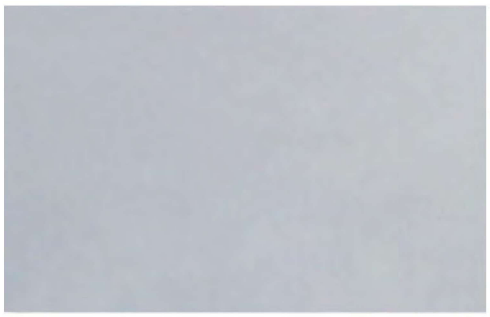
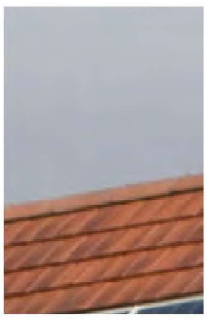






environmental economics



Energy Demand Study

Longridge Phase 2/3

Client: Barratt Manchester

Author: William Vincent


Revision History

Version	Date	Reason for Issue	Issued by	QA check
1	15/10/2018	Report provided in support of planning application	[redacted]	
2	18/10/2021	Report provided in support of planning application		

Contents

1. Project Overview

1.1. Introduction

This energy study was prepared by Environmental Economics Ltd on behalf of Barratt Homes Manchester (BHM) to support a planning application for a proposed development. The report assesses measures to reduce the energy demand for the domestic housing on site through an improvement in materials and products used.

1.2. Description of Site

The Longridge Phase 2/3 site consists of 198 dwellings. These units comprise a range of detached, semi-detached and terraced dwellings.

The updated site plan can viewed in appendix A.

This energy study addresses a domestic development being undertaken by BHM, and does not include any further proposals for subsequent developments or non-residential parcels.

1.3. Client Brief

BHM intent to reduce the energy consumption on the development by a fabric first approach and as such various upgrades to the fabric specification have been made in order to reduce energy demand.

This report quantifies these improvements to the building fabric and products in context of resultant reduction in energy demand against Part L 2013.

1.4. Building regulations

The SAP assessments have been undertaken using the appropriate legislative guidance; Approved Document Part L1A 2013. It should be noted that future policies and building regulations will reflect changes to the carbon content of fuels. In particular grid electricity is expected to become significantly decarbonized due to the ongoing investment in wind, solar and nuclear energy.

It is therefore possible that the solutions outlined in this report will require significant revision if the project is delivered against future building regulations. Currently, it is expected that Approved Document L will be updated in late 2021, and to be enforced in 2022.

2. Improvement Measures

2.1 Assessment Methodology

Environmental Economics have modelled the proposed dwellings using Design SAP software. The software provides a number of outputs which can be used to assess and compare the improvements from any number of build specifications in terms of:

- *Building regulations compliance*
- *Energy usage per year (kWh/annum)*
- *Carbon emissions as a measure of building regulations compliance (kg CO_2/m^2/year)*
- *Energy costs per year (£/annum)*
- *More detailed breakdowns by end use (space heating, water heating, cooking, lighting, appliances)*
- *Code for Sustainable Homes compliance*
- *Effective air change rate*

Each of these outputs can be used in different ways to analyse the performance of the dwelling. For this project the requirement as set out in the previous section relates to a reduction in energy demand.

The analysis, therefore, evaluated the regulated energy usage per year for each of the properties on site. The total regulated energy demand for each property is based upon:

- *Space heating*
- *Water heating*
- *Electricity for pumps and fans*
- *Electricity for lighting*

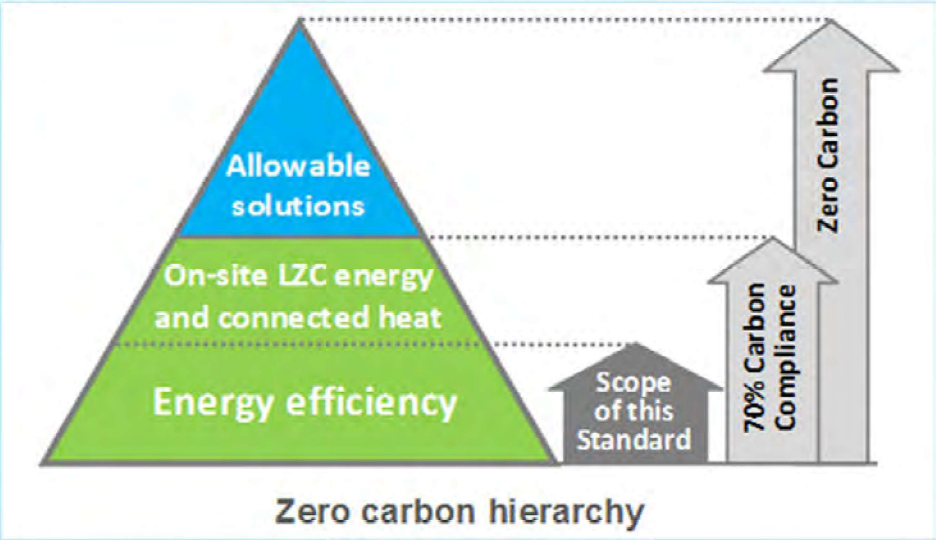
Two models were created in order to calculate the difference in energy demand from the specification improvements. The total energy demand for the site is calculated for each of the models, and then the difference used to establish the level of improvement.

The energy calculation for the space and water heating, as well as the electricity for pumps, fans and lighting were all assessed using the Standard Assessment Procedure (SAP 2013) through Design SAP software. An example of a SAP worksheet is shown in Appendix D.

2.2 Design Philosophy

BHM have upgraded a number of elements from their standard build specification in order to improve energy efficiency across the development. The site adopts the good design principles endorsed and promoted by The Zero Carbon Hub, the construction industries' key advisors and partners with the Governments Communities and Local Government Department. This guidance follows the general good principles of energy efficiency as the industry moves towards zero carbon. The principles are illustrated in figure 1 below.

Fig. 1



In order to reduce the residual carbon emissions a number of improvements were made to the standard material and product specification. These improvements include:

- Upgraded heating and hot water controls
- Delayed start controls
- Design air permeability of 5.01$m^3/hr/m^2$
- Bespoke thermal bridging details

2.3 Specification Improvements

In order to improve energy efficiency the products and the fabric of the dwellings was improved to an enhanced specification.

2.3.1 Product Improvements

The systems used in a property to supply hot water and heating, as well as control it, are important to the overall energy demand of a property. The 2013 Building Regulations state that all systems and their controls must adhere to the minimum standards shown in Domestic Heating Compliance Guide.

For a mains gas fired system the minimum boiler efficiency required is 86%. BHM intend to use Ideal Logic condensing boilers throughout the site for both combination and cylinder based systems. These boilers achieve an efficiency of at least 91% and are recommended by the Energy Saving Trust.

Where installed, hot water cylinders can lose a significant amount of energy. In order to minimise this energy loss and corresponding carbon emissions BHM will utilise Kingspan Tribune Cylinders which have higher levels of insulation in comparison to typical hot water cylinders.

Finally 100% Low-E lighting fixtures shall be fitted to all properties.

2.3.2 Fabric Improvements

The building fabric for all dwellings was improved from basic compliance with Part L1A 2013 to an enhanced specification. These fabric improvements reduce the space heating requirement on a property. The improvements have been made through a combination of upgraded materials and increased insulation thicknesses. Enhanced glazing with a larger transmittance factor allowing for increased solar gains will also be used. The proposed specification is shown in table 1 below.

Table 1

Element	*Minimum Standard*	*Improved Specification*	
-	***W/m²k***	***Description***	***W/m²k***
Walls	0.30	50mm Alreflex Platinum Cavity	0.27
Roof	0.20	400mm Mineral Wool Horizontal Ceiling, Loft Space	0.11
		Flat Roof	0.17
Floors	0.25	150mm TE Platinum Ground Floor	0.13 - 0.16
		150mm TE Platinum Ground Floor Beam & Block	0.13-0.15
Doors	2.00	Double glazed Low-E, u-PVC frame	1.00 – 1.70
Glazing	2.00	Double glazed Low-E, u-PVC frame	1.41

As improvements are made to the thermal conductivity of main elements, thermal bridging and air permeability becomes increasingly significant in the overall fabric performance. BHM utilise bespoke thermal bridging designs assessed by H&H Celcon, which achieve much lower heat loss levels in comparison with standard practice.

As a result of following these junction details and focusing on build quality air permeability will also decrease. A target air pressure rating of 5.01m^3/hr.m^2 has been set for all houses on site which is a 50% improvement on the maximum allowable rating in the 2013 Building Regulations.

2.3.3 Hi-Therm Lintels

As the latest set of building regulations have incorporated a Target Fabric Energy Efficiency (TFEE) standard for all new houses, some of the bespoke thermal bridging details would not be sufficient to achieve the latter.

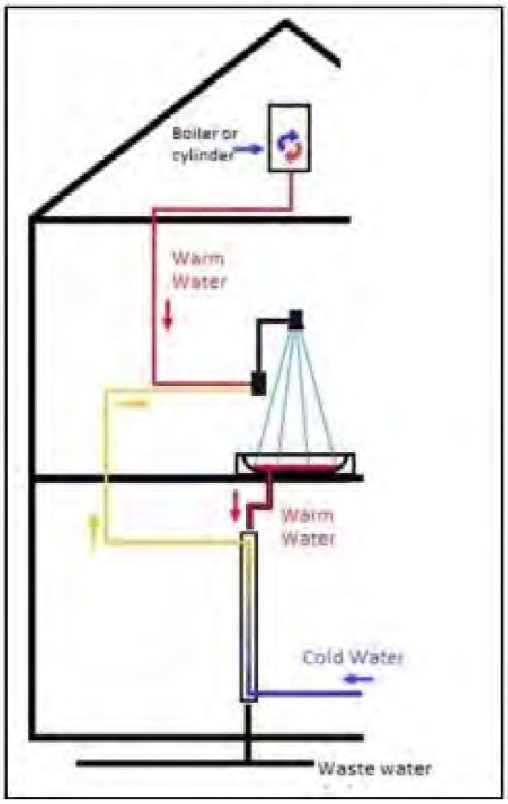
Since a significant amount of heating energy is lost through the dwelling's lintels, BHM intend to use IG Hi-Therm lintels on some house types. IG Hi-Therm lintels achieve a lower linear thermal transmittance (Psi value) of 0.05W/mK, in comparison to the normal IG lintels which achieve a Psi value of 0.23W/mK. More details are shown in Appendix C.

2.3.4 Waste Water Heat Recovery Systems (WWHRS)

WWHRS recovers heat from the warm waste water as it passes through a double walled heat exchanger, before going in the drainage system. The heat is transferred to the mains cold water supply, which is then supplied to the mains cold feed to the shower and/or a combination boiler or a hot water storage cylinder.

This process makes a significant reduction to the energy demand for providing hot water. The energy recovered depends on the temperature of the cold water feed to the dwelling, which varies by month, and the number of systems that are installed. The WWHRS is installed vertically below the point of demand, i.e. within the waste ducting below the shower or bath. A simple schematic of a WWHRS is shown in figure 2. The WWHRS will be installed in some of the house types.

Fig. 2



3. Evaluation

3.1 Conclusion

The table presented in Appendix B shows the energy saving that the improved specification will achieve in comparison to base compliance with Part L 2013 building regulations.

The total energy demand of the Part L 2013 base compliance model is 1,216.8MWh/Annum. The total energy demand for the actual model with the improved specification is 1,151.1MWh/Annum. This results in an average energy reduction of 5.4% across the site.

Approved for Release

Date: 18/10/2021

Appendix A


LAND RETAINED
IN AGRICULTURE
PHASE 1
LAND RETAINED
IN AGRICULTURE
Play Area
BARRATT
HOMES

Appendix B

Energy Demand Reduction Study
Longridge Ph2-3

Client:	**Barratt Manchester**
Project:	**Longridge Phase 2/3**
Report:	**Energy Demand Study**

House Type/ Plot Number	Space Heating Requirement	Hot Water Requirement	Lighting Requirement	Pumps and Fans Requirement	SAP Floor Area	Number of Plots	Total Energy Demand #1
-	*kWh/Annum*	*kWh/Annum*	*kWh/Annum*	*kWh/Annum*	*m^2*	-	*kWh/Annum*
Data Set 1: Base Case Design (Part L 2013 Compliant)							
Alderney Detached	5176	2558	443	75	112	1	8,251
Alderney Detached Beam & Block	5174	2558	443	75	112	11	90,740
Bedale Detached	2910	1999	266	75	55	1	5,249
Bedale End-Terrace	2696	2001	266	75	55	8	40,302
Bedale Mid-Terrace	2469	2005	266	75	55	5	24,074
Belmont End-Terrace	2845	2198	312	75	67	10	54,294
Belmont Mid-Terrace	2398	2206	312	75	67	6	29,944
Brandon End-Terrace	2606	2165	297	75	64	2	10,286
Brandon End-Terrace Beam & Block	2740	2163	297	75	64	16	84,402
Brandon Mid-Terrace	2183	2173	305	75	64	1	4,736
Braondon Mid-Terrace Beam & Block	2319	2170	305	75	64	6	29,212
Denby Detached	4199	2365	353	75	80	8	55,939
Denford End-Terrace	2475	2055	271	75	58	12	58,524
Denford Mid-Terrace	2021	2044	269	75	57	7	30,862
Ellerton End-Terrace	3087	2346	352	75	77	2	11,719
Ellerton End-Terrace Beam & Block	3087	2346	352	75	77	28	164,064
Ellerton Mid-Terrace	2635	2353	361	75	77	3	16,274
Kingsville End-Terrace	4164	2541	451	75	104	14	101,240
Kingsville Mid-Terrace	3432	2551	459	75	104	7	45,619
Lutterworth Detached	4141	2471	396	75	92	5	35,410
Moresby Detached	3627	2382	354	75	81	1	6,438
Moresby Detached Beam & Block	3706	2381	354	75	81	10	65,153
Moresby End-Terrace	3133	2389	356	75	81	1	5,953
Moresby End-Terrace Beam & Block	3372	2385	356	75	81	13	80,458
Thornton Detached	5110	2553	441	75	110	1	8,178
Windermere Detached	4867	2512	414	75	100	2	15,735
Windermere Detached Beam & Block	4867	2512	414	75	100	17	133,750
					Data Set 1 Total Energy Demand *(kWh/Annum)*		**1,216,806**

Energy Demand Reduction Study
Longridge Ph2-3

Client:	**Barratt Manchester**
Project:	**Longridge Phase 2/3**
Report:	**Energy Demand Study**

House Type/ Plot Number	Space Heating Requirement	Hot Water Requirement	Lighting Requirement	Pumps and Fans Requirement	SAP Floor Area	Number of Plots	Total Energy Demand #1
-	*kWh/Annum*	*kWh/Annum*	*kWh/Annum*	*kWh/Annum*	*m^2*	-	*kWh/Annum*
Data Set 2: Actual Case (Improved Specification)							
Alderney Detached	5414	1976	443	75	112	1	7,908
Alderney Detached Beam & Block	5291	1977	443	75	112	11	85,638
Bedale Detached	3062	1565	266	75	55	1	4,968
Bedale End-Terrace	2826	1566	266	75	55	8	37,864
Bedale Mid-Terrace	2511	1567	266	75	55	5	22,093
Belmont End-Terrace	3066	1700	312	75	67	10	51,532
Belmont Mid-Terrace	2493	1703	312	75	67	6	27,495
Brandon End-Terrace	2855	1676	297	75	64	2	9,806
Brandon End-Terrace Beam & Block	2918	1675	297	75	64	16	79,453
Brandon Mid-Terrace	2299	1678	305	75	64	1	4,357
Braondon Mid-Terrace Beam & Block	2406	1678	305	75	64	6	26,776
Denby Detached	4432	1912	353	75	80	8	54,174
Denford End-Terrace	2714	1600	271	75	58	12	55,929
Denford Mid-Terrace	2252	1588	269	75	57	7	29,286
Ellerton End-Terrace	3303	1803	352	75	77	2	11,066
Ellerton End-Terrace Beam & Block	3262	1803	352	75	77	28	153,804
Ellerton Mid-Terrace	2783	1805	361	75	77	3	15,074
Kingsville End-Terrace	4607	1957	451	75	104	14	99,268
Kingsville Mid-Terrace	3639	1960	459	75	104	7	42,933
Lutterworth Detached	4394	1902	396	75	92	5	33,831
Moresby Detached	4049	1832	354	75	81	1	6,310
Moresby Detached Beam & Block	4049	1832	354	75	81	10	63,101
Moresby End-Terrace	3441	1834	356	75	81	1	5,706
Moresby End-Terrace Beam & Block	3615	1833	356	75	81	13	76,435
Thornton Detached	5426	1972	441	75	110	1	7,913
Windermere Detached	4867	1939	414	75	100	2	14,589
Windermere Detached Beam & Block	4853	1939	414	75	100	17	123,776
					Data Set 2 Total Energy Demand *(kWh/Annum)*		**1,151,087**

Reduction in Energy Demand
5.4%

Notes
#1: Calculated by SAP2012 to include total energy demand for space heating, hot water, lighting, pumps and fans.

