lighting	**Luminous efficacy [lm/W]**			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
Basement B1 Small	90	-	-	369
Basement A3	-	90	22	104
Basement B1 Large Z1	90	-	-	359
Basement B1 Large Z2	90	-	-	611
Ground floor A1 Z1	-	90	22	278
Ground A3	-	90	22	161
Ground Floor B1 Z1	90	-	-	273
Ground Floor B1 Z2	90	-	-	263
First Floor B1	90	-	-	215
Ground floor A1 Z2	-	90	22	202
Ground floor B1 Z3	90	-	-	101
Adjoining buildings 1	90	-	-	1078
Adjoining buildings 2	90	-	-	349
Adjoining buildings 3	90	-	-	395
Adjoining buildings 4	90	-	-	365
Adjoining buildings 5	90	-	-	1101
Adjoining buildings 6	90	-	-	410
Adjoining buildings 7	90	-	-	1360

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

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
Basement B1 Small	NO (-4%)	NO
Basement A3	NO (-44%)	NO
Basement B1 Large Z1	YES (+6%)	NO
Basement B1 Large Z2	NO (-40%)	NO
Ground floor A1 Z1	YES (+54%)	NO
Ground A3	YES (+34%)	NO
Ground Floor B1 Z1	YES (+43%)	NO
Ground Floor B1 Z2	YES (+102%)	NO
First Floor B1	NO (-15%)	NO
Ground floor A1 Z2	NO (-19%)	NO
Ground floor B1 Z3	NO (-19%)	NO
Adjoining buildings 1	N/A	N/A
Adjoining buildings 2	N/A	N/A
Adjoining buildings 3	N/A	N/A
Adjoining buildings 4	N/A	N/A
Adjoining buildings 5	N/A	N/A
Adjoining buildings 6	N/A	N/A
Adjoining buildings 7	N/A	N/A

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

Separate submission

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

Separate submission

EPBD (Recast): Consideration of alternative energy systems

Were alternative energy systems considered and analysed as part of the design process?	NO
Is evidence of such assessment available as a separate submission?	NO
Are any such measures included in the proposed design?	NO

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m²]	461	461
External area [m²]	1961	1961
Weather	LON	LON
Infiltration [m³/hm²@ 50Pa]	4	3
Average conductance [W/K]	728	603
Average U-value [W/m²K]	0.37	0.31
Alpha value* [%]	14.28	14.28

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

Building Use

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

Energy Consumption by End Use [kWh/m²]

	Actual	Notional
Heating	3.12	1.36
Cooling	15.08	24.95
Auxiliary	6.28	5.31
Lighting	24.3	33.21
Hot water	34.07	31.29
Equipment*	55.86	55.86
TOTAL**	**82.85**	**96.13**

* Energy used by equipment does not count towards the total for calculating emissions.
** Total is net of any electrical energy displaced by CHP generators, if applicable.

Energy Production by Technology [kWh/m²]

	Actual	Notional
Photovoltaic systems	0	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m²]	215.57	344.63
Primary energy* [kWh/m²]	185.56	229.83
Total emissions [kg/m²]	31.7	39.2

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

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Split or multi-split system, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	9.6	205.8	3.2	15.9	6.6	0.83	3.6	0.92	3.6
	Notional	4.2	340.4	1.4	26.3	5.6	0.82	3.6	----	----

Key to terms

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

Key Features

The BCO can give particular attention to items with specifications that are better than typically expected.

Building fabric

Element	$U_{i\text{-}Typ}$	$U_{i\text{-}Min}$	Surface where the minimum value occurs*
Wall	0.23	0.15	Light Well Wall
Floor	0.2	0.15	Basement Floor New B1
Roof	0.15	0.14	Roof
Windows, roof windows, and rooflights	1.5	1.6	Basement A3 SE
Personnel doors	1.5	1.6	Basement A3 Door SW
Vehicle access & similar large doors	1.5	-	No vehicle doors in project
High usage entrance doors	1.5	-	No high usage entrance doors in project

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

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

Air Permeability	Typical value	This building
$m^3/(h.m^2)$ at 50 Pa	5	4