Bicester KMF, Plots 179-181

Vistry Homes West Midlands

Energy & Sustainability Statement

AES Sustainability Consultants Ltd

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	Author	Date	E-mail address
Produced By:	Eloise Utley	16.02.2021	Eloise.Utley@aessc.co.uk
Reviewed By:	Andrew McManus	16.02.2021	Andrew.McManus@aessc.co.uk

Revision	Author	Date	Comment
Rev0	Eloise Utley	16.02.2021	Initial Issue

Part of the Vistry Group

This statement has been commissioned by Vistry Homes West Midlands to detail the proposed approach to energy and CO_2 reduction to be employed in the development of plots 179-181 at Bicester KMF. It should be noted that the details presented, including the proposed specifications, are subject to change as the detailed design of the dwellings progresses, whilst ensuring that the overall commitments will be achieved.

AES Sustainability Consultants

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1. Introduction

Preface

1.1. This Energy and Sustainability Statement has been prepared by AES Sustainability Consultants on behalf of Vistry Homes West Midlands in order to detail the strategy that will be implemented to plots 179-181 at the Bicester KMF development.

Development Description

1.2. The three plots were granted full planning permission on the 18th March 2019 by Cherwell District Council under application reference: 18/01895/REM.

1.3. The plots make up a part of the KMF parcel of the larger Bicester development and are covered under the outline application reference: 13/00433/OUT which sought to increase the number of dwellings to be constructed by an additional 100 from the number previously granted permission. Outline approval was granted on the 15th August 2016.

Purpose and Scope of the Statement

1.4. The purpose of this statement is to detail the proposed response to discharge Condition 8 of the outline planning permission (Ref:13/00433/OUT) by demonstrating that the plots will be constructed to meet a 19% reduction in carbon dioxide emissions over a Building Regulations 2013 compliant development.

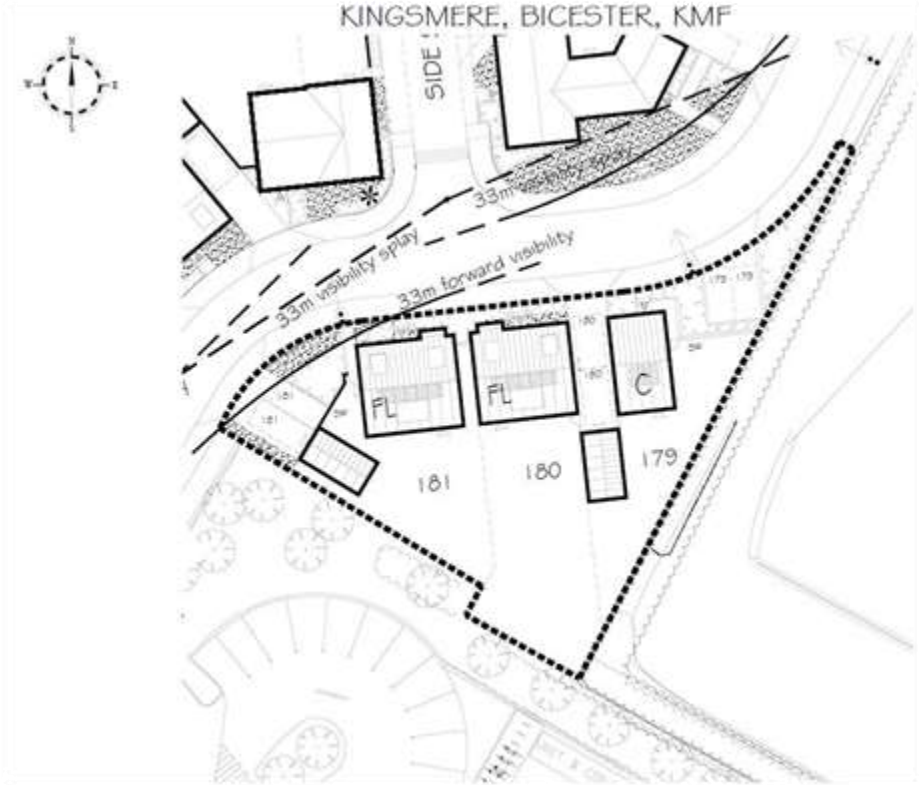

Figure 1. Proposed site layout – Bicester KMF plots 179-181

2. Planning Policy

Conditions of Outline Permission

2.1. This statement will address Condition 8 of outline planning permission 13/00433/OUT.

> Condition 8
>
> The dwellings hereby approved shall be constructed to be 19% more efficient than required by building regulations (2013 Part L). This shall be demonstrated in an Energy Statement which shall be submitted to and approved in writing by the LPA prior to the commencement of any development on the site. The development shall be built in accordance with the approved Energy Statement.
>
> Reason - To ensure sustainable construction and reduce carbon emissions in accordance with Policy ESD3 of the adopted Cherwell Local Plan Part 1 2011-2031 and Government guidance contained within the National Planning Policy Framework.

2.2. Condition 8 refers to Policy ESD3 of the Cherwell Local Plan 2011-2031 which is detailed below.

> Policy ESD 3: Sustainable Construction
>
> All new residential development will be expected to incorporate sustainable design and construction technology to achieve zero carbon development through a combination of fabric energy efficiency, carbon compliance and allowable solutions in line with Government policy.
>
> Cherwell District is in an area of water stress and as such the Council will seek a higher level of water efficiency than required in the Building Regulations, with developments achieving a limit of 110 litres/person/day.
>
> All new non-residential development will be expected to meet at least BREEAM 'Very Good' with immediate effect, subject to review over the plan period to ensure the target remains relevant. The demonstration of the achievement of this standard should be set out in the Energy Statement.
>
> The strategic site allocations identified in this Local Plan are expected to provide contributions to carbon emissions reductions and to wider sustainability.
>
> All development proposals will be encouraged to reflect high quality design and high environmental standards, demonstrating sustainable construction methods including but not limited to:
>
> - Minimising both energy demands and energy loss
> - Maximising passive solar lighting and natural ventilation
> - Maximising resource efficiency
> - Incorporating the use of recycled and energy efficient materials
> - Incorporating the use of locally sourced building materials
> - Reducing waste and pollution and making adequate provision for the recycling of waste
> - Making use of sustainable drainage methods
> - Reducing the impact on the external environment and maximising opportunities for cooling and shading (by the provision of open space and water, planting, and green roofs, for example); and
> - Making use of the embodied energy within buildings wherever possible and re-using materials where proposals involve demolition or redevelopment.
>
> Should the promoters of development consider that individual proposals would be unviable with the above requirements, 'open-book' financial analysis of proposed developments will be expected so that an independent economic viability assessment can be undertaken. Where it is agreed that an economic viability assessment is required, the cost shall be met by the promoter.

National Planning Policy Framework

2.3. In February 2019, the Government published the updated National Planning Policy Framework (NPPF), which sets out the Government's planning policies for England and how these are expected to be applied.

2.4. The planning process has been identified as a system to support the transition to a low carbon future in response to climate change by assisting in the reduction of greenhouse gas emissions and supporting renewable and low carbon energy.

2.5. Paragraph 150 sets out what is expected from new developments when considering strategies to mitigate and adapt to climate change:

> 150. New development should be planned for in ways that:
>
> Avoid increased vulnerability to the range of impacts arising from climate change. When new development is brought forward in areas which are vulnerable, care should be taken to ensure that risks can be managed through suitable adaption measures, including through the planning of green infrastructure; and
>
> Can help to reduce greenhouse gas emissions, such as through its location, orientation and design. Any local requirements for the sustainability of buildings should reflect the Government's policy for national technical standards.

2.6. The NPPF states that local plans are considered 'sound' if they are "consistent with national policy – enabling the delivery of sustainable development in accordance with the policies in this Framework."[1]

Proposed Strategy

2.7. It is proposed that the dwellings will be constructed following a fabric first approach to meet, and exceed where possible, the current Building Regulations, with insulation standards, thermal bridging and air leakage all improved beyond the minimum compliance levels. In addition, consideration will be given to building design, passive solar design and energy efficient site-layouts where possible.

2.8. In addition, in order to address Condition 8 of the full planning permission, it is proposed that the development will deliver a 19% overall reduction in CO_2 emissions over Building Regulations Part L 2013 standards, through a strategy of energy demand reduction and the incorporation of low carbon or renewable energy systems.

[1] Ministry of Housing, Communities & Local Government, 2019, *NPPF, paragraph 35*

3. Energy Demand Reduction

Energy Reduction Strategy – Fabric First

3.1. The construction specification and sustainable design principles applied to the development ensure that each dwelling will meet the CO_2 reductions mandated by Part L1A of the Building Regulations through fabric measures alone.

The proposed energy demand reduction strategy for the development incorporates further improvements beyond a Part L compliant specification and initially concentrates finance and efforts on reducing energy demand as the first stage of the Energy Hierarchy (Figure 2).

Figure 2. The Energy Hierarchy

3.2. As this hierarchy demonstrates, designing out energy use is weighted more highly than the generation of low-carbon or renewable energy to offset unnecessary demand. Applied to the development, this approach is referred to as 'fabric first' and concentrates finance and efforts on improving U-values, reducing thermal bridging, improving airtightness, and installing energy efficient ventilation and heating services.

Be Lean – reduce energy demand

3.3. The design of a development - from the masterplan to individual building design - will assist in reducing energy demand in a variety of ways, with a focus on minimising heating, cooling and lighting loads. Key considerations include:

- Building orientation – maximise passive solar gain and daylight
- Building placement – control overshading and wind sheltering
- Landscaping – control daylight, glare and mitigate heat island effects
- Building design – minimise energy demand through fabric specification

Be Clean – supply energy efficiently

3.4. The design and specification of building services to utilise energy efficiently is the next stage of the hierarchy, taking into account:

- High efficiency heating and cooling systems
- Ventilation systems (with heat recovery where applicable)
- Low energy lighting
- High efficiency appliances and ancillary equipment

Be Green – use low carbon / renewable energy

3.5. Low carbon and renewable energy systems form the final stage of the energy hierarchy and can be used to directly supply energy to buildings, or offset energy carbon emissions arising from unavoidable demand. This may be in the form of:

- Low carbon fuel sources – e.g. biomass
- Heat pump technologies
- Building scale renewable energy systems
- Small-scale heat networks
- Development-scale heat networks

3.6. This approach has been widely supported by industry and government for some time, particularly in the residential sector, with the Zero Carbon Hub[2] and the Energy Savings Trust[3] having both stressed the importance of prioritising energy demand as a key factor in delivering resilient, low energy buildings.

[2] Zero Carbon Hub, Zero Carbon Strategies for tomorrow's new homes, Feb 2013

[3] Energy Savings Trust, Fabric first: Focus on fabric and services improvements to increase energy performance in new homes, 2010

Passive design measures and overheating risk mitigation

3.7. Glazing has been specified with a solar transmittance value (g-value) to strike the balance between useful solar gain in the winter and unwanted solar gain in the summer.