Appendix C

IG LINTEL GUIDE

If lintels are required to carry loads not indicated on the load tables, please contact IG's Technical Department.

LINTEL HOTLINE
01633 486486

Fax Back Enquiry Forms are also available for download.
www.iglintels.com/technical

IG Fastrack CAD Database is accessible from iglintels.com

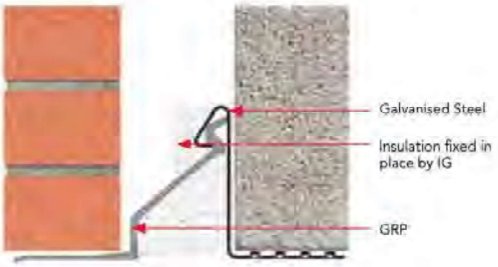
Cavity Wall

Cavity widths from **90mm to 165mm**

OUTER LEAF	INNER LEAF
102mm	100mm

Hi-Therm Lintel

IG leads the way with the development of a completely unique lintel range to address the thermal requirements of new building regulations.



Psi 0.05 W/m·K

Building regulations require that lintels should be assessed for their effect on the thermal performance of a building. The thermal performance of a lintel is expressed in terms of Psi Values (Ψ) i.e. linear thermal transmittance.

Psi COMPARISON CHART

To help understand the immense thermal benefits of the Hi-Therm Lintel it must be compared to other lintel types.

Lintel type comparison	Values
IG Hi-Therm Lintel	0.05 W/m·K
Typical IG Lintel	0.23 W/m·K
Non-plated Steel Lintel (default)	0.3 W/m·K
Plated Steel Lintel (default)	0.5 W/m·K

bre THERMAL PERFORMANCE TESTING

Testing of IG's Hi-Therm Lintel was carried out by the BRE (Building Research Establishment) using Physibel's thermal analysis software TRISCO which complies with BS EN ISO 10211-1. The modeling follows the requirements of the BRE conventions document BR497.

KEY BENEFITS

- Up to 5 times more thermally efficient than a steel cavity wall lintel, Hi-Therm outperforms other lintels.
- The significant reductions in thermal bridging due to the GRP component will assist in the building design process to achieve compliance with Part L and The Code for Sustainable Homes.
- The use of Hi-Therm will make a significant contribution to a buildings performance in respect of the Fabric Energy Efficiency Standards (FEES).
- Outperforms Stainless Steel on price and corrosion resistance.
- Hi-Therm has achieved the 1 hour fire resistance test as carried out by Exova Warringtonfire utilising the heating conditions of BS EN 1363-1 1999.

DESIGN FEATURES

- Patented GRP and Galvanised Steel hybrid design.
- Galvanised steel is used to support the heavier load on the inner leaf of the cavity wall.
- Profiled CFC free insulation ensures the continuity of insulation.

DAMP PROOFING

Not required on Hi-Therm lintels.
*Check severe exposure.

Appendix D

SAP reports on the following page

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

Design SAP
elmhurst energy

Property Reference	Alderney Detached BeamBlock	**Issued on Date**	15/10/2021
Assessment Reference	1	**Prop Type Ref**	
Property	Plot 142, Chipping Lane, Longridge , PR3		

SAP Rating	84 B	**DER**	16.41	**TER**	17.30
Environmental	86 B	**% DER<TER**	5.14		
CO_2 Emissions (t/year)	1.68	**DFEE**	50.01	**TFEE**	55.57
General Requirements Compliance	Pass	**% DFEE<TFEE**	10.02		

Assessor Details	Mr. William Vincent, William Vincent, Tel: 01582544250, William.Vincent@ee-ltd.co.uk	**Assessor ID**	T759-0001
Client			

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

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

Detached House, total floor area 112 m²

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

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 17.30 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 16.41 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)55.6 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)50.0 kWh/m²/yrOK

---
2 Fabric U-values

Element	Average	Highest	
External wall	0.27 (max. 0.30)	0.27 (max. 0.70)	OK
Floor	0.14 (max. 0.25)	0.14 (max. 0.70)	OK
Roof	0.11 (max. 0.20)	0.11 (max. 0.35)	OK
Openings	1.37 (max. 2.00)	1.41 (max. 3.30)	OK

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

---
3 Air permeability
Air permeability at 50 pascals: 5.01 (design value)
Maximum 10.0 OK

---
4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 35
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

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

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

Hot water controls: No cylinder

Boiler interlock: Yes OK

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

---
8 Mechanical ventilation
Not applicable

---
9 Summertime temperature
Overheating risk (West Pennines (England)):Not significant OK
Based on:
Overshading: Average
Windows facing North East: 3.15 m², No overhang
Windows facing South East: 4.68 m², No overhang
Windows facing South West: 5.27 m², No overhang
Windows facing North West: 6.75 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: Dark-coloured curtain or roller blind, closed 100% of daylight hours

---
10 Key features
Roof U-value 0.11 W/m²K
Door U-value 1.00 W/m²K
Thermal bridging y-value 0.033 W/m²K

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	56.0300 (1b)	x	2.3100 (2b)	=	129.4293	(1b) - (3b)
First floor	56.0300 (1c)	x	2.5600 (2c)	=	143.4368	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	112.0600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	272.8661	(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) =	0.1466	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.3971	(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) =	0.3375	(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	0.4303	0.4219	0.4135	0.3713	0.3628	0.3207	0.3207	0.3122	0.3375	0.3628	0.3797	0.3966	(22b)
Effective ac	0.5926	0.5890	0.5855	0.5689	0.5658	0.5514	0.5514	0.5487	0.5570	0.5658	0.5721	0.5786	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Opening Type 1 (Uw = 1.41)			19.8500	1.3347	26.4942			(27)
Opening Type 12			1.9700	1.0000	1.9700			(26)
150mm B&B			56.0300	0.1400	7.8442			(28a)
50mm Alreflex Plat	159.0100	21.8200	137.1900	0.2700	37.0413			(29a)
400mm	56.0300		56.0300	0.1100	6.1633			(30)
Total net area of external elements Aum(A, m2)			271.0700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		79.5130			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							152.8100	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							9.0341	(36)
Total fabric heat loss					(33) + (36) =		88.5472	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	53.3611	53.0374	52.7200	51.2293	50.9504	49.6521	49.6521	49.4116	50.1522	50.9504	51.5146	52.1045	(38)
Heat transfer coeff	141.9083	141.5845	141.2672	139.7765	139.4976	138.1992	138.1992	137.9588	138.6993	139.4976	140.0618	140.6516	(39)
Average = Sum(39)m / 12 =												139.7751	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2664	1.2635	1.2606	1.2473	1.2448	1.2333	1.2333	1.2311	1.2377	1.2448	1.2499	1.2551	(40)
HLP (average)												1.2473	(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												2.8266	(42)
Average daily hot water use (litres/day)												101.3327	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.4660	107.4127	103.3594	99.3061	95.2528	91.1995	91.1995	95.2528	99.3061	103.3594	107.4127	111.4660	(44)
Energy conte	165.3009	144.5732	149.1866	130.0645	124.8000	107.6929	99.7933	114.5143	115.8819	135.0492	147.4168	160.0851	(45)
Energy content (annual)										Total = Sum(45)m =		1594.3586	(45)
Distribution loss (46)m = 0.15 x (45)m	24.7951	21.6860	22.3780	19.5097	18.7200	16.1539	14.9690	17.1771	17.3823	20.2574	22.1125	24.0128	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1533	12.7723	14.1146	13.6228	14.0419	13.5485	13.9750	14.0183	13.5890	14.0807	13.6666	14.1408	(61)
Total heat required for water heating calculated for each month													
	179.4542	157.3455	163.3012	143.6873	138.8418	121.2414	113.7683	128.5326	129.4709	149.1299	161.0834	174.2258	(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													
	179.4542	157.3455	163.3012	143.6873	138.8418	121.2414	113.7683	128.5326	129.4709	149.1299	161.0834	174.2258	(64)
								Total per year (kWh/year) = Sum(64)m =				1760.0823	(64)
Heat gains from water heating, kWh/month													
	58.5009	51.2637	53.1332	46.6521	45.0065	39.1950	36.6750	41.5806	41.9280	48.4240	52.4327	56.7635	(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	141.3321	141.3321	141.3321	141.3321	141.3321	141.3321	141.3321	141.3321	141.3321	141.3321	141.3321	141.3321	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	25.0583	22.2566	18.1003	13.7031	10.2432	8.6477	9.3442	12.1459	16.3022	20.6994	24.1593	25.7548	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	274.4831	277.3313	270.1538	254.8736	235.5851	217.4567	205.3457	202.4975	209.6750	224.9552	244.2437	262.3721	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.1332	37.1332	37.1332	37.1332	37.1332	37.1332	37.1332	37.1332	37.1332	37.1332	37.1332	37.1332	(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)													
	-113.0657	-113.0657	-113.0657	-113.0657	-113.0657	-113.0657	-113.0657	-113.0657	-113.0657	-113.0657	-113.0657	-113.0657	(71)
Water heating gains (Table 5)													
	78.6302	76.2852	71.4156	64.7946	60.4926	54.4375	49.2944	55.8879	58.2333	65.0861	72.8232	76.2950	(72)
Total internal gains													
	446.5712	444.2727	428.0692	401.7709	374.7205	348.9415	332.3839	338.9309	352.6102	379.1403	409.6259	432.8215	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	3.1500	11.2829	0.7100	0.7000	0.7700	12.2412	(75)
Southeast	4.6800	36.7938	0.7100	0.7000	0.7700	59.3076	(77)
Southwest	5.2700	36.7938	0.7100	0.7000	0.7700	66.7844	(79)
Northwest	6.7500	11.2829	0.7100	0.7000	0.7700	26.2311	(81)

Solar gains	164.5643	293.0927	434.9654	595.8370	719.3171	736.9576	700.9999	605.3860	490.1255	333.0818	199.4372	139.3269	(83)
Total gains	611.1355	737.3655	863.0346	997.6079	1094.0376	1085.8992	1033.3838	944.3169	842.7357	712.2222	609.0631	572.1484	(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	33.5191	33.5957	33.6712	34.0303	34.0983	34.4187	34.4187	34.4787	34.2946	34.0983	33.9610	33.8186	
alpha	3.2346	3.2397	3.2447	3.2687	3.2732	3.2946	3.2946	3.2986	3.2863	3.2732	3.2641	3.2546	
util living area													
	0.9907	0.9824	0.9641	0.9184	0.8266	0.6833	0.5414	0.5995	0.8129	0.9479	0.9844	0.9925	(86)
MIT	18.9286	19.1729	19.5699	20.0856	20.5361	20.8313	20.9425	20.9188	20.6784	20.0844	19.4116	18.8865	(87)
Th 2	19.8673	19.8696	19.8718	19.8823	19.8843	19.8935	19.8935	19.8952	19.8899	19.8843	19.8803	19.8761	(88)
util rest of house													
	0.9886	0.9784	0.9556	0.8982	0.7820	0.6004	0.4234	0.4818	0.7479	0.9311	0.9803	0.9908	(89)
MIT 2	17.1076	17.4639	18.0391	18.7782	19.3896	19.7555	19.8629	19.8480	19.5906	18.7916	17.8203	17.0515	(90)
Living area fraction									fLA = Living area / (4) =			0.1428	(91)
MIT	17.3676	17.7079	18.2577	18.9649	19.5533	19.9091	20.0171	20.0009	19.7459	18.9761	18.0475	17.3135	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.2176	17.5579	18.1077	18.8149	19.4033	19.7591	19.8671	19.8509	19.5959	18.8261	17.8975	17.1635	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9807	0.9661	0.9368	0.8732	0.7591	0.5891	0.4204	0.4766	0.7269	0.9085	0.9687	0.9841	(94)
Useful gains	599.3565	712.3558	808.5247	871.0663	830.4509	639.7297	434.4032	450.0518	612.5655	647.0267	589.9790	563.0515	(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													
	1833.1084	1792.1661	1639.7870	1385.8689	1074.5917	712.9856	451.5071	476.0766	762.2832	1147.5270	1512.3131	1823.3371	(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													
	917.9114	725.6325	618.4592	370.6579	181.6407	0.0000	0.0000	0.0000	0.0000	372.3722	664.0805	937.6525	(98)
Space heating												4788.4069	(98)
Space heating per m2											(98) / (4) =	42.7307	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	5291.0573	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	917.9114	725.6325	618.4592	370.6579	181.6407	0.0000	0.0000	0.0000	0.0000	372.3722	664.0805	937.6525	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	1014.2667	801.8039	683.3803	409.5667	200.7080	0.0000	0.0000	0.0000	0.0000	411.4610	733.7906	1036.0801	(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													
	179.4542	157.3455	163.3012	143.6873	138.8418	121.2414	113.7683	128.5326	129.4709	149.1299	161.0834	174.2258	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9607	89.9127	89.8123	89.5827	89.0853	87.3000	87.3000	87.3000	87.3000	89.5612	89.8570	89.9832	(217)
Fuel for water heating, kWh/month													
	199.4805	174.9980	181.8250	160.3963	155.8527	138.8790	130.3188	147.2309	148.3057	166.5117	179.2663	193.6205	(219)
Water heating fuel used												1976.6855	(219)
Annual totals kWh/year													
Space heating fuel - main system												5291.0573	(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)												442.5378	(232)
Total delivered energy for all uses												7785.2805	(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	5291.0573	0.2160	1142.8684	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1976.6855	0.2160	426.9641	(264)
Space and water heating			1569.8324	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	442.5378	0.5190	229.6771	(268)
Total CO2, kg/year			1838.4345	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			16.4100	(273)

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

DER		16.4100	ZC1
Total Floor Area	TFA	112.0600	
Assumed number of occupants	N	2.8266	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		14.5148	ZC2
CO2 emissions from cooking, equation (L16)		1.6673	ZC3
Total CO2 emissions		32.5921	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		32.5921	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	56.0300 (1b)	x	2.3100 (2b)	=	129.4293	(1b) - (3b)
First floor	56.0300 (1c)	x	2.5600 (2c)	=	143.4368	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	112.0600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	272.8661	(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) =	0.1466	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3966	(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) =	0.3371	(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	0.4298	0.4214	0.4130	0.3708	0.3624	0.3202	0.3202	0.3118	0.3371	0.3624	0.3792	0.3961	(22b)
Effective ac	0.5924	0.5888	0.5853	0.5688	0.5657	0.5513	0.5513	0.5486	0.5568	0.5657	0.5719	0.5784	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			1.9700	1.0000	1.9700			(26)
TER Opening Type (Uw = 1.40)			19.8500	1.3258	26.3163			(27)
150mm B&B			56.0300	0.1300	7.2839			(28a)
50mm Alreflex Plat	159.0100	21.8200	137.1900	0.1800	24.6942			(29a)
400mm	56.0300		56.0300	0.1300	7.2839			(30)
Total net area of external elements Aum(A, m2)			271.0700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		67.5483			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							12.6742	(36)
Total fabric heat loss						(33) + (36) =	80.2225	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	53.3402	53.0172	52.7006	51.2137	50.9355	49.6404	49.6404	49.4006	50.1392	50.9355	51.4983	52.0867	(38)
Heat transfer coeff	133.5626	133.2397	132.9231	131.4362	131.1580	129.8629	129.8629	129.6231	130.3617	131.1580	131.7208	132.3091	(39)
Average = Sum(39)m / 12 =												131.4348	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1919	1.1890	1.1862	1.1729	1.1704	1.1589	1.1589	1.1567	1.1633	1.1704	1.1754	1.1807	(40)
HLP (average)												1.1729	(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												2.8266	(42)
Average daily hot water use (litres/day)												101.3327	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.4660	107.4127	103.3594	99.3061	95.2528	91.1995	91.1995	95.2528	99.3061	103.3594	107.4127	111.4660	(44)
Energy conte	165.3009	144.5732	149.1866	130.0645	124.8000	107.6929	99.7933	114.5143	115.8819	135.0492	147.4168	160.0851	(45)
Energy content (annual)										Total = Sum(45)m =		1594.3586	(45)
Distribution loss (46)m = 0.15 x (45)m	24.7951	21.6860	22.3780	19.5097	18.7200	16.1539	14.9690	17.1771	17.3823	20.2574	22.1125	24.0128	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	46.0274	50.9589	48.9729	48.5398	44.9751	46.4742	48.5398	48.9729	50.9589	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month													
	216.2598	190.6006	200.1455	179.0374	173.3398	152.6680	146.2675	163.0540	164.8548	186.0081	196.7318	211.0440	(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													
	216.2598	190.6006	200.1455	179.0374	173.3398	152.6680	146.2675	163.0540	164.8548	186.0081	196.7318	211.0440	(64)
								Total per year (kWh/year) = Sum(64)m =				2180.0113	(64)
Heat gains from water heating, kWh/month													
	67.7023	59.5774	62.3443	55.4897	53.6309	47.0517	44.7998	50.2109	50.7740	57.6436	61.3448	65.9680	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	141.3321	141.3321	141.3321	141.3321	141.3321	141.3321	141.3321	141.3321	141.3321	141.3321	141.3321	141.3321	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	25.0583	22.2566	18.1003	13.7031	10.2432	8.6477	9.3442	12.1459	16.3022	20.6994	24.1593	25.7548	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	274.4831	277.3313	270.1538	254.8736	235.5851	217.4567	205.3457	202.4975	209.6750	224.9552	244.2437	262.3721	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.1332	37.1332	37.1332	37.1332	37.1332	37.1332	37.1332	37.1332	37.1332	37.1332	37.1332	37.1332	(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)													
	-113.0657	-113.0657	-113.0657	-113.0657	-113.0657	-113.0657	-113.0657	-113.0657	-113.0657	-113.0657	-113.0657	-113.0657	(71)
Water heating gains (Table 5)													
	90.9977	88.6569	83.7961	77.0690	72.0846	65.3495	60.2148	67.4878	70.5194	77.4779	85.2012	88.6667	(72)
Total internal gains													
	458.9387	456.6444	440.4497	414.0453	386.3125	359.8535	343.3044	350.5308	364.8963	391.5322	422.0038	445.1932	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	3.1500	11.2829	0.6300	0.7000	0.7700	10.8619	(75)
Southeast	4.6800	36.7938	0.6300	0.7000	0.7700	52.6251	(77)
Southwest	5.2700	36.7938	0.6300	0.7000	0.7700	59.2594	(79)
Northwest	6.7500	11.2829	0.6300	0.7000	0.7700	23.2754	(81)

Solar gains	146.0218	260.0682	385.9552	528.7004	638.2673	653.9201	622.0140	537.1735	434.9001	295.5515	176.9654	123.6281	(83)
Total gains	604.9605	716.7126	826.4049	942.7457	1024.5798	1013.7737	965.3184	887.7043	799.7964	687.0837	598.9692	568.8213	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	58.2644	58.4056	58.5447	59.2070	59.3326	59.9243	59.9243	60.0352	59.6950	59.3326	59.0791	58.8164	
alpha	4.8843	4.8937	4.9030	4.9471	4.9555	4.9950	4.9950	5.0023	4.9797	4.9555	4.9386	4.9211	
util living area													
	0.9988	0.9969	0.9910	0.9679	0.8956	0.7412	0.5735	0.6385	0.8776	0.9831	0.9973	0.9991	(86)
MIT	19.6473	19.8094	20.0771	20.4342	20.7477	20.9333	20.9851	20.9754	20.8348	20.4251	19.9709	19.6211	(87)
Th 2	19.9265	19.9288	19.9311	19.9417	19.9437	19.9530	19.9530	19.9548	19.9495	19.9437	19.9397	19.9355	(88)
util rest of house													
	0.9983	0.9958	0.9876	0.9551	0.8537	0.6492	0.4464	0.5095	0.8123	0.9742	0.9962	0.9988	(89)
MIT 2	18.1197	18.3580	18.7492	19.2683	19.6911	19.9076	19.9475	19.9443	19.8112	19.2636	18.6023	18.0876	(90)
Living area fraction									fLA = Living area / (4) =			0.1428	(91)
MIT	18.3378	18.5653	18.9388	19.4348	19.8420	20.0541	20.0957	20.0916	19.9574	19.4294	18.7977	18.3065	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.3378	18.5653	18.9388	19.4348	19.8420	20.0541	20.0957	20.0916	19.9574	19.4294	18.7977	18.3065	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9973	0.9936	0.9830	0.9470	0.8488	0.6589	0.4645	0.5275	0.8129	0.9680	0.9942	0.9980	(94)
Useful gains	603.3250	712.1588	812.3796	892.7381	869.6926	667.9949	448.3438	468.2350	650.1517	665.0744	595.5125	567.6783	(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													
	1874.9268	1820.7553	1653.4042	1384.6541	1067.8817	708.2833	453.9566	478.5107	763.5793	1158.0502	1540.8301	1866.4244	(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													
	946.0717	744.9768	625.7223	354.1796	147.4527	0.0000	0.0000	0.0000	0.0000	366.7740	680.6287	966.2671	(98)
Space heating												4832.0729	(98)
Space heating per m2											(98) / (4) =	43.1204	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	93.4000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	5173.5256	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	946.0717	744.9768	625.7223	354.1796	147.4527	0.0000	0.0000	0.0000	0.0000	366.7740	680.6287	966.2671	(98)
Space heating efficiency (main heating system 1)	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)	1012.9248	797.6197	669.9383	379.2073	157.8722	0.0000	0.0000	0.0000	0.0000	392.6917	728.7245	1034.5472	(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	216.2598	190.6006	200.1455	179.0374	173.3398	152.6680	146.2675	163.0540	164.8548	186.0081	196.7318	211.0440	(64)
Efficiency of water heater												80.3000	(216)
(217)m	88.3328	88.1414	87.7260	86.7369	84.6470	80.3000	80.3000	80.3000	80.3000	86.7293	87.9203	88.4067	(217)
Fuel for water heating, kWh/month	244.8238	216.2440	228.1486	206.4143	204.7795	190.1220	182.1514	203.0561	205.2986	214.4698	223.7615	238.7194	(219)
Water heating fuel used												2557.9889	(219)
Annual totals kWh/year													
Space heating fuel - main system												5173.5256	(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)												442.5378	(232)
Total delivered energy for all uses												8249.0523	(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	5173.5256	0.2160	1117.4815	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2557.9889	0.2160	552.5256	(264)
Space and water heating			1670.0071	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	442.5378	0.5190	229.6771	(268)
Total CO2, kg/m2/year			1938.6092	(272)
Emissions per m2 for space and water heating			14.9028	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.0496	(272b)
Emissions per m2 for pumps and fans			0.3474	(272c)
Target Carbon Dioxide Emission Rate (TER) = (14.9028 * 1.00) + 2.0496 + 0.3474, rounded to 2 d.p.			17.3000	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	56.0300 (1b)	x	2.3100 (2b)	=	129.4293	(1b) - (3b)
First floor	56.0300 (1c)	x	2.5600 (2c)	=	143.4368	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	112.0600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	272.8661	(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) =	0.1466	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.3971	(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) =	0.3375	(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	0.4303	0.4219	0.4135	0.3713	0.3628	0.3207	0.3207	0.3122	0.3375	0.3628	0.3797	0.3966	(22b)
Effective ac	0.5926	0.5890	0.5855	0.5689	0.5658	0.5514	0.5514	0.5487	0.5570	0.5658	0.5721	0.5786	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Opening Type 1 (Uw = 1.41)			19.8500	1.3347	26.4942			(27)
Opening Type 12			1.9700	1.0000	1.9700			(26)
150mm B&B			56.0300	0.1400	7.8442			(28a)
50mm Alreflex Plat	159.0100	21.8200	137.1900	0.2700	37.0413			(29a)
400mm	56.0300		56.0300	0.1100	6.1633			(30)
Total net area of external elements Aum(A, m2)			271.0700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		79.5130			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							152.8100	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							9.0341	(36)
Total fabric heat loss						(33) + (36) =	88.5472	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	53.3611	53.0374	52.7200	51.2293	50.9504	49.6521	49.6521	49.4116	50.1522	50.9504	51.5146	52.1045	(38)
Heat transfer coeff	141.9083	141.5845	141.2672	139.7765	139.4976	138.1992	138.1992	137.9588	138.6993	139.4976	140.0618	140.6516	(39)
Average = Sum(39)m / 12 =												139.7751	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2664	1.2635	1.2606	1.2473	1.2448	1.2333	1.2333	1.2311	1.2377	1.2448	1.2499	1.2551	(40)
HLP (average)												1.2473	(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												2.8266	(42)
Average daily hot water use (litres/day)												101.3327	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.4660	107.4127	103.3594	99.3061	95.2528	91.1995	91.1995	95.2528	99.3061	103.3594	107.4127	111.4660	(44)
Energy conte	165.3009	144.5732	149.1866	130.0645	124.8000	107.6929	99.7933	114.5143	115.8819	135.0492	147.4168	160.0851	(45)
Energy content (annual)										Total = Sum(45)m =		1594.3586	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	35.1264	30.7218	31.7022	27.6387	26.5200	22.8847	21.2061	24.3343	24.6249	28.6980	31.3261	34.0181	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	141.3321	141.3321	141.3321	141.3321	141.3321	141.3321	141.3321	141.3321	141.3321	141.3321	141.3321	141.3321	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	25.0583	22.2566	18.1003	13.7031	10.2432	8.6477	9.3442	12.1459	16.3022	20.6994	24.1593	25.7548	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	274.4831	277.3313	270.1538	254.8736	235.5851	217.4567	205.3457	202.4975	209.6750	224.9552	244.2437	262.3721	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.1332	37.1332	37.1332	37.1332	37.1332	37.1332	37.1332	37.1332	37.1332	37.1332	37.1332	37.1332	(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)													
	-113.0657	-113.0657	-113.0657	-113.0657	-113.0657	-113.0657	-113.0657	-113.0657	-113.0657	-113.0657	-113.0657	-113.0657	(71)
Water heating gains (Table 5)													
	47.2130	45.7170	42.6104	38.3871	35.6452	31.7844	28.5028	32.7074	34.2013	38.5725	43.5084	45.7232	(72)
Total internal gains													
	412.1540	410.7045	396.2641	372.3634	346.8731	323.2884	308.5923	312.7504	325.5782	349.6268	377.3110	399.2498	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	3.1500	11.2829	0.7100	0.7000	0.7700	12.2412	(75)
Southeast	4.6800	36.7938	0.7100	0.7000	0.7700	59.3076	(77)
Southwest	5.2700	36.7938	0.7100	0.7000	0.7700	66.7844	(79)
Northwest	6.7500	11.2829	0.7100	0.7000	0.7700	26.2311	(81)

Solar gains	164.5643	293.0927	434.9654	595.8370	719.3171	736.9576	700.9999	605.3860	490.1255	333.0818	199.4372	139.3269	(83)
Total gains	576.7182	703.7972	831.2294	968.2003	1066.1902	1060.2460	1009.5922	918.1364	815.7037	682.7086	576.7483	538.5766	(84)

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7. Mean internal temperature (heating season)