3.8. Where feasible, dwellings will be fitted with high-efficiency combination boilers, removing the need for hot water cylinders which would lose useful heat to the dwelling at the rate of around 1.5kWh/day, or circa 550kWh over the course of a year.

3.9. Due to these measures to reduce internal heat gain, natural ventilation provided through window openings and the opportunity for cross ventilation will allow sufficient air exchange rates to purge any heat build-up. Active cooling systems are therefore not proposed.

3.10. By following these principles, the development will be designed to build in resilience to a potentially changing climate over the lifetime of the buildings and minimise overheating risk, which can be exacerbated by the drive to build better insulated, more airtight homes if not considered within the design and construction process.

Thermal bridging

3.11. The significance of thermal bridging as a potentially major source of fabric heat losses is increasingly understood. Improving the U-values for the main building fabric without accurately addressing the thermal bridging will not achieve the desired energy and CO_2 reduction targets.

3.12. The specification seeks to minimise unnecessary bridging of the insulation layers, with avoidable heat loss therefore being reduced wherever possible. Accurate calculation of these heat losses forms an integral part of the SAP calculations undertaken to establish energy demand of the dwellings, and as such thermal modelling has be undertaken to assess the performance of all main building junctions.

Air leakage

3.13. After conductive heat losses through building elements are reduced, convective losses through draughts are the next major source of energy wastage. The proposal adopts an airtightness standard of 5.01 $m^3/h.m^2$ at 50Pa, with pressure testing of all dwellings to be undertaken on completion to confirm that the design figure has been met.

Provisions for Energy-Efficient Operation of the Dwelling

3.14. The occupant of the dwelling should be provided with all necessary literature and guidance relating to the energy efficient operation of fixed building services. Currently it is assumed that all dwellings will be provided with modern gas-fired heating systems, fully insulated primary pipework, and controls including programmers, thermostats and Temperature Radiator Valves to avoid unnecessary heating of spaces when not required.

Building Regulations Standards – Fabric Energy Efficiency

3.15. In addition to the CO_2 reduction targets, the importance of energy demand reduction was further supported by the introduction of a minimum fabric standard into Part L1A 2013, based on energy use for heating and cooling a dwelling. This is referred to as the 'Target Fabric Energy Efficiency' (TFEE), and expressed in kWh/m^2/year.

3.16. The minimum 'Target Fabric Energy Efficiency' (TFEE), and the assessed average designed fabric energy efficiency (DFEE) after demand reduction measures are shown for the proposed development in Table 1.

Table 1. Fabric Energy Efficiency of dwellings

	Site Wide Average Fabric Energy Efficiency (kWh/m^2/yr)	
Building Regulations 2013 Compliant Development (TFEE)	56.88	
Proposed Development (DFEE)	49.61	
	(kWh/m^2/yr)	%
Improvement over Building Regulations 2013	7.28	12.79%

3.17. This standard enables the decoupling of energy use from CO_2 emissions and serves as an acknowledgement of the importance of reducing demand, rather than simply offsetting CO_2 emissions through low carbon or renewable energy technologies.

4. Proposed Renewable Energy Systems

4.1. A range of technologies have been assessed for potential incorporation into the scheme in accordance with Regulation 25A of the Building Regulations and with the intention of meeting a 19% reduction in CO_2 emissions when combined with fabric improvements and energy saving technologies.

4.2. Following this feasibility assessment, it is considered that roof-mounted solar Photovoltaic systems are the most appropriate for this development and will deliver significant carbon savings due to the high calculated CO_2 saving potential associated with the offset off grid-sourced electricity.

4.3. Each plot is ideally suited to the inclusion of PV with a southerly facing area of sloping roof. It has been calculated that two panels would be required to plot 179 and three panels to plots 180 and 181 in order for each plot to achieve an overall 19% reduction in carbon dioxide emissions from a combination of fabric measures and renewable energy.

4.4. The total offset in carbon dioxide emissions provided by the PV systems is detailed in the table below

Table 2. Proposed renewable energy systems and CO_2 offset achieved

Proposed renewable energy systems	
Panel size (kWp)	0.345
Total proposed systems size (kWp)	2.76
Estimated annual system annual generation (kWh/year)	2,346
Building Regulations Part L 2013 CO_2 emissions factor for electricity production ($kgCO_2$/kWh)	0.519
Annual CO_2 offset ($kgCO_2$/year)	1,218

4.5. The proposed schematic of the PV designs are included in Appendix A of this report.

5. CO_2 Savings Achieved

Calculated CO_2 Emissions

5.1. The development has been designed to meet the requirements of Part L1A of the Building Regulations 2013.

5.2. Part L compliance is assessed through the Standard Assessment Procedure (SAP), which uses the 'Target Emission Rate' (TER) – expressed in kilograms CO_2 per metre squared of total useful floor area, per annum – as the benchmark. The calculated performance of the dwelling as designed - the Dwelling Emission Rate (DER) – is required to be lower than this benchmark level.

5.3. Full SAP calculations have been undertaken for the proposed dwellings on this development to establish the improvement over Building Regulations. The total Part L compliant calculated baseline carbon emissions.

5.4. The Full SAP calculations are included in Appendix B of this report.

5.5. Through a combination of the described fabric first approach to sustainable construction and the installation of solar PV panels, the development will deliver CO_2 savings significantly in excess of Part L 2013 requirements. The overall reduction achieved for each plot is shown in Table 3.

Table 3. Part L CO_2 emissions

	DER $kgCO_2$/year	TER $kgCO_2$/year	% Reduction
Plot 179 – House Type C	1149	1568	26.68%
Plot 180 – Fletcher House Type	2147	2660	19.28%
Plot 180 – Fletcher House Type	2147	2660	19.28%

5.6. By implementing the described efficiency and renewable measures the total reduction in regulated site wide CO_2 emissions for dwellings will be 1,444 $kgCO_2$ per year; a saving of 20.97% against a Part L 2013 compliant scheme.

6. Conclusions

6.1. This Energy and Sustainability Statement has been prepared by AES Sustainability Consultants on behalf of Vistry Homes West Midlands in order to detail the strategy that will be implemented to plots 179-181 at the Bicester KMF development. These plots were granted full planning permission under application reference: 18/01895/REM.

6.2. The purpose of this statement is to detail the proposed response to discharge Condition 8 of the outline planning permission (Ref:13/00433/OUT) by demonstrating that the plots will be constructed to meet a 19% reduction in carbon dioxide emissions over a Building Regulations 2013 compliant development.

6.3. The statement sets out a fabric first approach to sustainable construction, demonstrating that improvements in insulation specification, a reduction in thermal bridging and unwanted air leakage paths and further passive design measures will ensure that energy demand and consequent CO_2 emissions are minimised.

6.4. A range of potentially appropriate low and zero carbon technologies have been assessed for feasibility, concluding that solar PV constitutes the preferred technology for this site. A total system size of 2.76 kWp is proposed, split between the three plots.

6.5. Calculations have been completed under the Government's approved Standard Assessment Procedure for the three proposed dwellings which demonstrate that the combination of fabric improvements and PV systems result in a minimum 19% reduction in CO_2 emissions reduction per plot over Building Regulations Part L 2013.

6.6. By implementing the described energy efficiency and renewable energy measures the total average reduction in regulated site wide CO_2 emissions for the dwellings is calculated at 20.97% against a Part L 2013 compliant scheme. The development will therefore accord with the requirements of Policy 8 of the outline planning permission (Ref:13/00433/OUT)

Appendices

Appendix A – PV Layout

Appendix B – Full SAP Calculations

KINGSMERE, BICESTER, KMF

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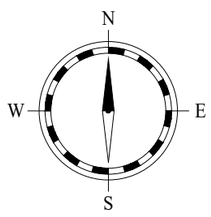
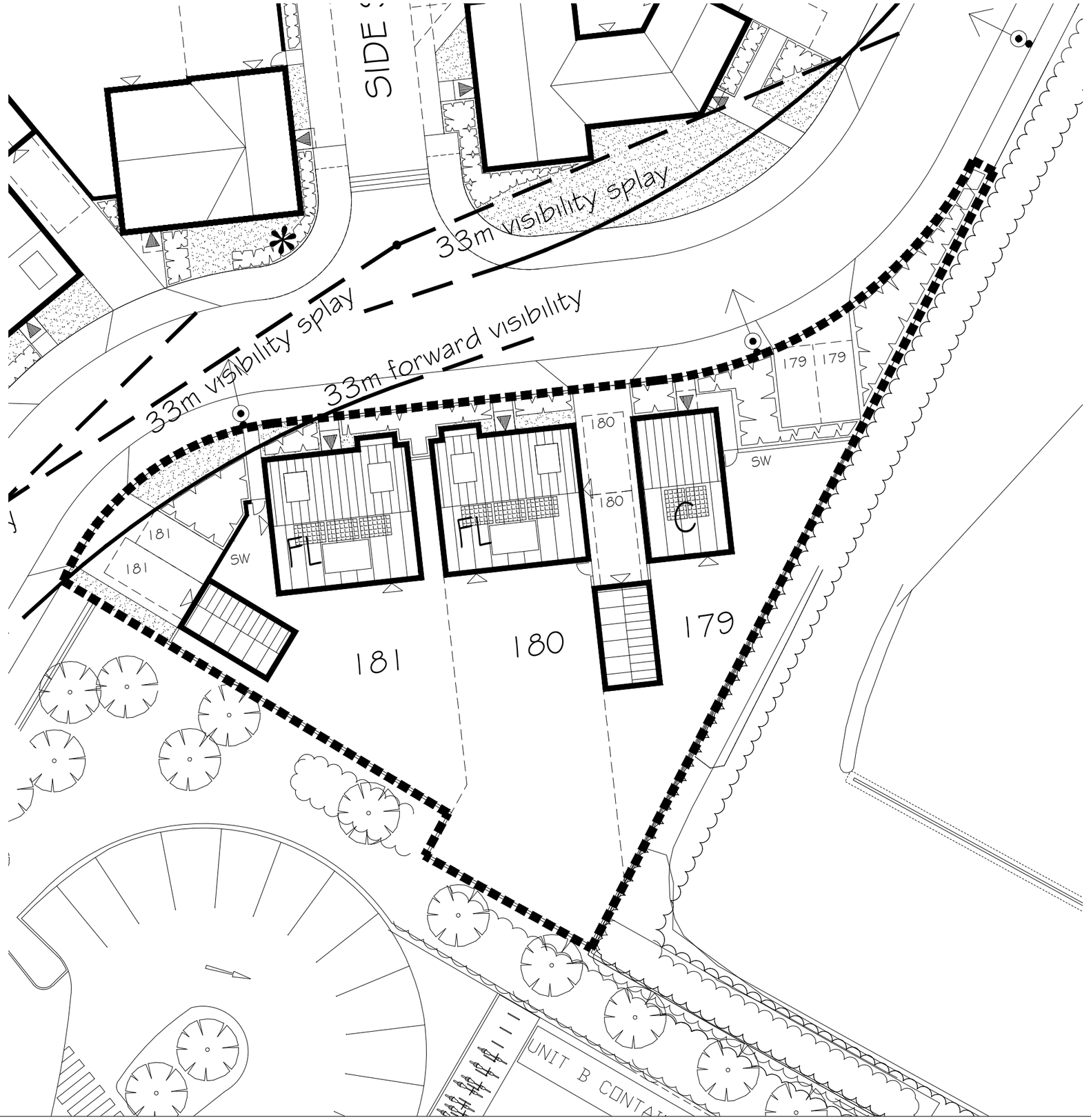
0 5m 10m 15m 20m

Sheet Size A3





Key

PV Panels - 3 panels to Flecther and 2 panels to Type C.