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

Utilisation factor for gains for living area, n1l,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.5191	33.5957	33.6712	34.0303	34.0983	34.4187	34.4187	34.4787	34.2946	34.0983	33.9610	33.8186	
alpha	3.2346	3.2397	3.2447	3.2687	3.2732	3.2946	3.2946	3.2986	3.2863	3.2732	3.2641	3.2546	
util living area													
	0.9922	0.9845	0.9674	0.9239	0.8349	0.6935	0.5515	0.6119	0.8238	0.9532	0.9867	0.9937	(86)
MIT	18.8895	19.1359	19.5372	20.0600	20.5193	20.8233	20.9392	20.9137	20.6629	20.0556	19.3756	18.8480	(87)
Th 2	19.8673	19.8696	19.8718	19.8823	19.8843	19.8935	19.8935	19.8952	19.8899	19.8843	19.8803	19.8761	(88)
util rest of house													
	0.9904	0.9810	0.9597	0.9048	0.7915	0.6109	0.4323	0.4934	0.7607	0.9378	0.9831	0.9923	(89)
MIT 2	17.9443	18.1907	18.5888	19.1049	19.5327	19.7942	19.8713	19.8606	19.6740	19.1112	18.4384	17.9094	(90)
Living area fraction										fLA = Living area / (4) =		0.1428	(91)
MIT	18.0792	18.3256	18.7242	19.2412	19.6736	19.9412	20.0238	20.0110	19.8152	19.2461	18.5722	18.0434	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.0792	18.3256	18.7242	19.2412	19.6736	19.9412	20.0238	20.0110	19.8152	19.2461	18.5722	18.0434	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9863	0.9744	0.9494	0.8912	0.7819	0.6149	0.4473	0.5070	0.7556	0.9261	0.9771	0.9889	(94)
Useful gains	568.8396	685.8024	789.1372	862.9047	833.6863	651.9246	451.6317	465.4791	616.3569	632.2829	563.5359	532.6069	(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													
	1955.3897	1900.8604	1726.8786	1445.4614	1112.2945	738.1471	473.1652	498.1640	792.6962	1206.1035	1606.8130	1947.0964	(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													
	1031.5933	816.5190	697.6797	419.4409	207.2845	0.0000	0.0000	0.0000	0.0000	426.9226	751.1595	1052.3802	(98)
Space heating												5402.9797	(98)
Space heating per m2											(98) / (4) =	48.2151	(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	1299.0727	1022.6742	1048.4868	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7819	0.8470	0.8117	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1015.6908	866.1932	851.0787	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1350.6643	1289.0193	1184.2206	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	241.1809	314.5826	247.8576	0.0000	0.0000	0.0000	0.0000	(104)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Space cooling											803.6210	(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	60.2952	78.6456	61.9644	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling											200.9053	(107)
Space cooling per m2											1.7928	(108)
Energy for space heating											48.2151	(99)
Energy for space cooling											1.7928	(108)
Total											50.0079	(109)
Dwelling Fabric Energy Efficiency (DFEE)											50.0	(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	56.0300 (1b)	x	2.3100 (2b)	=	129.4293	(1b) - (3b)
First floor	56.0300 (1c)	x	2.5600 (2c)	=	143.4368	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	112.0600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	272.8661	(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) =	0.1466	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3966	(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) =	0.3371	(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	0.4298	0.4214	0.4130	0.3708	0.3624	0.3202	0.3202	0.3118	0.3371	0.3624	0.3792	0.3961	(22b)
Effective ac	0.5924	0.5888	0.5853	0.5688	0.5657	0.5513	0.5513	0.5486	0.5568	0.5657	0.5719	0.5784	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			1.9700	1.0000	1.9700			(26)
TER Opening Type (Uw = 1.40)			19.8500	1.3258	26.3163			(27)
150mm B&B			56.0300	0.1300	7.2839			(28a)
50mm Alreflex Plat	159.0100	21.8200	137.1900	0.1800	24.6942			(29a)
400mm	56.0300		56.0300	0.1300	7.2839			(30)
Total net area of external elements Aum(A, m2)			271.0700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		67.5483			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							12.6742	(36)
Total fabric heat loss					(33) + (36) =		80.2225	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	53.3402	53.0172	52.7006	51.2137	50.9355	49.6404	49.6404	49.4006	50.1392	50.9355	51.4983	52.0867	(38)
Heat transfer coeff	133.5626	133.2397	132.9231	131.4362	131.1580	129.8629	129.8629	129.6231	130.3617	131.1580	131.7208	132.3091	(39)
Average = Sum(39)m / 12 =												131.4348	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1919	1.1890	1.1862	1.1729	1.1704	1.1589	1.1589	1.1567	1.1633	1.1704	1.1754	1.1807	(40)
HLP (average)												1.1729	(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												2.8266	(42)
Average daily hot water use (litres/day)												101.3327	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.4660	107.4127	103.3594	99.3061	95.2528	91.1995	91.1995	95.2528	99.3061	103.3594	107.4127	111.4660	(44)
Energy conte	165.3009	144.5732	149.1866	130.0645	124.8000	107.6929	99.7933	114.5143	115.8819	135.0492	147.4168	160.0851	(45)
Energy content (annual)										Total = Sum(45)m =		1594.3586	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	35.1264	30.7218	31.7022	27.6387	26.5200	22.8847	21.2061	24.3343	24.6249	28.6980	31.3261	34.0181	(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	141.3321	141.3321	141.3321	141.3321	141.3321	141.3321	141.3321	141.3321	141.3321	141.3321	141.3321	141.3321	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	25.0583	22.2566	18.1003	13.7031	10.2432	8.6477	9.3442	12.1459	16.3022	20.6994	24.1593	25.7548	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	274.4831	277.3313	270.1538	254.8736	235.5851	217.4567	205.3457	202.4975	209.6750	224.9552	244.2437	262.3721	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.1332	37.1332	37.1332	37.1332	37.1332	37.1332	37.1332	37.1332	37.1332	37.1332	37.1332	37.1332	(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)													
	-113.0657	-113.0657	-113.0657	-113.0657	-113.0657	-113.0657	-113.0657	-113.0657	-113.0657	-113.0657	-113.0657	-113.0657	(71)
Water heating gains (Table 5)													
	47.2130	45.7170	42.6104	38.3871	35.6452	31.7844	28.5028	32.7074	34.2013	38.5725	43.5084	45.7232	(72)
Total internal gains													
	412.1540	410.7045	396.2641	372.3634	346.8731	323.2884	308.5923	312.7504	325.5782	349.6268	377.3110	399.2498	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	3.1500	11.2829	0.6300	0.7000	0.7700	10.8619	(75)
Southeast	4.6800	36.7938	0.6300	0.7000	0.7700	52.6251	(77)
Southwest	5.2700	36.7938	0.6300	0.7000	0.7700	59.2594	(79)
Northwest	6.7500	11.2829	0.6300	0.7000	0.7700	23.2754	(81)

Solar gains	146.0218	260.0682	385.9552	528.7004	638.2673	653.9201	622.0140	537.1735	434.9001	295.5515	176.9654	123.6281	(83)
Total gains	558.1758	670.7727	782.2193	901.0638	985.1404	977.2085	930.6063	849.9239	760.4783	645.1783	554.2765	522.8778	(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, n1l,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	58.2644	58.4056	58.5447	59.2070	59.3326	59.9243	59.9243	60.0352	59.6950	59.3326	59.0791	58.8164	
alpha	4.8843	4.8937	4.9030	4.9471	4.9555	4.9950	4.9950	5.0023	4.9797	4.9555	4.9386	4.9211	
util living area													
	0.9991	0.9977	0.9928	0.9730	0.9073	0.7593	0.5921	0.6612	0.8943	0.9870	0.9981	0.9994	(86)
MIT	19.6087	19.7718	20.0419	20.4044	20.7278	20.9255	20.9829	20.9713	20.8165	20.3927	19.9341	19.5830	(87)
Th 2	19.9265	19.9288	19.9311	19.9417	19.9437	19.9530	19.9530	19.9548	19.9495	19.9437	19.9397	19.9355	(88)
util rest of house													
	0.9988	0.9968	0.9901	0.9619	0.8683	0.6683	0.4622	0.5302	0.8339	0.9799	0.9973	0.9992	(89)
MIT 2	18.6543	18.8189	19.0895	19.4539	19.7552	19.9178	19.9486	19.9463	19.8421	19.4483	18.9899	18.6357	(90)
Living area fraction									fLA = Living area / (4) =			0.1428	(91)
MIT	18.7905	18.9549	19.2254	19.5896	19.8941	20.0617	20.0963	20.0926	19.9812	19.5832	19.1248	18.7710	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7905	18.9549	19.2254	19.5896	19.8941	20.0617	20.0963	20.0926	19.9812	19.5832	19.1248	18.7710	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9984	0.9958	0.9876	0.9571	0.8661	0.6788	0.4809	0.5488	0.8361	0.9765	0.9964	0.9988	(94)
Useful gains	557.2600	667.9350	772.5336	862.4141	853.2482	663.3050	447.5011	466.4340	635.8627	629.9965	552.2557	522.2577	(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													
	1935.3948	1872.6736	1691.5053	1404.9970	1074.7153	709.2730	454.0413	478.6522	766.6895	1178.2132	1583.9094	1927.8746	(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													
	1025.3323	809.5843	683.7149	390.6597	164.7715	0.0000	0.0000	0.0000	0.0000	407.8733	742.7907	1045.7790	(98)
Space heating												5270.5056	(98)
Space heating per m2											(98) / (4) =	47.0329	(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	1220.7112	960.9854	985.1353	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8441	0.9100	0.8772	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1030.3679	874.4853	864.1609	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1253.6075	1196.6981	1104.4917	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	160.7325	239.7263	178.8061	0.0000	0.0000	0.0000	0.0000	(104)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Space cooling											579.2649	(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	40.1831	59.9316	44.7015	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling											144.8162	(107)
Space cooling per m2											1.2923	(108)
Energy for space heating											47.0329	(99)
Energy for space cooling											1.2923	(108)
Total											48.3252	(109)
Target Fabric Energy Efficiency (TFEE)											55.6	(109)

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

Design SAP
elmhurst energy

Property Reference	Alderney Detached	**Issued on Date**	15/10/2021
Assessment Reference	1	**Prop Type Ref**	
Property	Plot 028, Chipping Lane, Longridge , PR3		

SAP Rating	84 B	**DER**	16.64	**TER**	17.30
Environmental	85 B	**% DER<TER**	3.84		
CO_2 Emissions (t/year)	1.71	**DFEE**	51.12	**TFEE**	55.60
General Requirements Compliance	Pass	**% DFEE<TFEE**	8.05		

Assessor Details	Mr. William Vincent, William Vincent, Tel: 01582544250, William.Vincent@ee-ltd.co.uk	**Assessor ID**	T759-0001
Client			

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

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

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DWELLING AS DESIGNED

Detached House, total floor area 112 m²

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

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 17.30 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 16.64 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)55.6 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)51.1 kWh/m²/yrOK

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2 Fabric U-values

Element	Average	Highest	
External wall	0.27 (max. 0.30)	0.27 (max. 0.70)	OK
Floor	0.15 (max. 0.25)	0.15 (max. 0.70)	OK
Roof	0.11 (max. 0.20)	0.11 (max. 0.35)	OK
Openings	1.37 (max. 2.00)	1.41 (max. 3.30)	OK

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

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3 Air permeability
Air permeability at 50 pascals: 5.01 (design value)
Maximum 10.0 OK

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4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 35
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

---

5 Cylinder insulation
Hot water storage: No cylinder

---

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

Hot water controls: No cylinder

Boiler interlock: Yes OK

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

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8 Mechanical ventilation
Not applicable

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9 Summertime temperature
Overheating risk (West Pennines (England)):Not significant OK
Based on:
Overshading: Average
Windows facing North East: 4.68 m², No overhang
Windows facing South East: 3.15 m², No overhang
Windows facing South West: 6.75 m², No overhang
Windows facing North West: 5.27 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: Dark-coloured curtain or roller blind, closed 100% of daylight hours

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10 Key features
Roof U-value 0.11 W/m²K
Door U-value 1.00 W/m²K

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	56.0300 (1b)	x	2.3100 (2b)	=	129.4293	(1b) - (3b)
First floor	56.0300 (1c)	x	2.5600 (2c)	=	143.4368	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	112.0600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	272.8661	(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) =	0.1466	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.3971	(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) =	0.3375	(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	0.4303	0.4219	0.4135	0.3713	0.3628	0.3207	0.3207	0.3122	0.3375	0.3628	0.3797	0.3966	(22b)
Effective ac	0.5926	0.5890	0.5855	0.5689	0.5658	0.5514	0.5514	0.5487	0.5570	0.5658	0.5721	0.5786	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Opening Type 1 (Uw = 1.41)			19.8500	1.3347	26.4942			(27)
Opening Type 12			1.9700	1.0000	1.9700			(26)
150mm TE Platinum GF			56.0300	0.1500	8.4045			(28a)
50mm Alreflex Plat	159.0100	21.8200	137.1900	0.2700	37.0413			(29a)
400mm	56.0300		56.0300	0.1100	6.1633			(30)
Total net area of external elements Aum(A, m2)			271.0700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		80.0733			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							152.8100	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.9278	(36)
Total fabric heat loss					(33) + (36) =		91.0012	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	53.3611	53.0374	52.7200	51.2293	50.9504	49.6521	49.6521	49.4116	50.1522	50.9504	51.5146	52.1045	(38)
Heat transfer coeff	144.3623	144.0385	143.7212	142.2305	141.9516	140.6532	140.6532	140.4128	141.1533	141.9516	142.5158	143.1056	(39)
Average = Sum(39)m / 12 =												142.2291	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2883	1.2854	1.2825	1.2692	1.2667	1.2552	1.2552	1.2530	1.2596	1.2667	1.2718	1.2770	(40)
HLP (average)												1.2692	(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												2.8266	(42)
Average daily hot water use (litres/day)												101.3327	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.4660	107.4127	103.3594	99.3061	95.2528	91.1995	91.1995	95.2528	99.3061	103.3594	107.4127	111.4660	(44)
Energy conte	165.3009	144.5732	149.1866	130.0645	124.8000	107.6929	99.7933	114.5143	115.8819	135.0492	147.4168	160.0851	(45)
Energy content (annual)										Total = Sum(45)m =		1594.3586	(45)
Distribution loss (46)m = 0.15 x (45)m	24.7951	21.6860	22.3780	19.5097	18.7200	16.1539	14.9690	17.1771	17.3823	20.2574	22.1125	24.0128	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1533	12.7723	14.1146	13.6228	14.0419	13.5485	13.9750	14.0183	13.5890	14.0807	13.6666	14.1408	(61)
Total heat required for water heating calculated for each month													
	179.4542	157.3455	163.3012	143.6873	138.8418	121.2414	113.7683	128.5326	129.4709	149.1299	161.0834	174.2258	(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													
	179.4542	157.3455	163.3012	143.6873	138.8418	121.2414	113.7683	128.5326	129.4709	149.1299	161.0834	174.2258	(64)
								Total per year (kWh/year) = Sum(64)m =				1760.0823	(64)
Heat gains from water heating, kWh/month													
	58.5009	51.2637	53.1332	46.6521	45.0065	39.1950	36.6750	41.5806	41.9280	48.4240	52.4327	56.7635	(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	141.3321	141.3321	141.3321	141.3321	141.3321	141.3321	141.3321	141.3321	141.3321	141.3321	141.3321	141.3321	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	25.0583	22.2566	18.1003	13.7031	10.2432	8.6477	9.3442	12.1459	16.3022	20.6994	24.1593	25.7548	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	274.4831	277.3313	270.1538	254.8736	235.5851	217.4567	205.3457	202.4975	209.6750	224.9552	244.2437	262.3721	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.1332	37.1332	37.1332	37.1332	37.1332	37.1332	37.1332	37.1332	37.1332	37.1332	37.1332	37.1332	(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)													
	-113.0657	-113.0657	-113.0657	-113.0657	-113.0657	-113.0657	-113.0657	-113.0657	-113.0657	-113.0657	-113.0657	-113.0657	(71)
Water heating gains (Table 5)													
	78.6302	76.2852	71.4156	64.7946	60.4926	54.4375	49.2944	55.8879	58.2333	65.0861	72.8232	76.2950	(72)
Total internal gains													
	446.5712	444.2727	428.0692	401.7709	374.7205	348.9415	332.3839	338.9309	352.6102	379.1403	409.6259	432.8215	(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	4.6800	11.2829	0.7100	0.7000	0.7700	18.1869	(75)
Southeast	3.1500	36.7938	0.7100	0.7000	0.7700	39.9186	(77)
Southwest	6.7500	36.7938	0.7100	0.7000	0.7700	85.5398	(79)
Northwest	5.2700	11.2829	0.7100	0.7000	0.7700	20.4797	(81)

Solar gains	164.1249	292.4089	434.2012	595.1775	718.8407	736.6000	700.6071	604.8390	489.3948	332.3723	198.9228	138.9433	(83)
Total gains	610.6961	736.6817	862.2704	996.9484	1093.5611	1085.5416	1032.9910	943.7699	842.0050	711.5127	608.5486	571.7648	(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	32.9493	33.0234	33.0963	33.4432	33.5089	33.8182	33.8182	33.8761	33.6984	33.5089	33.3762	33.2386	
alpha	3.1966	3.2016	3.2064	3.2295	3.2339	3.2545	3.2545	3.2584	3.2466	3.2339	3.2251	3.2159	
util living area													
	0.9907	0.9825	0.9645	0.9199	0.8301	0.6891	0.5480	0.6060	0.8168	0.9488	0.9845	0.9925	(86)
MIT	18.8917	19.1362	19.5358	20.0569	20.5159	20.8208	20.9378	20.9129	20.6635	20.0594	19.3799	18.8495	(87)
Th 2	19.8500	19.8523	19.8545	19.8650	19.8670	19.8761	19.8761	19.8778	19.8726	19.8670	19.8630	19.8589	(88)
util rest of house													
	0.9886	0.9786	0.9562	0.8999	0.7856	0.6054	0.4276	0.4864	0.7518	0.9320	0.9803	0.9908	(89)
MIT 2	17.0438	17.4004	17.9796	18.7268	19.3508	19.7297	19.8433	19.8273	19.5595	18.7454	17.7641	16.9875	(90)
Living area fraction									fLA = Living area / (4) =			0.1428	(91)
MIT	17.3077	17.6483	18.2018	18.9167	19.5172	19.8855	19.9995	19.9823	19.7171	18.9331	17.9948	17.2534	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.1577	17.4983	18.0518	18.7667	19.3672	19.7355	19.8495	19.8323	19.5671	18.7831	17.8448	17.1034	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9806	0.9661	0.9372	0.8744	0.7620	0.5936	0.4245	0.4810	0.7302	0.9092	0.9686	0.9840	(94)
Useful gains	598.8561	711.7013	808.1125	871.7766	833.2835	644.3505	438.5452	453.9368	614.8069	646.9091	589.4627	562.6017	(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													
	1856.1617	1814.6361	1660.2422	1403.3454	1088.3664	722.3205	457.0580	481.9336	771.6999	1161.5971	1531.2992	1846.5493	(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													
	935.4353	741.1722	633.9845	382.7295	189.7816	0.0000	0.0000	0.0000	0.0000	382.9279	678.1223	955.2570	(98)
Space heating												4899.4103	(98)
Space heating per m2											(98) / (4) =	43.7213	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	5413.7130	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	935.4353	741.1722	633.9845	382.7295	189.7816	0.0000	0.0000	0.0000	0.0000	382.9279	678.1223	955.2570	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	1033.6302	818.9748	700.5353	422.9056	209.7035	0.0000	0.0000	0.0000	0.0000	423.1247	749.3064	1055.5326	(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													
	179.4542	157.3455	163.3012	143.6873	138.8418	121.2414	113.7683	128.5326	129.4709	149.1299	161.0834	174.2258	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9692	89.9228	89.8256	89.6035	89.1198	87.3000	87.3000	87.3000	87.3000	89.5797	89.8677	89.9912	(217)
Fuel for water heating, kWh/month													
	199.4618	174.9784	181.7981	160.3590	155.7923	138.8790	130.3188	147.2309	148.3057	166.4774	179.2450	193.6033	(219)
Water heating fuel used												1976.4498	(219)
Annual totals kWh/year													
Space heating fuel - main system												5413.7130	(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)												442.5378	(232)
Total delivered energy for all uses												7907.7006	(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	5413.7130	0.2160	1169.3620	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1976.4498	0.2160	426.9132	(264)
Space and water heating			1596.2752	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	442.5378	0.5190	229.6771	(268)
Total CO2, kg/year			1864.8773	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			16.6400	(273)

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

DER		16.6400	ZC1
Total Floor Area	TFA	112.0600	
Assumed number of occupants	N	2.8266	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		14.5148	ZC2
CO2 emissions from cooking, equation (L16)		1.6673	ZC3
Total CO2 emissions		32.8221	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		32.8221	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	56.0300 (1b)	x	2.3100 (2b)	=	129.4293	(1b) - (3b)
First floor	56.0300 (1c)	x	2.5600 (2c)	=	143.4368	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	112.0600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	272.8661	(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) =	0.1466	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3966	(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) =	0.3371	(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	0.4298	0.4214	0.4130	0.3708	0.3624	0.3202	0.3202	0.3118	0.3371	0.3624	0.3792	0.3961	(22b)
Effective ac	0.5924	0.5888	0.5853	0.5688	0.5657	0.5513	0.5513	0.5486	0.5568	0.5657	0.5719	0.5784	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			1.9700	1.0000	1.9700			(26)
TER Opening Type (Uw = 1.40)			19.8500	1.3258	26.3163			(27)
150mm TE Platinum GF			56.0300	0.1300	7.2839			(28a)
50mm Alreflex Plat	159.0100	21.8200	137.1900	0.1800	24.6942			(29a)
400mm	56.0300		56.0300	0.1300	7.2839			(30)
Total net area of external elements Aum(A, m2)			271.0700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		67.5483			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							12.6742	(36)
Total fabric heat loss					(33) + (36) =		80.2225	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	53.3402	53.0172	52.7006	51.2137	50.9355	49.6404	49.6404	49.4006	50.1392	50.9355	51.4983	52.0867	(38)
Heat transfer coeff	133.5626	133.2397	132.9231	131.4362	131.1580	129.8629	129.8629	129.6231	130.3617	131.1580	131.7208	132.3091	(39)
Average = Sum(39)m / 12 =												131.4348	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1919	1.1890	1.1862	1.1729	1.1704	1.1589	1.1589	1.1567	1.1633	1.1704	1.1754	1.1807	(40)
HLP (average)												1.1729	(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												2.8266	(42)
Average daily hot water use (litres/day)												101.3327	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.4660	107.4127	103.3594	99.3061	95.2528	91.1995	91.1995	95.2528	99.3061	103.3594	107.4127	111.4660	(44)
Energy conte	165.3009	144.5732	149.1866	130.0645	124.8000	107.6929	99.7933	114.5143	115.8819	135.0492	147.4168	160.0851	(45)
Energy content (annual)										Total = Sum(45)m =		1594.3586	(45)
Distribution loss (46)m = 0.15 x (45)m	24.7951	21.6860	22.3780	19.5097	18.7200	16.1539	14.9690	17.1771	17.3823	20.2574	22.1125	24.0128	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	46.0274	50.9589	48.9729	48.5398	44.9751	46.4742	48.5398	48.9729	50.9589	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month													
	216.2598	190.6006	200.1455	179.0374	173.3398	152.6680	146.2675	163.0540	164.8548	186.0081	196.7318	211.0440	(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													
	216.2598	190.6006	200.1455	179.0374	173.3398	152.6680	146.2675	163.0540	164.8548	186.0081	196.7318	211.0440	(64)
								Total per year (kWh/year) = Sum(64)m =				2180.0113	(64)
Heat gains from water heating, kWh/month													
	67.7023	59.5774	62.3443	55.4897	53.6309	47.0517	44.7998	50.2109	50.7740	57.6436	61.3448	65.9680	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	141.3321	141.3321	141.3321	141.3321	141.3321	141.3321	141.3321	141.3321	141.3321	141.3321	141.3321	141.3321	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	25.0583	22.2566	18.1003	13.7031	10.2432	8.6477	9.3442	12.1459	16.3022	20.6994	24.1593	25.7548	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	274.4831	277.3313	270.1538	254.8736	235.5851	217.4567	205.3457	202.4975	209.6750	224.9552	244.2437	262.3721	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.1332	37.1332	37.1332	37.1332	37.1332	37.1332	37.1332	37.1332	37.1332	37.1332	37.1332	37.1332	(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)													
	-113.0657	-113.0657	-113.0657	-113.0657	-113.0657	-113.0657	-113.0657	-113.0657	-113.0657	-113.0657	-113.0657	-113.0657	(71)
Water heating gains (Table 5)													
	90.9977	88.6569	83.7961	77.0690	72.0846	65.3495	60.2148	67.4878	70.5194	77.4779	85.2012	88.6667	(72)
Total internal gains													
	458.9387	456.6444	440.4497	414.0453	386.3125	359.8535	343.3044	350.5308	364.8963	391.5322	422.0038	445.1932	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	4.6800	11.2829	0.6300	0.7000	0.7700	16.1376	(75)
Southeast	3.1500	36.7938	0.6300	0.7000	0.7700	35.4207	(77)
Southwest	6.7500	36.7938	0.6300	0.7000	0.7700	75.9015	(79)
Northwest	5.2700	11.2829	0.6300	0.7000	0.7700	18.1721	(81)

Solar gains	145.6320	259.4614	385.2771	528.1152	637.8445	653.6028	621.6655	536.6881	434.2517	294.9219	176.5089	123.2877	(83)
Total gains	604.5707	716.1059	825.7268	942.1605	1024.1571	1013.4564	964.9698	887.2190	799.1480	686.4541	598.5127	568.4809	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	58.2644	58.4056	58.5447	59.2070	59.3326	59.9243	59.9243	60.0352	59.6950	59.3326	59.0791	58.8164	
alpha	4.8843	4.8937	4.9030	4.9471	4.9555	4.9950	4.9950	5.0023	4.9797	4.9555	4.9386	4.9211	
util living area													
	0.9988	0.9969	0.9910	0.9680	0.8957	0.7413	0.5737	0.6388	0.8779	0.9832	0.9973	0.9991	(86)
MIT	19.6470	19.8089	20.0766	20.4338	20.7475	20.9332	20.9851	20.9753	20.8345	20.4246	19.9706	19.6208	(87)
Th 2	19.9265	19.9288	19.9311	19.9417	19.9437	19.9530	19.9530	19.9548	19.9495	19.9437	19.9397	19.9355	(88)
util rest of house													
	0.9983	0.9958	0.9876	0.9552	0.8538	0.6493	0.4466	0.5097	0.8127	0.9743	0.9962	0.9988	(89)
MIT 2	18.1192	18.3573	18.7484	19.2678	19.6908	19.9076	19.9475	19.9443	19.8109	19.2629	18.6017	18.0872	(90)
Living area fraction									fLA = Living area / (4) =			0.1428	(91)
MIT	18.3374	18.5646	18.9381	19.4343	19.8417	20.0540	20.0957	20.0915	19.9571	19.4288	18.7972	18.3061	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.3374	18.5646	18.9381	19.4343	19.8417	20.0540	20.0957	20.0915	19.9571	19.4288	18.7972	18.3061	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9973	0.9937	0.9831	0.9471	0.8490	0.6591	0.4646	0.5277	0.8132	0.9681	0.9942	0.9980	(94)
Useful gains	602.9406	711.5714	811.7557	892.2830	869.4880	667.9461	448.3340	468.2095	649.8925	664.5349	595.0693	567.3416	(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													
	1874.8668	1820.6633	1653.3058	1384.5824	1067.8506	708.2765	453.9553	478.5073	763.5410	1157.9655	1540.7613	1866.3723	(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													
	946.3130	745.3097	626.1133	354.4556	147.5818	0.0000	0.0000	0.0000	0.0000	367.1124	680.8983	966.4789	(98)
Space heating												4834.2629	(98)
Space heating per m2											(98) / (4) =	43.1400	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												5175.8703	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	946.3130	745.3097	626.1133	354.4556	147.5818	0.0000	0.0000	0.0000	0.0000	367.1124	680.8983	966.4789	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	1013.1831	797.9762	670.3568	379.5027	158.0105	0.0000	0.0000	0.0000	0.0000	393.0539	729.0131	1034.7740	(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													
	216.2598	190.6006	200.1455	179.0374	173.3398	152.6680	146.2675	163.0540	164.8548	186.0081	196.7318	211.0440	(64)
Efficiency of water heater												80.3000	(216)
(217)m	88.3333	88.1422	87.7272	86.7387	84.6492	80.3000	80.3000	80.3000	80.3000	86.7314	87.9211	88.4071	(217)
Fuel for water heating, kWh/month													
	244.8226	216.2421	228.1454	206.4100	204.7742	190.1220	182.1514	203.0561	205.2986	214.4644	223.7596	238.7185	(219)
Water heating fuel used												2557.9649	(219)
Annual totals kWh/year													
Space heating fuel - main system												5175.8703	(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)												442.5378	(232)
Total delivered energy for all uses												8251.3730	(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	5175.8703	0.2160	1117.9880	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2557.9649	0.2160	552.5204	(264)
Space and water heating			1670.5084	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	442.5378	0.5190	229.6771	(268)
Total CO2, kg/m2/year			1939.1105	(272)
Emissions per m2 for space and water heating			14.9073	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.0496	(272b)
Emissions per m2 for pumps and fans			0.3474	(272c)
Target Carbon Dioxide Emission Rate (TER) = (14.9073 * 1.00) + 2.0496 + 0.3474, rounded to 2 d.p.			17.3000	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	56.0300 (1b)	x	2.3100 (2b)	=	129.4293	(1b) - (3b)
First floor	56.0300 (1c)	x	2.5600 (2c)	=	143.4368	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	112.0600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	272.8661	(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) =	0.1466	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.3971	(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) =	0.3375	(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	0.4303	0.4219	0.4135	0.3713	0.3628	0.3207	0.3207	0.3122	0.3375	0.3628	0.3797	0.3966	(22b)
Effective ac	0.5926	0.5890	0.5855	0.5689	0.5658	0.5514	0.5514	0.5487	0.5570	0.5658	0.5721	0.5786	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Opening Type 1 (Uw = 1.41)			19.8500	1.3347	26.4942			(27)
Opening Type 12			1.9700	1.0000	1.9700			(26)
150mm TE Platinum GF			56.0300	0.1500	8.4045			(28a)
50mm Alreflex Plat	159.0100	21.8200	137.1900	0.2700	37.0413			(29a)
400mm	56.0300		56.0300	0.1100	6.1633			(30)
Total net area of external elements Aum(A, m2)			271.0700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		80.0733			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							152.8100	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.9278	(36)
Total fabric heat loss					(33) + (36) =		91.0012	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	53.3611	53.0374	52.7200	51.2293	50.9504	49.6521	49.6521	49.4116	50.1522	50.9504	51.5146	52.1045	(38)
Heat transfer coeff	144.3623	144.0385	143.7212	142.2305	141.9516	140.6532	140.6532	140.4128	141.1533	141.9516	142.5158	143.1056	(39)
Average = Sum(39)m / 12 =												142.2291	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2883	1.2854	1.2825	1.2692	1.2667	1.2552	1.2552	1.2530	1.2596	1.2667	1.2718	1.2770	(40)
HLP (average)												1.2692	(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	2.8266	(42)
Average daily hot water use (litres/day)	101.3327	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.4660	107.4127	103.3594	99.3061	95.2528	91.1995	91.1995	95.2528	99.3061	103.3594	107.4127	111.4660	(44)
Energy conte	165.3009	144.5732	149.1866	130.0645	124.8000	107.6929	99.7933	114.5143	115.8819	135.0492	147.4168	160.0851	(45)
Energy content (annual)										Total = Sum(45)m =		1594.3586	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	35.1264	30.7218	31.7022	27.6387	26.5200	22.8847	21.2061	24.3343	24.6249	28.6980	31.3261	34.0181	(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	141.3321	141.3321	141.3321	141.3321	141.3321	141.3321	141.3321	141.3321	141.3321	141.3321	141.3321	141.3321	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	25.0583	22.2566	18.1003	13.7031	10.2432	8.6477	9.3442	12.1459	16.3022	20.6994	24.1593	25.7548	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	274.4831	277.3313	270.1538	254.8736	235.5851	217.4567	205.3457	202.4975	209.6750	224.9552	244.2437	262.3721	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.1332	37.1332	37.1332	37.1332	37.1332	37.1332	37.1332	37.1332	37.1332	37.1332	37.1332	37.1332	(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)													
	-113.0657	-113.0657	-113.0657	-113.0657	-113.0657	-113.0657	-113.0657	-113.0657	-113.0657	-113.0657	-113.0657	-113.0657	(71)
Water heating gains (Table 5)													
	47.2130	45.7170	42.6104	38.3871	35.6452	31.7844	28.5028	32.7074	34.2013	38.5725	43.5084	45.7232	(72)
Total internal gains													
	412.1540	410.7045	396.2641	372.3634	346.8731	323.2884	308.5923	312.7504	325.5782	349.6268	377.3110	399.2498	(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	4.6800	11.2829	0.7100	0.7000	0.7700	18.1869	(75)
Southeast	3.1500	36.7938	0.7100	0.7000	0.7700	39.9186	(77)
Southwest	6.7500	36.7938	0.7100	0.7000	0.7700	85.5398	(79)
Northwest	5.2700	11.2829	0.7100	0.7000	0.7700	20.4797	(81)