Rev	Date	Init
-	-	-

Linden HOMES

PROJECT:
KINGSMERE, BICESTER, KMF

DRG TITLE:
PV LAYOUT
PLOTS 179 - 181

JOB NO:	DRG NO:	
-	110	
SCALE:	DRN BY:	REV:
1:500	-	-
DATE:	CKD BY:	
02/21	-	

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

AES Sustainability Consultants

Property Reference	4907-0026-4282-179	**Issued on Date**	16/02/2021
Assessment Reference	179	**Prop Type Ref**	C - Det (As)
Property	Plot 179, 3 Bed, K, WC, B, ES		

SAP Rating	87 B	**DER**	14.75	**TER**	20.12
Environmental	89 B	**% DER<TER**	26.68		
CO_2 Emissions (t/year)	0.88	**DFEE**	52.93	**TFEE**	59.33
General Requirements Compliance	Pass	**% DFEE<TFEE**	10.79		

Assessor Details	Mr. Silvio Junges, Silvio Junges, Tel: 01884 242050, silvio.junges@aessouthern.co.uk	**Assessor ID**	P637-0001
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 78 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) 20.12 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 14.75 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)59.3 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)52.9 kWh/m²/yrOK

---
2 Fabric U-values

Element	Average	Highest	
External wall	0.24 (max. 0.30)	0.24 (max. 0.70)	OK
Floor	0.13 (max. 0.25)	0.13 (max. 0.70)	OK
Roof	0.11 (max. 0.20)	0.11 (max. 0.35)	OK
Openings	1.38 (max. 2.00)	1.40 (max. 3.30)	OK

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

---
3 Air permeability
Air permeability at 50 pascals: 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
Continuous extract system (decentralised)
Specific fan power: 0.1900 0.1800 0.1600
Maximum 0.7 OK

---
9 Summertime temperature
Overheating risk (Thames Valley): Slight OK
Based on:
Overshading: Average
Windows facing North: 3.82 m², No overhang
Windows facing South: 6.51 m², No overhang
Windows facing West: 0.51 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

---
10 Key features
Roof U-value 0.11 W/m²K
Thermal bridging y-value 0.037 W/m²K
Photovoltaic array 0.69 kW

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	38.9600 (1b)	x	2.3900 (2b)	=	93.1144	(1b) - (3b)
First floor	38.9600 (1c)	x	2.7600 (2c)	=	107.5296	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	77.9200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	200.6440	(5)

2. Ventilation rate

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

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0.0000	/ (5) =	0.0000	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.2505	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.2505	(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	0.3194	0.3131	0.3069	0.2756	0.2693	0.2380	0.2380	0.2317	0.2505	0.2693	0.2818	0.2943	(22b)
Mechanical extract ventilation - decentralised													
If mechanical ventilation:												0.5000	(23a)
Effective ac	0.5694	0.5631	0.5569	0.5256	0.5193	0.5000	0.5000	0.5000	0.5005	0.5193	0.5318	0.5443	(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	
Solid Door			1.9800	1.3000	2.5740			(26)
Window (Uw = 1.40)			7.6900	1.3258	10.1951			(27)
French Door (Uw = 1.40)			3.1500	1.3258	4.1761			(27)
Ground Floor			38.9600	0.1300	5.0648	75.0000	2922.0000	(28a)
125mm Cavity	133.8000	12.8200	120.9800	0.2400	29.0352	60.0000	7258.8000	(29a)
400mm Mineral Wool	38.9600		38.9600	0.1100	4.2856	9.0000	350.6400	(30)
Total net area of external elements Aum(A, m2)			211.7200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	55.3308			(33)
Timber GF			51.8600			9.0000	466.7400	(32c)
Timber FF			99.8900			9.0000	899.0100	(32c)
Internal Floor			38.9600			18.0000	701.2800	(32d)
Internal Ceiling			38.9600			18.0000	701.2800	(32e)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		13299.7500	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							170.6847	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							7.8675	(36)
Total fabric heat loss					(33) + (36) =		63.1983	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	37.7006	37.2859	36.8713	34.7980	34.3833	33.1063	33.1063	33.1063	33.1394	34.3833	35.2126	36.0420	(38)
Heat transfer coeff	100.8989	100.4842	100.0696	97.9963	97.5816	96.3046	96.3046	96.3046	96.3377	97.5816	98.4109	99.2403	(39)
Average = Sum(39)m / 12 =												98.1262	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2949	1.2896	1.2843	1.2577	1.2523	1.2359	1.2359	1.2359	1.2364	1.2523	1.2630	1.2736	(40)
HLP (average)												1.2593	(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	2.4222	(42)
Average daily hot water use (litres/day)	91.7275	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												

	100.9002	97.2311	93.5620	89.8929	86.2238	82.5547	82.5547	86.2238	89.8929	93.5620	97.2311	100.9002	(44)
Energy conte	149.6321	130.8692	135.0453	117.7358	112.9703	97.4848	90.3340	103.6595	104.8976	122.2480	133.4432	144.9107	(45)
Energy content (annual)										Total = Sum(45)m =		1443.2304	(45)
Distribution loss (46)m = 0.15 x (45)m													
	22.4448	19.6304	20.2568	17.6604	16.9455	14.6227	13.5501	15.5489	15.7346	18.3372	20.0165	21.7366	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1157	12.7307	14.0598	13.5668	13.9903	13.5059	13.9355	13.9711	13.5391	14.0311	13.6242	14.1043	(61)
Total heat required for water heating calculated for each month													
	163.7478	143.5999	149.1051	131.3026	126.9606	110.9907	104.2695	117.6306	118.4367	136.2791	147.0674	159.0151	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	163.7478	143.5999	149.1051	131.3026	126.9606	110.9907	104.2695	117.6306	118.4367	136.2791	147.0674	159.0151	(64)
									Total per year (kWh/year) = Sum(64)m =			1608.4050	(64)
Heat gains from water heating, kWh/month													
	53.2816	46.6967	48.4175	42.5388	41.0602	35.7902	33.5199	37.9596	38.2632	44.1552	47.7759	51.7089	(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	121.1105	121.1105	121.1105	121.1105	121.1105	121.1105	121.1105	121.1105	121.1105	121.1105	121.1105	121.1105	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.5951	18.2924	14.8764	11.2624	8.4188	7.1075	7.6799	9.9826	13.3986	17.0126	19.8563	21.1675	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	215.0385	217.2699	211.6468	199.6758	184.5646	170.3622	160.8742	158.6428	164.2659	176.2368	191.3480	205.5504	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.1110	35.1110	35.1110	35.1110	35.1110	35.1110	35.1110	35.1110	35.1110	35.1110	35.1110	35.1110	(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)													
	-96.8884	-96.8884	-96.8884	-96.8884	-96.8884	-96.8884	-96.8884	-96.8884	-96.8884	-96.8884	-96.8884	-96.8884	(71)
Water heating gains (Table 5)													
	71.6151	69.4891	65.0773	59.0817	55.1884	49.7086	45.0537	51.0209	53.1434	59.3484	66.3555	69.5012	(72)
Total internal gains													
	369.5818	367.3846	353.9336	332.3531	310.5050	289.5114	275.9409	281.9794	293.1410	314.9310	339.8929	358.5523	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	3.8200	10.6334	0.7200	0.7000	0.7700	14.1873	(74)
South	3.3600	46.7521	0.7200	0.7000	0.7700	54.8661	(78)
West	0.5100	19.6403	0.7200	0.7000	0.7700	3.4985	(80)
South	3.1500	46.7521	0.7200	0.7000	0.7700	51.4369	(78)

Solar gains	123.9888	208.0533	279.1103	341.0862	381.0215	378.6993	364.8612	334.4171	300.1641	228.1746	147.8694	106.5598	(83)
Total gains	493.5706	575.4379	633.0440	673.4393	691.5265	668.2107	640.8021	616.3966	593.3051	543.1057	487.7622	465.1121	(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	36.6146	36.7657	36.9181	37.6991	37.8593	38.3614	38.3614	38.3614	38.3482	37.8593	37.5403	37.2266	
alpha	3.4410	3.4510	3.4612	3.5133	3.5240	3.5574	3.5574	3.5574	3.5565	3.5240	3.5027	3.4818	
util living area													
	0.9896	0.9816	0.9673	0.9358	0.8709	0.7480	0.6006	0.6385	0.8226	0.9454	0.9825	0.9915	(86)
MIT	19.1405	19.3617	19.6934	20.1290	20.5209	20.8164	20.9388	20.9221	20.7216	20.2130	19.6085	19.1163	(87)
Th 2	19.8448	19.8490	19.8532	19.8742	19.8784	19.8914	19.8914	19.8914	19.8910	19.8784	19.8700	19.8616	(88)
util rest of house													
	0.9871	0.9772	0.9589	0.9179	0.8311	0.6653	0.4734	0.5148	0.7559	0.9267	0.9775	0.9895	(89)
MIT 2	17.3838	17.7072	18.1892	18.8241	19.3649	19.7412	19.8599	19.8478	19.6385	18.9538	18.0813	17.3589	(90)
Living area fraction									fLA = Living area / (4) =			0.2669	(91)
MIT	17.8527	18.1488	18.5907	19.1725	19.6735	20.0282	20.1479	20.1345	19.9276	19.2899	18.4890	17.8280	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.7027	17.9988	18.4407	19.0225	19.5235	19.8782	19.9979	19.9845	19.7776	19.1399	18.3390	17.6780	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9800	0.9668	0.9446	0.9003	0.8158	0.6641	0.4867	0.5263	0.7478	0.9100	0.9674	0.9834	(94)
Useful gains	483.6876	556.3238	597.9615	606.2792	564.1301	443.7914	311.8497	324.4159	443.6547	494.2207	471.8687	457.3758	(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													
	1352.3187	1316.2245	1194.9044	991.9640	763.4274	508.3180	327.2295	345.2073	546.9712	833.3423	1106.0381	1337.5596	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	646.2615	510.6533	444.1255	277.6930	148.2772	0.0000	0.0000	0.0000	0.0000	252.3065	456.6020	654.8568	(98)
Space heating												3390.7758	(98)
Space heating per m2											(98) / (4) =	43.5161	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3746.7136	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	646.2615	510.6533	444.1255	277.6930	148.2772	0.0000	0.0000	0.0000	0.0000	252.3065	456.6020	654.8568	(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)													
	714.1011	564.2578	490.7464	306.8431	163.8422	0.0000	0.0000	0.0000	0.0000	278.7917	504.5326	723.5987	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	163.7478	143.5999	149.1051	131.3026	126.9606	110.9907	104.2695	117.6306	118.4367	136.2791	147.0674	159.0151	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8343	89.7777	89.6738	89.4474	88.9953	87.3000	87.3000	87.3000	87.3000	89.3514	89.6990	89.8565	(217)
Fuel for water heating, kWh/month													
	182.2775	159.9505	166.2749	146.7930	142.6600	127.1371	119.4381	134.7430	135.6663	152.5204	163.9566	176.9656	(219)
Water heating fuel used												1808.3832	(219)
Annual totals kWh/year													
Space heating fuel - main system												3746.7136	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
(MEVDecentralised, Database: total watage = 8.0270, total flow = 37.0000, SFP = 0.2169)													
mechanical ventilation fans (SFP = 0.2169)												53.1053	(230a)
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												128.1053	(231)
Electricity for lighting (calculated in Appendix L)												363.7166	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 0.69 * 1068 * 1.00) =											-589.5749	-589.5749	(233)
Total delivered energy for all uses												5457.3437	(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	3746.7136	0.2160	809.2901	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1808.3832	0.2160	390.6108	(264)
Space and water heating			1199.9009	(265)
Pumps and fans	128.1053	0.5190	66.4866	(267)
Energy for lighting	363.7166	0.5190	188.7689	(268)
Energy saving/generation technologies				
PV Unit	-589.5749	0.5190	-305.9894	(269)
Total CO2, kg/year			1149.1671	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			14.7500	(273)

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

DER		14.7500	ZC1
Total Floor Area	TFA	77.9200	
Assumed number of occupants	N	2.4222	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		16.3536	ZC2
CO2 emissions from cooking, equation (L16)		2.2733	ZC3
Total CO2 emissions		33.3769	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		33.3769	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	38.9600 (1b)	x	2.3900 (2b)	=	93.1144	(1b) - (3b)
First floor	38.9600 (1c)	x	2.7600 (2c)	=	107.5296	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	77.9200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	200.6440	(5)

2. Ventilation rate

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

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1495	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3995	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3995	(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	0.5094	0.4994	0.4894	0.4395	0.4295	0.3795	0.3795	0.3696	0.3995	0.4295	0.4495	0.4694	(22b)
Effective ac	0.6297	0.6247	0.6198	0.5966	0.5922	0.5720	0.5720	0.5683	0.5798	0.5922	0.6010	0.6102	(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			1.9800	1.0000	1.9800			(26)
TER Opening Type (Uw = 1.40)			10.8400	1.3258	14.3712			(27)
Ground Floor			38.9600	0.1300	5.0648			(28a)
125mm Cavity	133.8000	12.8200	120.9800	0.1800	21.7764			(29a)
400mm Mineral Wool	38.9600		38.9600	0.1300	5.0648			(30)
Total net area of external elements Aum(A, m2)			211.7200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		48.2572			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.5766	(36)
Total fabric heat loss (33) + (36) =	57.8338	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.6965	41.3629	41.0359	39.5002	39.2129	37.8753	37.8753	37.6276	38.3905	39.2129	39.7941	40.4018	(38)
Heat transfer coeff	99.5303	99.1967	98.8698	97.3340	97.0467	95.7091	95.7091	95.4614	96.2243	97.0467	97.6280	98.2357	(39)
Average = Sum(39)m / 12 =												97.3326	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2773	1.2731	1.2689	1.2492	1.2455	1.2283	1.2283	1.2251	1.2349	1.2455	1.2529	1.2607	(40)
HLP (average)												1.2491	(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	2.4222 (42)
Average daily hot water use (litres/day)	91.7275 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	100.9002	97.2311	93.5620	89.8929	86.2238	82.5547	82.5547	86.2238	89.8929	93.5620	97.2311	100.9002	(44)
Energy conte	149.6321	130.8692	135.0453	117.7358	112.9703	97.4848	90.3340	103.6595	104.8976	122.2480	133.4432	144.9107	(45)
Energy content (annual)										Total = Sum(45)m =		1443.2304	(45)
Distribution loss (46)m = 0.15 x (45)m	22.4448	19.6304	20.2568	17.6604	16.9455	14.6227	13.5501	15.5489	15.7346	18.3372	20.0165	21.7366	(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	44.7530	47.6782	44.3308	43.9387	40.7119	42.0690	43.9387	44.3308	47.6782	47.9496	50.9589	(61)
Total heat required for water heating calculated for each month													
	200.5910	175.6222	182.7235	162.0665	156.9090	138.1967	132.4029	147.5983	149.2283	169.9262	181.3928	195.8696	(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													
	200.5910	175.6222	182.7235	162.0665	156.9090	138.1967	132.4029	147.5983	149.2283	169.9262	181.3928	195.8696	(64)
								Total per year (kWh/year) = Sum(64)m =				1992.5271	(64)
Heat gains from water heating, kWh/month													
	62.4924	54.7023	56.8221	50.2298	48.5473	42.5917	40.5533	45.4515	45.9611	52.5670	56.3573	60.9225	(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	121.1105	121.1105	121.1105	121.1105	121.1105	121.1105	121.1105	121.1105	121.1105	121.1105	121.1105	121.1105	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.5951	18.2924	14.8764	11.2624	8.4188	7.1075	7.6799	9.9826	13.3986	17.0126	19.8563	21.1675	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	215.0385	217.2699	211.6468	199.6758	184.5646	170.3622	160.8742	158.6428	164.2659	176.2368	191.3480	205.5504	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.1110	35.1110	35.1110	35.1110	35.1110	35.1110	35.1110	35.1110	35.1110	35.1110	35.1110	35.1110	(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)													
	-96.8884	-96.8884	-96.8884	-96.8884	-96.8884	-96.8884	-96.8884	-96.8884	-96.8884	-96.8884	-96.8884	-96.8884	(71)
Water heating gains (Table 5)													
	83.9952	81.4022	76.3738	69.7637	65.2517	59.1551	54.5071	61.0907	63.8349	70.6546	78.2740	81.8851	(72)
Total internal gains													
	381.9619	379.2976	365.2301	343.0350	320.5683	298.9580	285.3943	292.0492	303.8326	326.2372	351.8114	370.9362	(73)

---

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	3.8200	10.6334	0.6300	0.7000	0.7700	12.4139	(74)
South	6.5100	46.7521	0.6300	0.7000	0.7700	93.0151	(78)
West	0.5100	19.6403	0.6300	0.7000	0.7700	3.0612	(80)

Solar gains	108.4902	182.0467	244.2215	298.4504	333.3938	331.3619	319.2535	292.6150	262.6436	199.6528	129.3857	93.2398	(83)
Total gains	490.4521	561.3443	609.4517	641.4854	653.9621	630.3198	604.6479	584.6642	566.4761	525.8900	481.1971	464.1761	(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	54.3665	54.5493	54.7297	55.5932	55.7578	56.5371	56.5371	56.6838	56.2343	55.7578	55.4258	55.0830	
alpha	4.6244	4.6366	4.6486	4.7062	4.7172	4.7691	4.7691	4.7789	4.7490	4.7172	4.6951	4.6722	
util living area													
	0.9975	0.9949	0.9891	0.9731	0.9284	0.8146	0.6535	0.6922	0.8846	0.9773	0.9950	0.9981	(86)
MIT	19.6183	19.7756	20.0199	20.3447	20.6500	20.8823	20.9691	20.9591	20.8067	20.4132	19.9610	19.5975	(87)
Th 2	19.8586	19.8620	19.8653	19.8809	19.8838	19.8974	19.8974	19.9000	19.8922	19.8838	19.8779	19.8717	(88)
util rest of house													
	0.9966	0.9931	0.9851	0.9617	0.8947	0.7265	0.5104	0.5539	0.8193	0.9656	0.9930	0.9974	(89)
MIT 2	18.0302	18.2619	18.6193	19.0973	19.5210	19.8120	19.8853	19.8821	19.7301	19.2016	18.5442	18.0089	(90)
Living area fraction									fLA = Living area / (4) =			0.2669	(91)
MIT	18.4542	18.6660	18.9932	19.4303	19.8224	20.0977	20.1746	20.1696	20.0175	19.5250	18.9224	18.4329	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.4542	18.6660	18.9932	19.4303	19.8224	20.0977	20.1746	20.1696	20.0175	19.5250	18.9224	18.4329	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9950	0.9904	0.9807	0.9557	0.8924	0.7447	0.5489	0.5907	0.8282	0.9604	0.9903	0.9961	(94)
Useful gains	488.0155	555.9479	597.6617	613.0769	583.6137	469.4063	331.9170	345.3657	469.1432	505.0583	476.5506	462.3777	(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													
	1408.7680	1365.5431	1235.2000	1024.9567	788.2492	526.1770	342.1246	359.8471	569.4048	866.1426	1154.1944	1398.1812	(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													
	685.0398	544.0480	474.3285	296.5535	152.2488	0.0000	0.0000	0.0000	0.0000	268.6467	487.9035	696.2378	(98)
Space heating												3605.0067	(98)
Space heating per m2											(98) / (4) =	46.2655	(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												3859.7502	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	685.0398	544.0480	474.3285	296.5535	152.2488	0.0000	0.0000	0.0000	0.0000	268.6467	487.9035	696.2378	(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)													
	733.4474	582.4925	507.8463	317.5091	163.0073	0.0000	0.0000	0.0000	0.0000	287.6303	522.3807	745.4367	(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													
	200.5910	175.6222	182.7235	162.0665	156.9090	138.1967	132.4029	147.5983	149.2283	169.9262	181.3928	195.8696	(64)
Efficiency of water heater												80.3000	(216)
(217)m	87.8960	87.7079	87.3448	86.5529	84.9754	80.3000	80.3000	80.3000	80.3000	86.1992	87.4200	87.9706	(217)
Fuel for water heating, kWh/month													
	228.2140	200.2353	209.1979	187.2455	184.6522	172.1005	164.8854	183.8085	185.8385	197.1319	207.4958	222.6534	(219)
Water heating fuel used												2343.4590	(219)
Annual totals kWh/year													
Space heating fuel - main system												3859.7502	(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)												363.7166	(232)
Total delivered energy for all uses												6641.9258	(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	3859.7502	0.2160	833.7060	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2343.4590	0.2160	506.1871	(264)
Space and water heating			1339.8932	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	363.7166	0.5190	188.7689	(268)
Total CO2, kg/m2/year			1567.5871	(272)
Emissions per m2 for space and water heating			17.1958	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.4226	(272b)
Emissions per m2 for pumps and fans			0.4996	(272c)
Target Carbon Dioxide Emission Rate (TER) = (17.1958 * 1.00) + 2.4226 + 0.4996, rounded to 2 d.p.			20.1200	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	38.9600 (1b)	x	2.3900 (2b)	=	93.1144	(1b) - (3b)
First floor	38.9600 (1c)	x	2.7600 (2c)	=	107.5296	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	77.9200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	200.6440	(5)