Solar gains	164.1249	292.4089	434.2012	595.1775	718.8407	736.6000	700.6071	604.8390	489.3948	332.3723	198.9228	138.9433	(83)
Total gains	576.2789	703.1134	830.4653	967.5408	1065.7137	1059.8884	1009.1994	917.5894	814.9730	681.9991	576.2338	538.1930	(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, n1l,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.9493	33.0234	33.0963	33.4432	33.5089	33.8182	33.8182	33.8761	33.6984	33.5089	33.3762	33.2386	
alpha	3.1966	3.2016	3.2064	3.2295	3.2339	3.2545	3.2545	3.2584	3.2466	3.2339	3.2251	3.2159	
util living area													
	0.9921	0.9846	0.9678	0.9253	0.8382	0.6991	0.5580	0.6183	0.8276	0.9540	0.9867	0.9937	(86)
MIT	18.8529	19.0994	19.5032	20.0313	20.4989	20.8126	20.9344	20.9075	20.6478	20.0307	19.3441	18.8113	(87)
Th 2	19.8500	19.8523	19.8545	19.8650	19.8670	19.8761	19.8761	19.8778	19.8726	19.8670	19.8630	19.8589	(88)
util rest of house													
	0.9903	0.9811	0.9602	0.9063	0.7949	0.6159	0.4365	0.4980	0.7644	0.9387	0.9831	0.9922	(89)
MIT 2	17.8955	18.1420	18.5428	19.0642	19.5005	19.7709	19.8523	19.8408	19.6470	19.0742	18.3947	17.8604	(90)
Living area fraction										fLA = Living area / (4) =		0.1428	(91)
MIT	18.0322	18.2787	18.6799	19.2022	19.6431	19.9196	20.0068	19.9931	19.7899	19.2108	18.5302	17.9962	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.0322	18.2787	18.6799	19.2022	19.6431	19.9196	20.0068	19.9931	19.7899	19.2108	18.5302	17.9962	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9863	0.9745	0.9497	0.8925	0.7849	0.6194	0.4518	0.5116	0.7589	0.9268	0.9771	0.9888	(94)
Useful gains	568.3590	685.1512	788.6946	863.5446	836.4532	656.5465	455.9131	469.4281	618.4813	632.0947	563.0244	532.1783	(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													
	1982.4128	1927.0495	1750.5101	1465.2935	1127.5293	748.2249	479.1772	504.5225	803.1483	1222.3174	1628.9871	1974.3141	(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													
	1052.0560	834.5557	715.5908	433.2592	216.5606	0.0000	0.0000	0.0000	0.0000	439.1257	767.4932	1072.9491	(98)
Space heating												5531.5901	(98)
Space heating per m2											(98) / (4) =	49.3628	(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	1322.1403	1040.8338	1067.1372	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7729	0.8392	0.8031	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1021.9327	873.4795	857.0617	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1350.2463	1288.5602	1183.5812	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	236.3858	308.8201	242.9305	0.0000	0.0000	0.0000	0.0000	(104)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Space cooling											788.1363	(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	59.0964	77.2050	60.7326	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling											197.0341	(107)
Space cooling per m2											1.7583	(108)
Energy for space heating											49.3628	(99)
Energy for space cooling											1.7583	(108)
Total											51.1210	(109)
Dwelling Fabric Energy Efficiency (DFEE)											51.1	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	56.0300 (1b)	x	2.3100 (2b)	=	129.4293	(1b) - (3b)
First floor	56.0300 (1c)	x	2.5600 (2c)	=	143.4368	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	112.0600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	272.8661	(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) =	0.1466	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3966	(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) =	0.3371	(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	0.4298	0.4214	0.4130	0.3708	0.3624	0.3202	0.3202	0.3118	0.3371	0.3624	0.3792	0.3961	(22b)
Effective ac	0.5924	0.5888	0.5853	0.5688	0.5657	0.5513	0.5513	0.5486	0.5568	0.5657	0.5719	0.5784	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			1.9700	1.0000	1.9700			(26)
TER Opening Type (Uw = 1.40)			19.8500	1.3258	26.3163			(27)
150mm TE Platinum GF			56.0300	0.1300	7.2839			(28a)
50mm Alreflex Plat	159.0100	21.8200	137.1900	0.1800	24.6942			(29a)
400mm	56.0300		56.0300	0.1300	7.2839			(30)
Total net area of external elements Aum(A, m2)			271.0700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		67.5483			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							12.6742	(36)
Total fabric heat loss					(33) + (36) =		80.2225	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	53.3402	53.0172	52.7006	51.2137	50.9355	49.6404	49.6404	49.4006	50.1392	50.9355	51.4983	52.0867	(38)
Heat transfer coeff	133.5626	133.2397	132.9231	131.4362	131.1580	129.8629	129.8629	129.6231	130.3617	131.1580	131.7208	132.3091	(39)
Average = Sum(39)m / 12 =												131.4348	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1919	1.1890	1.1862	1.1729	1.1704	1.1589	1.1589	1.1567	1.1633	1.1704	1.1754	1.1807	(40)
HLP (average)												1.1729	(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												2.8266	(42)
Average daily hot water use (litres/day)												101.3327	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.4660	107.4127	103.3594	99.3061	95.2528	91.1995	91.1995	95.2528	99.3061	103.3594	107.4127	111.4660	(44)
Energy conte	165.3009	144.5732	149.1866	130.0645	124.8000	107.6929	99.7933	114.5143	115.8819	135.0492	147.4168	160.0851	(45)
Energy content (annual)										Total = Sum(45)m =		1594.3586	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	35.1264	30.7218	31.7022	27.6387	26.5200	22.8847	21.2061	24.3343	24.6249	28.6980	31.3261	34.0181	(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	141.3321	141.3321	141.3321	141.3321	141.3321	141.3321	141.3321	141.3321	141.3321	141.3321	141.3321	141.3321	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	25.0583	22.2566	18.1003	13.7031	10.2432	8.6477	9.3442	12.1459	16.3022	20.6994	24.1593	25.7548	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	274.4831	277.3313	270.1538	254.8736	235.5851	217.4567	205.3457	202.4975	209.6750	224.9552	244.2437	262.3721	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.1332	37.1332	37.1332	37.1332	37.1332	37.1332	37.1332	37.1332	37.1332	37.1332	37.1332	37.1332	(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)													
	-113.0657	-113.0657	-113.0657	-113.0657	-113.0657	-113.0657	-113.0657	-113.0657	-113.0657	-113.0657	-113.0657	-113.0657	(71)
Water heating gains (Table 5)													
	47.2130	45.7170	42.6104	38.3871	35.6452	31.7844	28.5028	32.7074	34.2013	38.5725	43.5084	45.7232	(72)
Total internal gains													
	412.1540	410.7045	396.2641	372.3634	346.8731	323.2884	308.5923	312.7504	325.5782	349.6268	377.3110	399.2498	(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	4.6800	11.2829	0.6300	0.7000	0.7700	16.1376	(75)
Southeast	3.1500	36.7938	0.6300	0.7000	0.7700	35.4207	(77)
Southwest	6.7500	36.7938	0.6300	0.7000	0.7700	75.9015	(79)
Northwest	5.2700	11.2829	0.6300	0.7000	0.7700	18.1721	(81)

Solar gains	145.6320	259.4614	385.2771	528.1152	637.8445	653.6028	621.6655	536.6881	434.2517	294.9219	176.5089	123.2877	(83)
Total gains	557.7859	670.1660	781.5412	900.4786	984.7176	976.8912	930.2578	849.4385	759.8299	644.5487	553.8200	522.5375	(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, n1l,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	58.2644	58.4056	58.5447	59.2070	59.3326	59.9243	59.9243	60.0352	59.6950	59.3326	59.0791	58.8164	
alpha	4.8843	4.8937	4.9030	4.9471	4.9555	4.9950	4.9950	5.0023	4.9797	4.9555	4.9386	4.9211	
util living area													
	0.9991	0.9977	0.9929	0.9731	0.9074	0.7595	0.5923	0.6615	0.8945	0.9870	0.9981	0.9994	(86)
MIT	19.6083	19.7713	20.0413	20.4040	20.7276	20.9254	20.9829	20.9712	20.8162	20.3922	19.9337	19.5827	(87)
Th 2	19.9265	19.9288	19.9311	19.9417	19.9437	19.9530	19.9530	19.9548	19.9495	19.9437	19.9397	19.9355	(88)
util rest of house													
	0.9988	0.9969	0.9901	0.9620	0.8685	0.6685	0.4624	0.5305	0.8342	0.9799	0.9973	0.9992	(89)
MIT 2	18.6539	18.8184	19.0889	19.4535	19.7550	19.9178	19.9486	19.9463	19.8419	19.4478	18.9896	18.6355	(90)
Living area fraction									fLA = Living area / (4) =			0.1428	(91)
MIT	18.7902	18.9544	19.2249	19.5892	19.8939	20.0617	20.0963	20.0926	19.9810	19.5827	19.1244	18.7707	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7902	18.9544	19.2249	19.5892	19.8939	20.0617	20.0963	20.0926	19.9810	19.5827	19.1244	18.7707	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9984	0.9958	0.9877	0.9572	0.8663	0.6789	0.4810	0.5491	0.8365	0.9766	0.9964	0.9988	(94)
Useful gains	556.8736	667.3415	771.8967	861.9394	853.0282	663.2505	447.4899	466.4039	635.5746	629.4364	551.8080	521.9195	(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													
	1935.3518	1872.6074	1691.4339	1404.9438	1074.6910	709.2673	454.0401	478.6491	766.6583	1178.1508	1583.8600	1927.8372	(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													
	1025.5878	809.9387	684.1357	390.9632	164.9171	0.0000	0.0000	0.0000	0.0000	408.2435	743.0775	1046.0028	(98)
Space heating												5272.8663	(98)
Space heating per m2											(98) / (4) =	47.0540	(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	1220.7112	960.9854	985.1353	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8440	0.9099	0.8770	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1030.2228	874.3934	863.9848	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1253.2366	1196.2907	1103.9244	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	160.5699	239.4916	178.5151	0.0000	0.0000	0.0000	0.0000	(104)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Space cooling											578.5766	(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	40.1425	59.8729	44.6288	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling											144.6441	(107)
Space cooling per m2											1.2908	(108)
Energy for space heating											47.0540	(99)
Energy for space cooling											1.2908	(108)
Total											48.3447	(109)
Target Fabric Energy Efficiency (TFEE)											55.6	(109)

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

Design SAP
elmhurst energy

Property Reference	Bedale Detached	**Issued on Date**	15/10/2021
Assessment Reference	1	**Prop Type Ref**	
Property	Plot 093, Chipping Lane , Longridge , PR3		

SAP Rating	82 B	**DER**	21.29	**TER**	22.38
Environmental	86 B	**% DER<TER**	4.89		
CO_2 Emissions (t/year)	1.07	**DFEE**	57.80	**TFEE**	63.79
General Requirements Compliance	Pass	**% DFEE<TFEE**	9.39		

Assessor Details	Mr. William Vincent, William Vincent, Tel: 01582544250, William.Vincent@ee-ltd.co.uk	**Assessor ID**	T759-0001
Client			

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DWELLING AS DESIGNED

Detached Bungalow, total floor area 55 m²

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

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 22.38 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 21.29 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)63.8 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)57.8 kWh/m²/yrOK

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2 Fabric U-values

Element	Average	Highest	
External wall	0.27 (max. 0.30)	0.27 (max. 0.70)	OK
Floor	0.15 (max. 0.25)	0.15 (max. 0.70)	OK
Roof	0.11 (max. 0.20)	0.11 (max. 0.35)	OK
Openings	1.33 (max. 2.00)	1.41 (max. 3.30)	OK

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

---

3 Air permeability
Air permeability at 50 pascals: 5.01 (design value)
Maximum 10.0 OK

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4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 35
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

---

5 Cylinder insulation
Hot water storage: No cylinder

---

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

Hot water controls: No cylinder

Boiler interlock: Yes OK

---

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

---

8 Mechanical ventilation
Not applicable

---

9 Summertime temperature
Overheating risk (West Pennines (England)):Slight OK
Based on:
Overshading: Average
Windows facing North East: 6.14 m², No overhang
Windows facing South West: 2.48 m², No overhang
Air change rate: 3.00 ach
Blinds/curtains: None

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10 Key features
Roof U-value 0.11 W/m²K
Door U-value 1.00 W/m²K

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	55.2600 (1b)	x	2.4000 (2b)	=	132.6240	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	55.2600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	132.6240	(5)