2. Ventilation rate

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

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1495	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.4000	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.4000	(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	0.5100	0.5000	0.4900	0.4400	0.4300	0.3800	0.3800	0.3700	0.4000	0.4300	0.4500	0.4700	(22b)
Effective ac	0.6301	0.6250	0.6201	0.5968	0.5925	0.5722	0.5722	0.5685	0.5800	0.5925	0.6013	0.6105	(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	
Solid Door			1.9800	1.3000	2.5740			(26)
Window (Uw = 1.40)			7.6900	1.3258	10.1951			(27)
French Door (Uw = 1.40)			3.1500	1.3258	4.1761			(27)
Ground Floor			38.9600	0.1300	5.0648	75.0000	2922.0000	(28a)
125mm Cavity	133.8000	12.8200	120.9800	0.2400	29.0352	60.0000	7258.8000	(29a)
400mm Mineral Wool	38.9600		38.9600	0.1100	4.2856	9.0000	350.6400	(30)
Total net area of external elements Aum(A, m2)			211.7200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	55.3308			(33)
Timber GF			51.8600			9.0000	466.7400	(32c)
Timber FF			99.8900			9.0000	899.0100	(32c)
Internal Floor			38.9600			18.0000	701.2800	(32d)
Internal Ceiling			38.9600			9.0000	350.6400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12949.1100 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		166.1847 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		7.8675 (36)
Total fabric heat loss	(33) + (36) =	63.1983 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.7180	41.3836	41.0558	39.5162	39.2282	37.8872	37.8872	37.6389	38.4038	39.2282	39.8109	40.4201	(38)
Heat transfer coeff	104.9163	104.5819	104.2541	102.7145	102.4265	101.0855	101.0855	100.8372	101.6021	102.4265	103.0092	103.6184	(39)
Average = Sum(39)m / 12 =												102.7131	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3465	1.3422	1.3380	1.3182	1.3145	1.2973	1.2973	1.2941	1.3039	1.3145	1.3220	1.3298	(40)
HLP (average)												1.3182	(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		2.4222 (42)
Average daily hot water use (litres/day)		91.7275 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	100.9002	97.2311	93.5620	89.8929	86.2238	82.5547	82.5547	86.2238	89.8929	93.5620	97.2311	100.9002	(44)
Energy conte	149.6321	130.8692	135.0453	117.7358	112.9703	97.4848	90.3340	103.6595	104.8976	122.2480	133.4432	144.9107	(45)
Energy content (annual)										Total = Sum(45)m =		1443.2304	(45)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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Distribution loss  (46)m = 0.15 x (45)m
                0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (46)
Water storage loss:
Total storage loss
                0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (56)
If cylinder contains dedicated solar storage
                0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (57)
Primary loss    0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (59)
Heat gains from water heating, kWh/month
               31.7968    27.8097    28.6971    25.0189    24.0062    20.7155    19.1960    22.0277    22.2907    25.9777    28.3567    30.7935 (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         121.1105   121.1105   121.1105   121.1105   121.1105   121.1105   121.1105   121.1105   121.1105   121.1105   121.1105   121.1105 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
               20.5951    18.2924    14.8764    11.2624     8.4188     7.1075     7.6799     9.9826    13.3986    17.0126    19.8563    21.1675 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
              215.0385   217.2699   211.6468   199.6758   184.5646   170.3622   160.8742   158.6428   164.2659   176.2368   191.3480   205.5504 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
               35.1110    35.1110    35.1110    35.1110    35.1110    35.1110    35.1110    35.1110    35.1110    35.1110    35.1110    35.1110 (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)
              -96.8884   -96.8884   -96.8884   -96.8884   -96.8884   -96.8884   -96.8884   -96.8884   -96.8884   -96.8884   -96.8884   -96.8884 (71)
Water heating gains (Table 5)
               42.7377    41.3835    38.5714    34.7484    32.2664    28.7715    25.8010    29.6071    30.9593    34.9163    39.3843    41.3892 (72)
Total internal gains
              337.7044   336.2790   324.4277   305.0198   284.5829   265.5744   253.6882   257.5656   267.9570   287.4989   309.9217   327.4403 (73)


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6. Solar gains
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[Jan]                                    Area          Solar flux              g                FF            Access            Gains
                                          m2           Table 6a      Specific data    Specific data        factor                W
                                                          W/m2      or Table 6b      or Table 6c       Table 6d
-------------------------------------------------------------------------------------------------------------------------------
North                                   3.8200           10.6334           0.7200           0.7000           0.7700           14.1873 (74)
South                                   3.3600           46.7521           0.7200           0.7000           0.7700           54.8661 (78)
West                                    0.5100           19.6403           0.7200           0.7000           0.7700            3.4985 (80)
South                                   3.1500           46.7521           0.7200           0.7000           0.7700           51.4369 (78)
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Solar gains   123.9888   208.0533   279.1103   341.0862   381.0215   378.6993   364.8612   334.4171   300.1641   228.1746   147.8694   106.5598 (83)
Total gains   461.6932   544.3323   603.5381   646.1059   665.6045   644.2737   618.5494   591.9827   568.1211   515.6735   457.7911   434.0001 (84)


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7. Mean internal temperature (heating season)
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Temperature during heating periods in the living area from Table 9, Th1 (C)                                                21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau           34.2842    34.3939    34.5020    35.0191    35.1176    35.5835    35.5835    35.6711    35.4026    35.1176    34.9190    34.7137
alpha          3.2856     3.2929     3.3001     3.3346     3.3412     3.3722     3.3722     3.3781     3.3602     3.3412     3.3279     3.3142
util living area
                0.9908     0.9834     0.9704     0.9424     0.8847     0.7729     0.6321     0.6702     0.8441     0.9523     0.9846     0.9925 (86)

MIT            18.9754    19.2022    19.5490    20.0020    20.4270    20.7643    20.9149    20.8937    20.6501    20.0953    19.4569    18.9432 (87)
Th 2           19.8046    19.8079    19.8112    19.8266    19.8295    19.8429    19.8429    19.8454    19.8378    19.8295    19.8237    19.8176 (88)
util rest of house
                0.9885     0.9794     0.9628     0.9259     0.8473     0.6911     0.4988     0.5425     0.7805     0.9354     0.9802     0.9906 (89)
MIT 2          17.9745    18.2019    18.5472    19.0016    19.4061    19.7089    19.8124    19.8039    19.6173    19.0999    18.4679    17.9519 (90)
Living area fraction                                                                                    fLA = Living area / (4) =      0.2669 (91)
MIT            18.2417    18.4689    18.8146    19.2686    19.6786    19.9906    20.1067    20.0948    19.8930    19.3656    18.7319    18.2165 (92)
Temperature adjustment                                                                                                         0.0000
adjusted MIT   18.2417    18.4689    18.8146    19.2686    19.6786    19.9906    20.1067    20.0948    19.8930    19.3656    18.7319    18.2165 (93)


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8. Space heating requirement
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                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation     0.9844     0.9733     0.9543     0.9161     0.8415     0.7030     0.5321     0.5731     0.7841     0.9266     0.9745     0.9871 (94)
Useful gains  454.4938   529.7916   575.9747   591.8872   560.1132   452.9057   329.0997   339.2940   445.4580   477.8476   446.1013   428.4143 (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
              1462.7111  1419.0659  1283.8487  1065.0075   817.2193   544.9103   354.4754   372.5724   588.5812   897.8322  1198.1919  1452.3714 (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
              750.1137   597.5923   526.6583   340.6466   191.2869     0.0000     0.0000     0.0000     0.0000   312.4686   541.5052   761.8241 (98)
Space heating                                                                                                                 4022.0956 (98)
Space heating per m2                                                                                                 (98) / (4) =    51.6183 (99)


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8c. Space cooling requirement
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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   950.2042   748.0331   766.3629     0.0000     0.0000     0.0000     0.0000 (100)
```

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7236	0.8018	0.7796	0.0000	0.0000	0.0000	0.0000 (101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	687.5226	599.7967	597.4714	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	843.8475	811.9723	782.6206	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	112.5539	157.8586	137.7511	0.0000	0.0000	0.0000	0.0000 (104)
Space cooling												408.1635 (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	28.1385	39.4646	34.4378	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												102.0409 (107)
Space cooling per m2												1.3096 (108)
Energy for space heating												51.6183 (99)
Energy for space cooling												1.3096 (108)
Total												52.9278 (109)
Dwelling Fabric Energy Efficiency (DFEE)												52.9 (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	38.9600 (1b)	x	2.3900 (2b)	=	93.1144	(1b) - (3b)
First floor	38.9600 (1c)	x	2.7600 (2c)	=	107.5296	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	77.9200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	200.6440	(5)

2. Ventilation rate

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

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1495	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3995	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3995	(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	0.5094	0.4994	0.4894	0.4395	0.4295	0.3795	0.3795	0.3696	0.3995	0.4295	0.4495	0.4694	(22b)
Effective ac	0.6297	0.6247	0.6198	0.5966	0.5922	0.5720	0.5720	0.5683	0.5798	0.5922	0.6010	0.6102	(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			1.9800	1.0000	1.9800			(26)
TER Opening Type (Uw = 1.40)			10.8400	1.3258	14.3712			(27)
Ground Floor			38.9600	0.1300	5.0648			(28a)
125mm Cavity	133.8000	12.8200	120.9800	0.1800	21.7764			(29a)
400mm Mineral Wool	38.9600		38.9600	0.1300	5.0648			(30)
Total net area of external elements Aum(A, m2)			211.7200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		48.2572			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.5766	(36)
Total fabric heat loss	(33) + (36) = 57.8338	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.6965	41.3629	41.0359	39.5002	39.2129	37.8753	37.8753	37.6276	38.3905	39.2129	39.7941	40.4018	(38)
Heat transfer coeff	99.5303	99.1967	98.8698	97.3340	97.0467	95.7091	95.7091	95.4614	96.2243	97.0467	97.6280	98.2357	(39)
Average = Sum(39)m / 12 =												97.3326	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2773	1.2731	1.2689	1.2492	1.2455	1.2283	1.2283	1.2251	1.2349	1.2455	1.2529	1.2607	(40)
HLP (average)												1.2491	(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	2.4222	(42)
Average daily hot water use (litres/day)	91.7275	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	100.9002	97.2311	93.5620	89.8929	86.2238	82.5547	82.5547	86.2238	89.8929	93.5620	97.2311	100.9002	(44)
Energy conte	149.6321	130.8692	135.0453	117.7358	112.9703	97.4848	90.3340	103.6595	104.8976	122.2480	133.4432	144.9107	(45)
Energy content (annual)										Total = Sum(45)m =		1443.2304	(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													
	31.7968	27.8097	28.6971	25.0189	24.0062	20.7155	19.1960	22.0277	22.2907	25.9777	28.3567	30.7935	(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	121.1105	121.1105	121.1105	121.1105	121.1105	121.1105	121.1105	121.1105	121.1105	121.1105	121.1105	121.1105	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.5951	18.2924	14.8764	11.2624	8.4188	7.1075	7.6799	9.9826	13.3986	17.0126	19.8563	21.1675	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	215.0385	217.2699	211.6468	199.6758	184.5646	170.3622	160.8742	158.6428	164.2659	176.2368	191.3480	205.5504	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.1110	35.1110	35.1110	35.1110	35.1110	35.1110	35.1110	35.1110	35.1110	35.1110	35.1110	35.1110	(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)													
	-96.8884	-96.8884	-96.8884	-96.8884	-96.8884	-96.8884	-96.8884	-96.8884	-96.8884	-96.8884	-96.8884	-96.8884	(71)
Water heating gains (Table 5)													
	42.7377	41.3835	38.5714	34.7484	32.2664	28.7715	25.8010	29.6071	30.9593	34.9163	39.3843	41.3892	(72)
Total internal gains													
	337.7044	336.2790	324.4277	305.0198	284.5829	265.5744	253.6882	257.5656	267.9570	287.4989	309.9217	327.4403	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	3.8200	10.6334	0.6300	0.7000	0.7700	12.4139	(74)
South	6.5100	46.7521	0.6300	0.7000	0.7700	93.0151	(78)
West	0.5100	19.6403	0.6300	0.7000	0.7700	3.0612	(80)

Solar gains	108.4902	182.0467	244.2215	298.4504	333.3938	331.3619	319.2535	292.6150	262.6436	199.6528	129.3857	93.2398	(83)
Total gains	446.1946	518.3257	568.6493	603.4702	617.9768	596.9363	572.9418	550.1806	530.6006	487.1517	439.3074	420.6801	(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	54.3665	54.5493	54.7297	55.5932	55.7578	56.5371	56.5371	56.6838	56.2343	55.7578	55.4258	55.0830	
alpha	4.6244	4.6366	4.6486	4.7062	4.7172	4.7691	4.7691	4.7789	4.7490	4.7172	4.6951	4.6722	
util living area													
	0.9983	0.9963	0.9918	0.9786	0.9403	0.8372	0.6810	0.7228	0.9044	0.9831	0.9966	0.9987	(86)
MIT	19.5668	19.7261	19.9740	20.3048	20.6192	20.8659	20.9632	20.9507	20.7815	20.3717	19.9125	19.5466	(87)
Th 2	19.8586	19.8620	19.8653	19.8809	19.8838	19.8974	19.8974	19.9000	19.8922	19.8838	19.8779	19.8717	(88)
util rest of house													
	0.9977	0.9950	0.9886	0.9693	0.9108	0.7531	0.5360	0.5840	0.8457	0.9740	0.9952	0.9983	(89)
MIT 2	18.5589	18.7203	18.9696	19.3080	19.6097	19.8291	19.8873	19.8847	19.7633	19.3785	18.9192	18.5490	(90)
Living area fraction									fLA = Living area / (4) =			0.2669	(91)
MIT	18.8279	18.9888	19.2377	19.5741	19.8792	20.1059	20.1745	20.1693	20.0351	19.6436	19.1844	18.8153	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8279	18.9888	19.2377	19.5741	19.8792	20.1059	20.1745	20.1693	20.0351	19.6436	19.1844	18.8153	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9970	0.9936	0.9862	0.9660	0.9107	0.7715	0.5754	0.6215	0.8550	0.9713	0.9939	0.9977	(94)
Useful gains	444.8505	515.0322	560.8210	582.9270	562.7632	460.5123	329.6936	341.9202	453.6527	473.1804	436.6299	419.7187	(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													
	1445.9698	1397.5645	1259.3737	1038.9520	793.7635	526.9656	342.1131	359.8206	571.0989	877.6560	1179.7716	1435.7436	(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													
	744.8328	593.0617	519.7232	328.3380	171.8642	0.0000	0.0000	0.0000	0.0000	300.9298	535.0620	755.9226	(98)
Space heating												3949.7342	(98)
Space heating per m2											(98) / (4) =	50.6896	(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	899.6657	708.2475	725.5068	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7681	0.8538	0.8316	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	691.0125	604.7092	603.3324	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	788.5180	758.6646	733.7610	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	70.2040	114.5428	97.0389	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												281.7857	(104)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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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   17.5510   28.6357   24.2597    0.0000    0.0000    0.0000    0.0000 (107)
Space cooling                                                                                                          70.4464 (107)
Space cooling per m2                                                                                                    0.9041 (108)
Energy for space heating                                                                                               50.6896 (99)
Energy for space cooling                                                                                                0.9041 (108)
Total                                                                                                                  51.5937 (109)
Target Fabric Energy Efficiency (TFEE)                                                                                    59.3 (109)


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CALCULATION OF HEAT DEMAND 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	38.9600 (1b)	x	2.3900 (2b)	=	93.1144	(1b) - (3b)
First floor	38.9600 (1c)	x	2.7600 (2c)	=	107.5296	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	77.9200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	200.6440	(5)

2. Ventilation rate

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

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0.0000	/ (5) =	0.0000	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.2505	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.2505	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.2630	0.2505	0.2505	0.2317	0.2317	0.2067	0.2129	0.2004	0.2067	0.2192	0.2192	0.2380	(22b)
Mechanical extract ventilation - decentralised													
If mechanical ventilation:												0.5000	(23a)
Effective ac	0.5130	0.5005	0.5005	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			1.9800	1.3000	2.5740			(26)
Window (Uw = 1.40)			7.6900	1.3258	10.1951			(27)
French Door (Uw = 1.40)			3.1500	1.3258	4.1761			(27)
Ground Floor			38.9600	0.1300	5.0648	75.0000	2922.0000	(28a)
125mm Cavity	133.8000	12.8200	120.9800	0.2400	29.0352	60.0000	7258.8000	(29a)
400mm Mineral Wool	38.9600		38.9600	0.1100	4.2856	9.0000	350.6400	(30)
Total net area of external elements Aum(A, m2)			211.7200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	55.3308			(33)
Timber GF			51.8600			9.0000	466.7400	(32c)
Timber FF			99.8900			9.0000	899.0100	(32c)
Internal Floor			38.9600			18.0000	701.2800	(32d)
Internal Ceiling			38.9600			18.0000	701.2800	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 13299.7500	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	170.6847	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	7.8675	(36)
Total fabric heat loss	(33) + (36) = 63.1983	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	33.9687	33.1394	33.1394	33.1063	33.1063	33.1063	33.1063	33.1063	33.1063	33.1063	33.1063	33.1063	(38)
Heat transfer coeff	97.1670	96.3377	96.3377	96.3046	96.3046	96.3046	96.3046	96.3046	96.3046	96.3046	96.3046	96.3046	(39)
Average = Sum(39)m / 12 =												96.3819	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2470	1.2364	1.2364	1.2359	1.2359	1.2359	1.2359	1.2359	1.2359	1.2359	1.2359	1.2359	(40)
HLP (average)												1.2369	(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	2.4222 (42)
Average daily hot water use (litres/day)	91.7275 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												

CALCULATION OF HEAT DEMAND 09 Jan 2014

	100.9002	97.2311	93.5620	89.8929	86.2238	82.5547	82.5547	86.2238	89.8929	93.5620	97.2311	100.9002	(44)
Energy conte	149.6321	130.8692	135.0453	117.7358	112.9703	97.4848	90.3340	103.6595	104.8976	122.2480	133.4432	144.9107	(45)
Energy content (annual)										Total = Sum(45)m =		1443.2304	(45)
Distribution loss (46)m = 0.15 x (45)m													