2. Ventilation rate

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

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1508	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.4013	(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) =	0.3411	(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	0.4349	0.4264	0.4179	0.3752	0.3667	0.3241	0.3241	0.3155	0.3411	0.3667	0.3837	0.4008	(22b)
Effective ac	0.5946	0.5909	0.5873	0.5704	0.5672	0.5525	0.5525	0.5498	0.5582	0.5672	0.5736	0.5803	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Opening Type 1			2.1200	1.0000	2.1200			(26)
Opening Type 2 (Uw = 1.41)			8.6200	1.3347	11.5053			(27)
150mm TE Platinum			55.2600	0.1500	8.2890			(28a)
50mm Alreflex	71.8100	10.7400	61.0700	0.2700	16.4889			(29a)
400mm Mineral Wool	55.2600		55.2600	0.1100	6.0786			(30)
Total net area of external elements Aum(A, m2)			182.3300					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	44.4818			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							187.4500	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							7.5343	(36)
Total fabric heat loss						(33) + (36) =	52.0161	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	26.0221	25.8613	25.7038	24.9638	24.8254	24.1809	24.1809	24.0615	24.4291	24.8254	25.1055	25.3983	(38)
Heat transfer coeff	78.0381	77.8774	77.7199	76.9799	76.8414	76.1969	76.1969	76.0776	76.4452	76.8414	77.1215	77.4143	(39)
Average = Sum(39)m / 12 =												76.9792	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.4122	1.4093	1.4064	1.3930	1.3905	1.3789	1.3789	1.3767	1.3834	1.3905	1.3956	1.4009	(40)
HLP (average)												1.3930	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		1.8450 (42)
Average daily hot water use (litres/day)		78.0181 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	85.8199	82.6992	79.5785	76.4578	73.3370	70.2163	70.2163	73.3370	76.4578	79.5785	82.6992	85.8199	(44)
Energy conte	127.2685	111.3098	114.8618	100.1393	96.0860	82.9149	76.8329	88.1668	89.2198	103.9771	113.4992	123.2527	(45)
Energy content (annual)										Total = Sum(45)m =		1227.5289	(45)
Distribution loss (46)m = 0.15 x (45)m	19.0903	16.6965	17.2293	15.0209	14.4129	12.4372	11.5249	13.2250	13.3830	15.5966	17.0249	18.4879	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Combi loss	14.0187	12.6462	13.9759	13.4966	13.9257	13.4525	13.8860	13.9117	13.4765	13.9551	13.5381	14.0104	(61)
Total heat required for water heating calculated for each month													
	141.2872	123.9560	128.8377	113.6358	110.0117	96.3675	90.7189	102.0786	102.6964	117.9323	127.0372	137.2632	(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													
	141.2872	123.9560	128.8377	113.6358	110.0117	96.3675	90.7189	102.0786	102.6964	117.9323	127.0372	137.2632	(64)
									Total per year (kWh/year) = Sum(64)m =			1391.8224	(64)
Heat gains from water heating, kWh/month													
	45.8214	40.1721	41.6855	36.6704	35.4300	30.9323	29.0184	32.7934	33.0347	38.0612	41.1230	44.4841	(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	92.2487	92.2487	92.2487	92.2487	92.2487	92.2487	92.2487	92.2487	92.2487	92.2487	92.2487	92.2487	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	15.0372	13.3559	10.8618	8.2230	6.1468	5.1894	5.6073	7.2886	9.7828	12.4215	14.4977	15.4551	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	160.8554	162.5246	158.3183	149.3637	138.0600	127.4362	120.3389	118.6697	122.8759	131.8306	143.1342	153.7581	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	32.2249	32.2249	32.2249	32.2249	32.2249	32.2249	32.2249	32.2249	32.2249	32.2249	32.2249	32.2249	(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)													
	-73.7989	-73.7989	-73.7989	-73.7989	-73.7989	-73.7989	-73.7989	-73.7989	-73.7989	-73.7989	-73.7989	-73.7989	(71)
Water heating gains (Table 5)													
	61.5880	59.7799	56.0289	50.9312	47.6210	42.9616	39.0033	44.0772	45.8816	51.1575	57.1153	59.7905	(72)
Total internal gains													
	291.1559	289.3350	278.8836	262.1925	245.5025	229.2618	218.6941	223.7101	232.2149	249.0842	268.4218	282.6783	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	6.1400	11.2829	0.7100	0.7000	0.7700	23.8605	(75)
Southwest	2.4800	36.7938	0.7100	0.7000	0.7700	31.4280	(79)

Solar gains	55.2885	102.1023	160.7524	234.4656	294.8282	306.8630	289.9530	242.7540	185.9377	118.5208	67.6662	46.3815	(83)
Total gains	346.4437	391.4373	439.6360	496.6582	540.3306	536.1248	508.5771	466.4641	418.1526	367.6050	336.0880	329.0598	(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	36.8712	36.9473	37.0222	37.3780	37.4454	37.7621	37.7621	37.8214	37.6395	37.4454	37.3094	37.1683	
alpha	3.4581	3.4632	3.4681	3.4919	3.4964	3.5175	3.5175	3.5214	3.5093	3.4964	3.4873	3.4779	
util living area													
	0.9925	0.9877	0.9763	0.9448	0.8717	0.7404	0.5980	0.6566	0.8587	0.9631	0.9879	0.9937	(86)
MIT	19.0816	19.2649	19.6032	20.0720	20.5107	20.8173	20.9373	20.9120	20.6612	20.1059	19.5151	19.0486	(87)
Th 2	19.7540	19.7562	19.7584	19.7687	19.7706	19.7796	19.7796	19.7812	19.7761	19.7706	19.7667	19.7626	(88)
util rest of house													
	0.9904	0.9844	0.9694	0.9272	0.8278	0.6479	0.4573	0.5188	0.7924	0.9481	0.9840	0.9920	(89)
MIT 2	17.2270	17.4950	17.9866	18.6625	19.2620	19.6400	19.7510	19.7363	19.4739	18.7226	17.8676	17.1841	(90)
Living area fraction										fLA = Living area / (4) =		0.2646	(91)
MIT	17.7177	17.9632	18.4143	19.0354	19.5924	19.9515	20.0649	20.0474	19.7880	19.0886	18.3035	17.6774	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.5677	17.8132	18.2643	18.8854	19.4424	19.8015	19.9149	19.8974	19.6380	18.9386	18.1535	17.5274	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9848	0.9764	0.9574	0.9104	0.8134	0.6498	0.4744	0.5336	0.7830	0.9334	0.9760	0.9871	(94)
Useful gains	341.1737	382.1929	420.9159	452.1589	439.5238	348.3777	241.2605	248.8835	327.4217	343.1339	328.0375	324.8231	(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													
	1035.3832	1005.6495	914.3213	768.6770	594.9347	396.3374	252.5825	266.0704	423.3521	640.7497	852.4601	1031.7298	(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													
	516.4919	418.9628	367.0936	227.8930	115.6257	0.0000	0.0000	0.0000	0.0000	221.4261	377.5843	525.9386	(98)
Space heating												2771.0160	(98)
Space heating per m2											(98) / (4) =	50.1451	(99)

8c. Space cooling requirement

Not applicable

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

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3061.8961	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	516.4919	418.9628	367.0936	227.8930	115.6257	0.0000	0.0000	0.0000	0.0000	221.4261	377.5843	525.9386	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	570.7093	462.9424	405.6283	251.8154	127.7632	0.0000	0.0000	0.0000	0.0000	244.6697	417.2202	581.1476	(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													
	141.2872	123.9560	128.8377	113.6358	110.0117	96.3675	90.7189	102.0786	102.6964	117.9323	127.0372	137.2632	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7930	89.7489	89.6463	89.4095	88.9110	87.3000	87.3000	87.3000	87.3000	89.3617	89.6725	89.8186	(217)
Fuel for water heating, kWh/month													
	157.3476	138.1143	143.7178	127.0959	123.7324	110.3866	103.9163	116.9285	117.6361	131.9718	141.6680	152.8227	(219)
Water heating fuel used												1565.3378	(219)
Annual totals kWh/year													
Space heating fuel - main system												3061.8961	(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)												265.5617	(232)
Total delivered energy for all uses												4967.7957	(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	3061.8961	0.2160	661.3696	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1565.3378	0.2160	338.1130	(264)
Space and water heating			999.4825	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	265.5617	0.5190	137.8265	(268)
Total CO2, kg/year			1176.2341	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			21.2900	(273)

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

DER		21.2900	ZC1
Total Floor Area	TFA	55.2600	
Assumed number of occupants	N	1.8450	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		17.2493	ZC2
CO2 emissions from cooking, equation (L16)		2.9547	ZC3
Total CO2 emissions		41.4940	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		41.4940	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	55.2600 (1b)	x	2.4000 (2b)	=	132.6240	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	55.2600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	132.6240	(5)

2. Ventilation rate

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

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1508	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4008	(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) =	0.3407	(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	0.4344	0.4259	0.4173	0.3748	0.3662	0.3236	0.3236	0.3151	0.3407	0.3662	0.3833	0.4003	(22b)
Effective ac	0.5943	0.5907	0.5871	0.5702	0.5671	0.5524	0.5524	0.5497	0.5580	0.5671	0.5734	0.5801	(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			2.1200	1.0000	2.1200			(26)
TER Opening Type (Uw = 1.40)			8.6200	1.3258	11.4280			(27)
150mm TE Platinum			55.2600	0.1300	7.1838			(28a)
50mm Alreflex	71.8100	10.7400	61.0700	0.1800	10.9926			(29a)
400mm Mineral Wool	55.2600		55.2600	0.1300	7.1838			(30)
Total net area of external elements Aum(A, m2)			182.3300					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	38.9082			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							8.8235	(36)
Total fabric heat loss					(33) + (36) =		47.7317	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	26.0118	25.8514	25.6943	24.9562	24.8180	24.1752	24.1752	24.0561	24.4228	24.8180	25.0974	25.3895	(38)
Heat transfer coeff	73.7435	73.5832	73.4260	72.6879	72.5498	71.9069	71.9069	71.7878	72.1545	72.5498	72.8292	73.1212	(39)
Average = Sum(39)m / 12 =												72.6872	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3345	1.3316	1.3287	1.3154	1.3129	1.3012	1.3012	1.2991	1.3057	1.3129	1.3179	1.3232	(40)
HLP (average)												1.3154	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		1.8450 (42)
Average daily hot water use (litres/day)		78.0181 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	85.8199	82.6992	79.5785	76.4578	73.3370	70.2163	70.2163	73.3370	76.4578	79.5785	82.6992	85.8199	(44)
Energy conte	127.2685	111.3098	114.8618	100.1393	96.0860	82.9149	76.8329	88.1668	89.2198	103.9771	113.4992	123.2527	(45)
Energy content (annual)										Total = Sum(45)m =		1227.5289	(45)
Distribution loss (46)m = 0.15 x (45)m	19.0903	16.6965	17.2293	15.0209	14.4129	12.4372	11.5249	13.2250	13.3830	15.5966	17.0249	18.4879	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Combi loss	43.7329	38.0643	40.5523	37.7052	37.3718	34.6272	35.7815	37.3718	37.7052	40.5523	40.7832	43.7329	(61)
Total heat required for water heating calculated for each month													
	171.0014	149.3741	155.4141	137.8445	133.4578	117.5422	112.6143	125.5386	126.9250	144.5294	154.2823	166.9856	(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													
	171.0014	149.3741	155.4141	137.8445	133.4578	117.5422	112.6143	125.5386	126.9250	144.5294	154.2823	166.9856	(64)
									Total per year (kWh/year) = Sum(64)m =			1695.5094	(64)
Heat gains from water heating, kWh/month													
	53.2500	46.5266	48.3296	42.7226	41.2915	36.2260	34.4923	38.6584	39.0919	44.7105	47.9343	51.9148	(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	92.2487	92.2487	92.2487	92.2487	92.2487	92.2487	92.2487	92.2487	92.2487	92.2487	92.2487	92.2487	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	15.0372	13.3559	10.8618	8.2230	6.1468	5.1894	5.6073	7.2886	9.7828	12.4215	14.4977	15.4551	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	160.8554	162.5246	158.3183	149.3637	138.0600	127.4362	120.3389	118.6697	122.8759	131.8306	143.1342	153.7581	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	32.2249	32.2249	32.2249	32.2249	32.2249	32.2249	32.2249	32.2249	32.2249	32.2249	32.2249	32.2249	(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)													
	-73.7989	-73.7989	-73.7989	-73.7989	-73.7989	-73.7989	-73.7989	-73.7989	-73.7989	-73.7989	-73.7989	-73.7989	(71)
Water heating gains (Table 5)													
	71.5726	69.2360	64.9692	59.3370	55.4994	50.3139	46.3606	51.9602	54.2943	60.0947	66.5754	69.7779	(72)
Total internal gains													
	301.1398	298.7911	287.8139	270.5983	253.3809	236.6142	225.9814	231.5931	240.6276	258.0214	277.8819	292.6657	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	6.1400	11.2829	0.6300	0.7000	0.7700	21.1720	(75)
Southwest	2.4800	36.7938	0.6300	0.7000	0.7700	27.8868	(79)

Solar gains	49.0588	90.5978	142.6394	208.0470	261.6081	272.2868	257.2823	215.4015	164.9870	105.1664	60.0418	41.1554	(83)
Total gains	350.1986	389.3889	430.4533	478.6453	514.9890	508.9010	483.2637	446.9946	405.6146	363.1878	337.9238	333.8211	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	52.0385	52.1519	52.2635	52.7942	52.8947	53.3676	53.3676	53.4561	53.1845	52.8947	52.6918	52.4813	
alpha	4.4692	4.4768	4.4842	4.5196	4.5263	4.5578	4.5578	4.5637	4.5456	4.5263	4.5128	4.4988	
util living area													
	0.9974	0.9954	0.9897	0.9698	0.9101	0.7765	0.6185	0.6793	0.8925	0.9807	0.9953	0.9979	(86)
MIT	19.5494	19.6887	19.9488	20.3148	20.6599	20.8925	20.9710	20.9560	20.7755	20.3425	19.8852	19.5249	(87)
Th 2	19.8139	19.8162	19.8184	19.8288	19.8308	19.8399	19.8399	19.8415	19.8363	19.8308	19.8268	19.8227	(88)
util rest of house													
	0.9965	0.9937	0.9857	0.9571	0.8699	0.6802	0.4729	0.5356	0.8279	0.9703	0.9933	0.9972	(89)
MIT 2	17.8991	18.1039	18.4838	19.0162	19.4877	19.7657	19.8292	19.8230	19.6473	19.0637	18.3988	17.8694	(90)
Living area fraction									fLA = Living area / (4) =			0.2646	(91)
MIT	18.3357	18.5232	18.8714	19.3598	19.7979	20.0638	20.1313	20.1227	19.9458	19.4020	18.7921	18.3074	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.3357	18.5232	18.8714	19.3598	19.7979	20.0638	20.1313	20.1227	19.9458	19.4020	18.7921	18.3074	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9948	0.9911	0.9812	0.9504	0.8685	0.7011	0.5118	0.5735	0.8353	0.9649	0.9906	0.9958	(94)
Useful gains	348.3676	385.9154	422.3645	454.8995	447.2781	356.7690	247.3234	256.3487	338.8233	350.4479	334.7572	332.4076	(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													
	1035.0446	1002.4372	908.3807	760.2997	587.4973	392.8847	253.9224	267.2465	421.7986	638.5866	851.5226	1031.5502	(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													
	510.8877	414.3027	361.5961	219.8882	104.3231	0.0000	0.0000	0.0000	0.0000	214.3752	372.0711	520.1621	(98)
Space heating												2717.6060	(98)
Space heating per m2											(98) / (4) =	49.1785	(99)

8c. Space cooling requirement

Not applicable

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

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	93.4000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2909.6424	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	510.8877	414.3027	361.5961	219.8882	104.3231	0.0000	0.0000	0.0000	0.0000	214.3752	372.0711	520.1621	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	546.9889	443.5789	387.1478	235.4263	111.6950	0.0000	0.0000	0.0000	0.0000	229.5237	398.3630	556.9187	(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													
	171.0014	149.3741	155.4141	137.8445	133.4578	117.5422	112.6143	125.5386	126.9250	144.5294	154.2823	166.9856	(64)
Efficiency of water heater												80.3000	(216)
(217)m	87.6358	87.4841	87.1066	86.2212	84.4390	80.3000	80.3000	80.3000	80.3000	86.0419	87.1857	87.7188	(217)
Fuel for water heating, kWh/month													
	195.1274	170.7444	178.4183	159.8731	158.0522	146.3788	140.2420	156.3370	158.0636	167.9756	176.9583	190.3647	(219)
Water heating fuel used												1998.5353	(219)
Annual totals kWh/year													
Space heating fuel - main system												2909.6424	(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)												265.5617	(232)
Total delivered energy for all uses												5248.7395	(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	2909.6424	0.2160	628.4828	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1998.5353	0.2160	431.6836	(264)
Space and water heating			1060.1664	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	265.5617	0.5190	137.8265	(268)
Total CO2, kg/m2/year			1236.9179	(272)
Emissions per m2 for space and water heating			19.1851	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.4941	(272b)
Emissions per m2 for pumps and fans			0.7044	(272c)
Target Carbon Dioxide Emission Rate (TER) = (19.1851 * 1.00) + 2.4941 + 0.7044, rounded to 2 d.p.			22.3800	(273)

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1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	55.2600 (1b)	x	2.4000 (2b)	=	132.6240	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	55.2600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	132.6240	(5)