	22.4448	19.6304	20.2568	17.6604	16.9455	14.6227	13.5501	15.5489	15.7346	18.3372	20.0165	21.7366	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1157	12.7307	14.0598	13.5668	13.9903	13.5059	13.9355	13.9711	13.5391	14.0311	13.6242	14.1043	(61)
Total heat required for water heating calculated for each month													
	163.7478	143.5999	149.1051	131.3026	126.9606	110.9907	104.2695	117.6306	118.4367	136.2791	147.0674	159.0151	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	163.7478	143.5999	149.1051	131.3026	126.9606	110.9907	104.2695	117.6306	118.4367	136.2791	147.0674	159.0151	(64)
									Total per year (kWh/year) = Sum(64)m =			1608.4050	(64)
RHI water heating demand												1608	(64)
Heat gains from water heating, kWh/month													
	53.2816	46.6967	48.4175	42.5388	41.0602	35.7902	33.5199	37.9596	38.2632	44.1552	47.7759	51.7089	(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	145.3326	145.3326	145.3326	145.3326	145.3326	145.3326	145.3326	145.3326	145.3326	145.3326	145.3326	145.3326	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	51.4879	45.7311	37.1910	28.1560	21.0469	17.7687	19.1997	24.9565	33.4966	42.5316	49.6406	52.9189	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	320.9530	324.2835	315.8907	298.0236	275.4696	254.2720	240.1107	236.7802	245.1730	263.0401	285.5941	306.7917	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	51.9555	51.9555	51.9555	51.9555	51.9555	51.9555	51.9555	51.9555	51.9555	51.9555	51.9555	51.9555	(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)													
	-96.8884	-96.8884	-96.8884	-96.8884	-96.8884	-96.8884	-96.8884	-96.8884	-96.8884	-96.8884	-96.8884	-96.8884	(71)
Water heating gains (Table 5)													
	71.6151	69.4891	65.0773	59.0817	55.1884	49.7086	45.0537	51.0209	53.1434	59.3484	66.3555	69.5012	(72)
Total internal gains													
	547.4555	542.9033	521.5587	488.6610	455.1046	425.1489	407.7637	416.1573	435.2125	468.3197	504.9898	532.6114	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	3.8200	11.9814	0.7200	0.7000	0.7700	15.9859	(74)
South	3.3600	50.9848	0.7200	0.7000	0.7700	59.8334	(78)
West	0.5100	22.3313	0.7200	0.7000	0.7700	3.9778	(80)
South	3.1500	50.9848	0.7200	0.7000	0.7700	56.0938	(78)

Solar gains	135.8910	205.1210	272.4473	345.4011	378.5026	403.8691	384.3798	358.2066	318.2944	240.2892	165.9944	115.6959	(83)
Total gains	683.3465	748.0243	794.0060	834.0621	833.6073	829.0180	792.1435	774.3639	753.5069	708.6090	670.9843	648.3073	(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	38.0209	38.3482	38.3482	38.3614	38.3614	38.3614	38.3614	38.3614	38.3614	38.3614	38.3614	38.3614	
alpha	3.5347	3.5565	3.5565	3.5574	3.5574	3.5574	3.5574	3.5574	3.5574	3.5574	3.5574	3.5574	
util living area													
	0.9680	0.9546	0.9261	0.8658	0.7488	0.5424	0.3695	0.3888	0.6525	0.8648	0.9464	0.9723	(86)
MIT	19.6114	19.7874	20.0942	20.4534	20.7696	20.9497	20.9908	20.9888	20.8945	20.5392	20.0278	19.5804	(87)
Th 2	19.8826	19.8910	19.8910	19.8914	19.8914	19.8914	19.8914	19.8914	19.8914	19.8914	19.8914	19.8914	(88)
util rest of house													
	0.9607	0.9444	0.9087	0.8327	0.6845	0.4369	0.2409	0.2585	0.5565	0.8246	0.9322	0.9659	(89)
MIT 2	18.0873	18.3440	18.7791	19.2734	19.6766	19.8625	19.8892	19.8885	19.8164	19.3971	18.6919	18.0489	(90)
Living area fraction									fLA = Living area / (4) =			0.2669	(91)
MIT	18.4941	18.7293	19.1301	19.5884	19.9684	20.1527	20.1833	20.1822	20.1042	19.7020	19.0485	18.4577	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.3441	18.5793	18.9801	19.4384	19.8184	20.0027	20.0333	20.0322	19.9542	19.5520	18.8985	18.3077	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9469	0.9285	0.8908	0.8166	0.6798	0.4481	0.2578	0.2755	0.5624	0.8098	0.9156	0.9532	(94)
Useful gains	647.0849	694.5365	707.3011	681.1019	566.6680	371.5220	204.1882	213.3409	423.8050	573.8474	614.3321	617.9945	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W													
	1286.8928	1250.3956	1115.6032	918.5931	656.6401	385.4776	205.4418	214.9720	457.8507	765.8092	1049.5775	1271.9651	(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													
	476.0171	373.5373	303.7767	170.9937	66.9392	0.0000	0.0000	0.0000	0.0000	142.8196	313.3767	486.5541	(98)
Space heating												2334.0144	(98)
RHI space heating demand												2334	(98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	38.9600 (1b)	x	2.3900 (2b)	=	93.1144	(1b) - (3b)
First floor	38.9600 (1c)	x	2.7600 (2c)	=	107.5296	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	77.9200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	200.6440	(5)

2. Ventilation rate

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

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			0.0000 / (5) =	0.0000	(8)
Pressure test				Yes	
Measured/design AP50				5.0100	
Infiltration rate				0.2505	(18)
Number of sides sheltered				0	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.2505	(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	0.3194	0.3131	0.3069	0.2756	0.2693	0.2380	0.2380	0.2317	0.2505	0.2693	0.2818	0.2943	(22b)
Mechanical extract ventilation - decentralised													
If mechanical ventilation:												0.5000	(23a)
Effective ac	0.5694	0.5631	0.5569	0.5256	0.5193	0.5000	0.5000	0.5000	0.5005	0.5193	0.5318	0.5443	(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	
Solid Door			1.9800	1.3000	2.5740			(26)
Window (Uw = 1.40)			7.6900	1.3258	10.1951			(27)
French Door (Uw = 1.40)			3.1500	1.3258	4.1761			(27)
Ground Floor			38.9600	0.1300	5.0648	75.0000	2922.0000	(28a)
125mm Cavity	133.8000	12.8200	120.9800	0.2400	29.0352	60.0000	7258.8000	(29a)
400mm Mineral Wool	38.9600		38.9600	0.1100	4.2856	9.0000	350.6400	(30)
Total net area of external elements Aum(A, m2)			211.7200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	55.3308			(33)
Timber GF			51.8600			9.0000	466.7400	(32c)
Timber FF			99.8900			9.0000	899.0100	(32c)
Internal Floor			38.9600			18.0000	701.2800	(32d)
Internal Ceiling			38.9600			18.0000	701.2800	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	13299.7500 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		170.6847 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		7.8675 (36)
Total fabric heat loss	(33) + (36) =	63.1983 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	37.7006	37.2859	36.8713	34.7980	34.3833	33.1063	33.1063	33.1063	33.1394	34.3833	35.2126	36.0420	(38)
Heat transfer coeff	100.8989	100.4842	100.0696	97.9963	97.5816	96.3046	96.3046	96.3046	96.3377	97.5816	98.4109	99.2403	(39)
Average = Sum(39)m / 12 =												98.1262	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2949	1.2896	1.2843	1.2577	1.2523	1.2359	1.2359	1.2359	1.2364	1.2523	1.2630	1.2736	(40)
HLP (average)												1.2593	(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		2.4222 (42)
Average daily hot water use (litres/day)		91.7275 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												

CALCULATION OF ENERGY RATINGS 09 Jan 2014

	100.9002	97.2311	93.5620	89.8929	86.2238	82.5547	82.5547	86.2238	89.8929	93.5620	97.2311	100.9002	(44)
Energy conte	149.6321	130.8692	135.0453	117.7358	112.9703	97.4848	90.3340	103.6595	104.8976	122.2480	133.4432	144.9107	(45)
Energy content (annual)										Total = Sum(45)m =		1443.2304	(45)
Distribution loss (46)m = 0.15 x (45)m													
	22.4448	19.6304	20.2568	17.6604	16.9455	14.6227	13.5501	15.5489	15.7346	18.3372	20.0165	21.7366	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1157	12.7307	14.0598	13.5668	13.9903	13.5059	13.9355	13.9711	13.5391	14.0311	13.6242	14.1043	(61)
Total heat required for water heating calculated for each month													
	163.7478	143.5999	149.1051	131.3026	126.9606	110.9907	104.2695	117.6306	118.4367	136.2791	147.0674	159.0151	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	163.7478	143.5999	149.1051	131.3026	126.9606	110.9907	104.2695	117.6306	118.4367	136.2791	147.0674	159.0151	(64)
									Total per year (kWh/year) = Sum(64)m =			1608.4050	(64)
Heat gains from water heating, kWh/month													
	53.2816	46.6967	48.4175	42.5388	41.0602	35.7902	33.5199	37.9596	38.2632	44.1552	47.7759	51.7089	(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	145.3326	145.3326	145.3326	145.3326	145.3326	145.3326	145.3326	145.3326	145.3326	145.3326	145.3326	145.3326	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	51.4879	45.7311	37.1910	28.1560	21.0469	17.7687	19.1997	24.9565	33.4966	42.5316	49.6406	52.9189	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	320.9530	324.2835	315.8907	298.0236	275.4696	254.2720	240.1107	236.7802	245.1730	263.0401	285.5941	306.7917	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	51.9555	51.9555	51.9555	51.9555	51.9555	51.9555	51.9555	51.9555	51.9555	51.9555	51.9555	51.9555	(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)													
	-96.8884	-96.8884	-96.8884	-96.8884	-96.8884	-96.8884	-96.8884	-96.8884	-96.8884	-96.8884	-96.8884	-96.8884	(71)
Water heating gains (Table 5)													
	71.6151	69.4891	65.0773	59.0817	55.1884	49.7086	45.0537	51.0209	53.1434	59.3484	66.3555	69.5012	(72)
Total internal gains													
	547.4555	542.9033	521.5587	488.6610	455.1046	425.1489	407.7637	416.1573	435.2125	468.3197	504.9898	532.6114	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	3.8200	10.6334	0.7200	0.7000	0.7700	14.1873	(74)
South	3.3600	46.7521	0.7200	0.7000	0.7700	54.8661	(78)
West	0.5100	19.6403	0.7200	0.7000	0.7700	3.4985	(80)
South	3.1500	46.7521	0.7200	0.7000	0.7700	51.4369	(78)

Solar gains	123.9888	208.0533	279.1103	341.0862	381.0215	378.6993	364.8612	334.4171	300.1641	228.1746	147.8694	106.5598	(83)
Total gains	671.4443	750.9566	800.6690	829.7472	836.1262	803.8482	772.6249	750.5745	735.3766	696.4944	652.8592	639.1712	(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	36.6146	36.7657	36.9181	37.6991	37.8593	38.3614	38.3614	38.3614	38.3482	37.8593	37.5403	37.2266	
alpha	3.4410	3.4510	3.4612	3.5133	3.5240	3.5574	3.5574	3.5574	3.5565	3.5240	3.5027	3.4818	
util living area													
	0.9742	0.9608	0.9384	0.8930	0.8097	0.6677	0.5172	0.5495	0.7395	0.8982	0.9594	0.9778	(86)
MIT	19.3980	19.6054	19.9100	20.3027	20.6382	20.8745	20.9619	20.9518	20.8095	20.3890	19.8388	19.3722	(87)
Th 2	19.8448	19.8490	19.8532	19.8742	19.8784	19.8914	19.8914	19.8914	19.8910	19.8784	19.8700	19.8616	(88)
util rest of house													
	0.9684	0.9521	0.9242	0.8668	0.7605	0.5815	0.3999	0.4334	0.6629	0.8682	0.9488	0.9728	(89)
MIT 2	17.7548	18.0551	18.4926	19.0563	19.5054	19.7941	19.8729	19.8661	19.7285	19.1871	18.4086	17.7285	(90)
Living area fraction										fLA = Living area / (4) =		0.2669	(91)
MIT	18.1935	18.4690	18.8710	19.3890	19.8078	20.0825	20.1636	20.1559	20.0171	19.5079	18.7904	18.1673	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.0435	18.3190	18.7210	19.2390	19.6578	19.9325	20.0136	20.0059	19.8671	19.3579	18.6404	18.0173	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9557	0.9365	0.9061	0.8489	0.7493	0.5850	0.4136	0.4462	0.6610	0.8510	0.9333	0.9613	(94)
Useful gains	641.7023	703.2959	725.4900	704.3777	626.5179	470.2578	319.5231	334.8699	486.1033	592.6911	609.3444	614.4367	(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													
	1386.6995	1348.3940	1222.9469	1013.1865	776.5347	513.5449	328.7468	347.2656	555.5864	854.6112	1135.6984	1371.2281	(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													
	554.2779	433.5059	370.1079	222.3424	111.6125	0.0000	0.0000	0.0000	0.0000	194.8685	378.9748	563.0528	(98)