2. Ventilation rate

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

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1508	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.4013	(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) =	0.3411	(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	0.4349	0.4264	0.4179	0.3752	0.3667	0.3241	0.3241	0.3155	0.3411	0.3667	0.3837	0.4008	(22b)
Effective ac	0.5946	0.5909	0.5873	0.5704	0.5672	0.5525	0.5525	0.5498	0.5582	0.5672	0.5736	0.5803	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Opening Type 1			2.1200	1.0000	2.1200			(26)
Opening Type 2 (Uw = 1.41)			8.6200	1.3347	11.5053			(27)
150mm TE Platinum			55.2600	0.1500	8.2890			(28a)
50mm Alreflex	71.8100	10.7400	61.0700	0.2700	16.4889			(29a)
400mm Mineral Wool	55.2600		55.2600	0.1100	6.0786			(30)
Total net area of external elements Aum(A, m2)			182.3300					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		44.4818			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							187.4500	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							7.5343	(36)
Total fabric heat loss					(33) + (36) =		52.0161	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	26.0221	25.8613	25.7038	24.9638	24.8254	24.1809	24.1809	24.0615	24.4291	24.8254	25.1055	25.3983	(38)
Heat transfer coeff	78.0381	77.8774	77.7199	76.9799	76.8414	76.1969	76.1969	76.0776	76.4452	76.8414	77.1215	77.4143	(39)
Average = Sum(39)m / 12 =												76.9792	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.4122	1.4093	1.4064	1.3930	1.3905	1.3789	1.3789	1.3767	1.3834	1.3905	1.3956	1.4009	(40)
HLP (average)												1.3930	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		1.8450 (42)
Average daily hot water use (litres/day)		78.0181 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	85.8199	82.6992	79.5785	76.4578	73.3370	70.2163	70.2163	73.3370	76.4578	79.5785	82.6992	85.8199	(44)
Energy conte	127.2685	111.3098	114.8618	100.1393	96.0860	82.9149	76.8329	88.1668	89.2198	103.9771	113.4992	123.2527	(45)
Energy content (annual)										Total = Sum(45)m =		1227.5289	(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)

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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													
	27.0446	23.6533	24.4081	21.2796	20.4183	17.6194	16.3270	18.7355	18.9592	22.0951	24.1186	26.1912	(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	92.2487	92.2487	92.2487	92.2487	92.2487	92.2487	92.2487	92.2487	92.2487	92.2487	92.2487	92.2487	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	15.0372	13.3559	10.8618	8.2230	6.1468	5.1894	5.6073	7.2886	9.7828	12.4215	14.4977	15.4551	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	160.8554	162.5246	158.3183	149.3637	138.0600	127.4362	120.3389	118.6697	122.8759	131.8306	143.1342	153.7581	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	32.2249	32.2249	32.2249	32.2249	32.2249	32.2249	32.2249	32.2249	32.2249	32.2249	32.2249	32.2249	(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)													
	-73.7989	-73.7989	-73.7989	-73.7989	-73.7989	-73.7989	-73.7989	-73.7989	-73.7989	-73.7989	-73.7989	-73.7989	(71)
Water heating gains (Table 5)													
	36.3502	35.1984	32.8066	29.5550	27.4439	24.4714	21.9449	25.1821	26.3322	29.6978	33.4980	35.2032	(72)
Total internal gains													
	262.9174	261.7535	252.6613	237.8163	222.3254	207.7717	198.5657	201.8150	209.6656	224.6245	241.8046	255.0910	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	6.1400	11.2829	0.7100	0.7000	0.7700	23.8605	(75)
Southwest	2.4800	36.7938	0.7100	0.7000	0.7700	31.4280	(79)

Solar gains	55.2885	102.1023	160.7524	234.4656	294.8282	306.8630	289.9530	242.7540	185.9377	118.5208	67.6662	46.3815	(83)
Total gains	318.2060	363.8558	413.4137	472.2820	517.1536	514.6346	488.5187	444.5690	395.6033	343.1453	309.4708	301.4725	(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	36.8712	36.9473	37.0222	37.3780	37.4454	37.7621	37.7621	37.8214	37.6395	37.4454	37.3094	37.1683	
alpha	3.4581	3.4632	3.4681	3.4919	3.4964	3.5175	3.5175	3.5214	3.5093	3.4964	3.4873	3.4779	
util living area													
	0.9942	0.9902	0.9802	0.9517	0.8836	0.7572	0.6162	0.6781	0.8746	0.9696	0.9906	0.9952	(86)
MIT	19.0267	19.2122	19.5552	20.0323	20.4824	20.8027	20.9311	20.9023	20.6349	20.0630	19.4641	18.9946	(87)
Th 2	19.7540	19.7562	19.7584	19.7687	19.7706	19.7796	19.7796	19.7812	19.7761	19.7706	19.7667	19.7626	(88)
util rest of house													
	0.9926	0.9874	0.9744	0.9360	0.8423	0.6663	0.4738	0.5398	0.8127	0.9569	0.9875	0.9939	(89)
MIT 2	17.9741	18.1602	18.5019	18.9763	19.3998	19.6753	19.7578	19.7465	19.5500	19.0146	18.4197	17.9484	(90)
Living area fraction										fLA = Living area / (4) =		0.2646	(91)
MIT	18.2526	18.4386	18.7805	19.2557	19.6863	19.9736	20.0682	20.0523	19.8370	19.2920	18.6960	18.2252	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2526	18.4386	18.7805	19.2557	19.6863	19.9736	20.0682	20.0523	19.8370	19.2920	18.6960	18.2252	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9899	0.9834	0.9681	0.9276	0.8389	0.6826	0.5104	0.5741	0.8165	0.9501	0.9837	0.9916	(94)
Useful gains	314.9930	357.8203	400.2278	438.0875	433.8422	351.3093	249.3639	255.2464	323.0140	326.0310	304.4273	298.9374	(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													
	1088.8362	1054.3485	954.4423	797.1814	613.6752	409.4488	264.2656	277.8560	438.5671	667.9028	894.3011	1085.7509	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	575.7393	468.0670	412.3356	258.5476	133.7957	0.0000	0.0000	0.0000	0.0000	254.3526	424.7091	585.3893	(98)
Space heating												3112.9363	(98)
Space heating per m2											(98) / (4) =	56.3325	(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	716.2513	563.8574	578.1897	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7526	0.8247	0.7860	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	539.0855	465.0371	454.4782	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	671.1335	639.2939	589.0753	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	95.0746	129.6470	100.1403	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												324.8619	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)													

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	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	23.7686	32.4118	25.0351	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												81.2155 (107)
Space cooling per m2												1.4697 (108)
Energy for space heating												56.3325 (99)
Energy for space cooling												1.4697 (108)
Total												57.8022 (109)
Dwelling Fabric Energy Efficiency (DFEE)												57.8 (109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	55.2600 (1b)	x	2.4000 (2b)	=	132.6240	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	55.2600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	132.6240	(5)

2. Ventilation rate

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

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1508	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4008	(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) =	0.3407	(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	0.4344	0.4259	0.4173	0.3748	0.3662	0.3236	0.3236	0.3151	0.3407	0.3662	0.3833	0.4003	(22b)
Effective ac	0.5943	0.5907	0.5871	0.5702	0.5671	0.5524	0.5524	0.5497	0.5580	0.5671	0.5734	0.5801	(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			2.1200	1.0000	2.1200			(26)
TER Opening Type (Uw = 1.40)			8.6200	1.3258	11.4280			(27)
150mm TE Platinum			55.2600	0.1300	7.1838			(28a)
50mm Alreflex	71.8100	10.7400	61.0700	0.1800	10.9926			(29a)
400mm Mineral Wool	55.2600		55.2600	0.1300	7.1838			(30)
Total net area of external elements Aum(A, m2)			182.3300					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	38.9082			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							8.8235	(36)
Total fabric heat loss					(33) + (36) =		47.7317	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	26.0118	25.8514	25.6943	24.9562	24.8180	24.1752	24.1752	24.0561	24.4228	24.8180	25.0974	25.3895	(38)
Heat transfer coeff	73.7435	73.5832	73.4260	72.6879	72.5498	71.9069	71.9069	71.7878	72.1545	72.5498	72.8292	73.1212	(39)
Average = Sum(39)m / 12 =												72.6872	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3345	1.3316	1.3287	1.3154	1.3129	1.3012	1.3012	1.2991	1.3057	1.3129	1.3179	1.3232	(40)
HLP (average)												1.3154	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		1.8450 (42)
Average daily hot water use (litres/day)		78.0181 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	85.8199	82.6992	79.5785	76.4578	73.3370	70.2163	70.2163	73.3370	76.4578	79.5785	82.6992	85.8199	(44)
Energy conte	127.2685	111.3098	114.8618	100.1393	96.0860	82.9149	76.8329	88.1668	89.2198	103.9771	113.4992	123.2527	(45)
Energy content (annual)										Total = Sum(45)m =		1227.5289	(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)

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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													
	27.0446	23.6533	24.4081	21.2796	20.4183	17.6194	16.3270	18.7355	18.9592	22.0951	24.1186	26.1912	(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	92.2487	92.2487	92.2487	92.2487	92.2487	92.2487	92.2487	92.2487	92.2487	92.2487	92.2487	92.2487	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	15.0372	13.3559	10.8618	8.2230	6.1468	5.1894	5.6073	7.2886	9.7828	12.4215	14.4977	15.4551	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	160.8554	162.5246	158.3183	149.3637	138.0600	127.4362	120.3389	118.6697	122.8759	131.8306	143.1342	153.7581	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	32.2249	32.2249	32.2249	32.2249	32.2249	32.2249	32.2249	32.2249	32.2249	32.2249	32.2249	32.2249	(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)													
	-73.7989	-73.7989	-73.7989	-73.7989	-73.7989	-73.7989	-73.7989	-73.7989	-73.7989	-73.7989	-73.7989	-73.7989	(71)
Water heating gains (Table 5)													
	36.3502	35.1984	32.8066	29.5550	27.4439	24.4714	21.9449	25.1821	26.3322	29.6978	33.4980	35.2032	(72)
Total internal gains													
	262.9174	261.7535	252.6613	237.8163	222.3254	207.7717	198.5657	201.8150	209.6656	224.6245	241.8046	255.0910	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	6.1400	11.2829	0.6300	0.7000	0.7700	21.1720	(75)
Southwest	2.4800	36.7938	0.6300	0.7000	0.7700	27.8868	(79)

Solar gains	49.0588	90.5978	142.6394	208.0470	261.6081	272.2868	257.2823	215.4015	164.9870	105.1664	60.0418	41.1554	(83)
Total gains	311.9763	352.3513	395.3008	445.8633	483.9335	480.0585	455.8480	417.2165	374.6526	329.7908	301.8464	296.2465	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	52.0385	52.1519	52.2635	52.7942	52.8947	53.3676	53.3676	53.4561	53.1845	52.8947	52.6918	52.4813	
alpha	4.4692	4.4768	4.4842	4.5196	4.5263	4.5578	4.5578	4.5637	4.5456	4.5263	4.5128	4.4988	
util living area													
	0.9984	0.9969	0.9926	0.9766	0.9253	0.8023	0.6478	0.7135	0.9143	0.9866	0.9970	0.9987	(86)
MIT	19.4872	19.6289	19.8934	20.2673	20.6254	20.8759	20.9651	20.9462	20.7433	20.2917	19.8269	19.4636	(87)
Th 2	19.8139	19.8162	19.8184	19.8288	19.8308	19.8399	19.8399	19.8415	19.8363	19.8308	19.8268	19.8227	(88)
util rest of house													
	0.9978	0.9958	0.9897	0.9664	0.8898	0.7092	0.4991	0.5688	0.8580	0.9790	0.9957	0.9983	(89)
MIT 2	18.4446	18.5878	18.8527	19.2290	19.5678	19.7798	19.8308	19.8254	19.6835	19.2583	18.7939	18.4279	(90)
Living area fraction										fLA = Living area / (4) =		0.2646	(91)
MIT	18.7205	18.8632	19.1280	19.5037	19.8476	20.0698	20.1309	20.1219	19.9639	19.5317	19.0672	18.7019	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7205	18.8632	19.1280	19.5037	19.8476	20.0698	20.1309	20.1219	19.9639	19.5317	19.0672	18.7019	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9971	0.9945	0.9873	0.9627	0.8904	0.7302	0.5392	0.6075	0.8657	0.9763	0.9945	0.9977	(94)
Useful gains	311.0566	350.4235	390.2966	429.2165	430.9002	350.5265	245.7722	253.4690	324.3390	321.9893	300.1937	295.5574	(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													
	1063.4153	1027.4572	927.2274	770.7631	591.1097	393.3146	253.8963	267.1888	423.1089	647.9930	871.5627	1060.3946	(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													
	559.7549	454.9666	399.4766	245.9135	119.1959	0.0000	0.0000	0.0000	0.0000	242.5467	411.3857	569.0389	(98)
Space heating												3002.2788	(98)
Space heating per m2											(98) / (4) =	54.3301	(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	675.9247	532.1109	545.5875	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7906	0.8662	0.8287	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	534.3739	460.9209	452.1420	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	630.7199	601.1073	557.1048	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	69.3691	104.2987	78.0924	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												251.7601	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)													

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000 (106)
Space cooling kWh												
	0.0000	0.0000	0.0000	0.0000	0.0000	17.3423	26.0747	19.5231	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												62.9400 (107)
Space cooling per m2												1.1390 (108)
Energy for space heating												54.3301 (99)
Energy for space cooling												1.1390 (108)
Total												55.4690 (109)
Target Fabric Energy Efficiency (TFEE)												63.8 (109)

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

Design SAP
elmhurst energy

Property Reference	Bedale End-Terrace	**Issued on Date**	15/10/2021
Assessment Reference	1	**Prop Type Ref**	
Property	Plot 037, Chipping Lane , Longridge , PR3		

SAP Rating	82 B	**DER**	20.37	**TER**	21.56
Environmental	86 B	**% DER<TER**	5.51		
CO_2 Emissions (t/year)	1.01	**DFEE**	53.07	**TFEE**	59.20
General Requirements Compliance	Pass	**% DFEE<TFEE**	10.36		

Assessor Details	Mr. William Vincent, William Vincent, Tel: 01582544250, William.Vincent@ee-ltd.co.uk	**Assessor ID**	T759-0001
Client			

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DWELLING AS DESIGNED

End-Terrace Bungalow, total floor area 55 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) 21.56 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 20.37 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)59.2 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)53.1 kWh/m²/yrOK

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2 Fabric U-values

Element	Average	Highest	
External wall	0.27 (max. 0.30)	0.27 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.15 (max. 0.25)	0.15 (max. 0.70)	OK
Roof	0.11 (max. 0.20)	0.11 (max. 0.35)	OK
Openings	1.33 (max. 2.00)	1.41 (max. 3.30)	OK

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

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3 Air permeability
Air permeability at 50 pascals: 5.01 (design value)
Maximum 10.0 OK

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4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 35
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

---

5 Cylinder insulation
Hot water storage: No cylinder

---

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

Hot water controls: No cylinder

Boiler interlock: Yes OK

---

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

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8 Mechanical ventilation
Not applicable

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9 Summertime temperature
Overheating risk (West Pennines (England)):Not significant OK
Based on:
Overshading: Average
Windows facing North: 6.14 m², No overhang
Windows facing South: 2.48 m², No overhang
Air change rate: 3.00 ach
Blinds/curtains: None

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10 Key features
Party wall U-value 0.00 W/m²K
Roof U-value 0.11 W/m²K
Door U-value 1.00 W/m²K