Space heating												2828.7427	(98)
Space heating per m2											(98) / (4) =	36.3032	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3125.6825	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	554.2779	433.5059	370.1079	222.3424	111.6125	0.0000	0.0000	0.0000	0.0000	194.8685	378.9748	563.0528	(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)													
	612.4618	479.0121	408.9590	245.6822	123.3287	0.0000	0.0000	0.0000	0.0000	215.3244	418.7567	622.1577	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	163.7478	143.5999	149.1051	131.3026	126.9606	110.9907	104.2695	117.6306	118.4367	136.2791	147.0674	159.0151	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7498	89.6820	89.5573	89.2849	88.7684	87.3000	87.3000	87.3000	87.3000	89.1551	89.5820	89.7753	(217)
Fuel for water heating, kWh/month													
	182.4493	160.1211	166.4913	147.0603	143.0245	127.1371	119.4381	134.7430	135.6663	152.8562	164.1708	177.1256	(219)
Water heating fuel used												1810.2836	(219)
Annual totals kWh/year													
Space heating fuel - main system												3125.6825	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
(MEVDecentralised, Database: total watage = 8.0270, total flow = 37.0000, SFP = 0.2169)													
mechanical ventilation fans (SFP = 0.2169)												53.1053	(230a)
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												128.1053	(231)
Electricity for lighting (calculated in Appendix L)												363.7166	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 0.69 * 1068 * 1.00) =										-589.5749		-589.5749	(233)
Total delivered energy for all uses												4838.2132	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3125.6825	3.4800	108.7738	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1810.2836	3.4800	62.9979	(247)
Mechanical ventilation fans	53.1053	13.1900	7.0046	(249)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	363.7166	13.1900	47.9742	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-589.5749	13.1900	-77.7649	(252)
Total energy cost			278.8780	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.9529	(257)
SAP value		86.7072	
SAP rating (Section 12)		87	(258)
SAP band		B	

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3125.6825	0.2160	675.1474	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1810.2836	0.2160	391.0213	(264)
Space and water heating			1066.1687	(265)
Pumps and fans	128.1053	0.5190	66.4866	(267)
Energy for lighting	363.7166	0.5190	188.7689	(268)
Energy saving/generation technologies				
PV Unit	-589.5749	0.5190	-305.9894	(269)
Total kg/year			1015.4349	(272)
CO2 emissions per m2			13.0300	(273)
EI value			88.9303	
EI rating			89	(274)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

EI band B

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8873 = 3.922, stars = 4
Water heating environmental impact	0.216 / 0.8873 = 0.2434, stars = 4

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

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	38.9600 (1b)	x	2.3900 (2b)	=	93.1144	(1b) - (3b)
First floor	38.9600 (1c)	x	2.7600 (2c)	=	107.5296	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	77.9200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	200.6440	(5)

2. Ventilation rate

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

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0.0000	/ (5) =	0.0000	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.2505	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.2505	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.2630	0.2505	0.2505	0.2317	0.2317	0.2067	0.2129	0.2004	0.2067	0.2192	0.2192	0.2380	(22b)
Mechanical extract ventilation - decentralised													
If mechanical ventilation:												0.5000	(23a)
Effective ac	0.5130	0.5005	0.5005	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			1.9800	1.3000	2.5740			(26)
Window (Uw = 1.40)			7.6900	1.3258	10.1951			(27)
French Door (Uw = 1.40)			3.1500	1.3258	4.1761			(27)
Ground Floor			38.9600	0.1300	5.0648	75.0000	2922.0000	(28a)
125mm Cavity	133.8000	12.8200	120.9800	0.2400	29.0352	60.0000	7258.8000	(29a)
400mm Mineral Wool	38.9600		38.9600	0.1100	4.2856	9.0000	350.6400	(30)
Total net area of external elements Aum(A, m2)			211.7200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	55.3308			(33)
Timber GF			51.8600			9.0000	466.7400	(32c)
Timber FF			99.8900			9.0000	899.0100	(32c)
Internal Floor			38.9600			18.0000	701.2800	(32d)
Internal Ceiling			38.9600			18.0000	701.2800	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	13299.7500 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		170.6847 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		7.8675 (36)
Total fabric heat loss	(33) + (36) =	63.1983 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	33.9687	33.1394	33.1394	33.1063	33.1063	33.1063	33.1063	33.1063	33.1063	33.1063	33.1063	33.1063	(38)
Heat transfer coeff	97.1670	96.3377	96.3377	96.3046	96.3046	96.3046	96.3046	96.3046	96.3046	96.3046	96.3046	96.3046	(39)
Average = Sum(39)m / 12 =												96.3819	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2470	1.2364	1.2364	1.2359	1.2359	1.2359	1.2359	1.2359	1.2359	1.2359	1.2359	1.2359	(40)
HLP (average)												1.2369	(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		2.4222 (42)
Average daily hot water use (litres/day)		91.7275 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												

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

	100.9002	97.2311	93.5620	89.8929	86.2238	82.5547	82.5547	86.2238	89.8929	93.5620	97.2311	100.9002	(44)
Energy conte	149.6321	130.8692	135.0453	117.7358	112.9703	97.4848	90.3340	103.6595	104.8976	122.2480	133.4432	144.9107	(45)
Energy content (annual)										Total = Sum(45)m =		1443.2304	(45)
Distribution loss (46)m = 0.15 x (45)m													
	22.4448	19.6304	20.2568	17.6604	16.9455	14.6227	13.5501	15.5489	15.7346	18.3372	20.0165	21.7366	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1157	12.7307	14.0598	13.5668	13.9903	13.5059	13.9355	13.9711	13.5391	14.0311	13.6242	14.1043	(61)
Total heat required for water heating calculated for each month													
	163.7478	143.5999	149.1051	131.3026	126.9606	110.9907	104.2695	117.6306	118.4367	136.2791	147.0674	159.0151	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	163.7478	143.5999	149.1051	131.3026	126.9606	110.9907	104.2695	117.6306	118.4367	136.2791	147.0674	159.0151	(64)
									Total per year (kWh/year) = Sum(64)m =			1608.4050	(64)
Heat gains from water heating, kWh/month													
	53.2816	46.6967	48.4175	42.5388	41.0602	35.7902	33.5199	37.9596	38.2632	44.1552	47.7759	51.7089	(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	145.3326	145.3326	145.3326	145.3326	145.3326	145.3326	145.3326	145.3326	145.3326	145.3326	145.3326	145.3326	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	51.4879	45.7311	37.1910	28.1560	21.0469	17.7687	19.1997	24.9565	33.4966	42.5316	49.6406	52.9189	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	320.9530	324.2835	315.8907	298.0236	275.4696	254.2720	240.1107	236.7802	245.1730	263.0401	285.5941	306.7917	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	51.9555	51.9555	51.9555	51.9555	51.9555	51.9555	51.9555	51.9555	51.9555	51.9555	51.9555	51.9555	(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)													
	-96.8884	-96.8884	-96.8884	-96.8884	-96.8884	-96.8884	-96.8884	-96.8884	-96.8884	-96.8884	-96.8884	-96.8884	(71)
Water heating gains (Table 5)													
	71.6151	69.4891	65.0773	59.0817	55.1884	49.7086	45.0537	51.0209	53.1434	59.3484	66.3555	69.5012	(72)
Total internal gains													
	547.4555	542.9033	521.5587	488.6610	455.1046	425.1489	407.7637	416.1573	435.2125	468.3197	504.9898	532.6114	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	3.8200	11.9814	0.7200	0.7000	0.7700	15.9859	(74)
South	3.3600	50.9848	0.7200	0.7000	0.7700	59.8334	(78)
West	0.5100	22.3313	0.7200	0.7000	0.7700	3.9778	(80)
South	3.1500	50.9848	0.7200	0.7000	0.7700	56.0938	(78)

Solar gains	135.8910	205.1210	272.4473	345.4011	378.5026	403.8691	384.3798	358.2066	318.2944	240.2892	165.9944	115.6959	(83)
Total gains	683.3465	748.0243	794.0060	834.0621	833.6073	829.0180	792.1435	774.3639	753.5069	708.6090	670.9843	648.3073	(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	38.0209	38.3482	38.3482	38.3614	38.3614	38.3614	38.3614	38.3614	38.3614	38.3614	38.3614	38.3614	
alpha	3.5347	3.5565	3.5565	3.5574	3.5574	3.5574	3.5574	3.5574	3.5574	3.5574	3.5574	3.5574	
util living area													
	0.9680	0.9546	0.9261	0.8658	0.7488	0.5424	0.3695	0.3888	0.6525	0.8648	0.9464	0.9723	(86)
MIT	19.6114	19.7874	20.0942	20.4534	20.7696	20.9497	20.9908	20.9888	20.8945	20.5392	20.0278	19.5804	(87)
Th 2	19.8826	19.8910	19.8910	19.8914	19.8914	19.8914	19.8914	19.8914	19.8914	19.8914	19.8914	19.8914	(88)
util rest of house													
	0.9607	0.9444	0.9087	0.8327	0.6845	0.4369	0.2409	0.2585	0.5565	0.8246	0.9322	0.9659	(89)
MIT 2	18.0873	18.3440	18.7791	19.2734	19.6766	19.8625	19.8892	19.8885	19.8164	19.3971	18.6919	18.0489	(90)
Living area fraction										fLA = Living area / (4) =		0.2669	(91)
MIT	18.4941	18.7293	19.1301	19.5884	19.9684	20.1527	20.1833	20.1822	20.1042	19.7020	19.0485	18.4577	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.3441	18.5793	18.9801	19.4384	19.8184	20.0027	20.0333	20.0322	19.9542	19.5520	18.8985	18.3077	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9469	0.9285	0.8908	0.8166	0.6798	0.4481	0.2578	0.2755	0.5624	0.8098	0.9156	0.9532	(94)
Useful gains	647.0849	694.5365	707.3011	681.1019	566.6680	371.5220	204.1882	213.3409	423.8050	573.8474	614.3321	617.9945	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W													
	1286.8928	1250.3956	1115.6032	918.5931	656.6401	385.4776	205.4418	214.9720	457.8507	765.8092	1049.5775	1271.9651	(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													
	476.0171	373.5373	303.7767	170.9937	66.9392	0.0000	0.0000	0.0000	0.0000	142.8196	313.3767	486.5541	(98)
Space heating												2334.0144	(98)
Space heating per m2											(98) / (4) =	29.9540	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2579.0214	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	476.0171	373.5373	303.7767	170.9937	66.9392	0.0000	0.0000	0.0000	0.0000	142.8196	313.3767	486.5541	(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)	525.9857	412.7484	335.6649	188.9433	73.9660	0.0000	0.0000	0.0000	0.0000	157.8117	346.2726	537.6288	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	163.7478	143.5999	149.1051	131.3026	126.9606	110.9907	104.2695	117.6306	118.4367	136.2791	147.0674	159.0151	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.6588	89.5881	89.4208	89.0817	88.3788	87.3000	87.3000	87.3000	87.3000	88.9087	89.4527	89.6902	(217)
Fuel for water heating, kWh/month	182.6343	160.2890	166.7453	147.3957	143.6550	127.1371	119.4381	134.7430	135.6663	153.2798	164.4080	177.2937	(219)
Water heating fuel used												1812.6853	(219)
Annual totals kWh/year													
Space heating fuel - main system												2579.0214	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
(MEVDecentralised, Database: total watage = 8.0270, total flow = 37.0000, SFP = 0.2169)													
mechanical ventilation fans (SFP = 0.2169)												53.1053	(230a)
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												128.1053	(231)
Electricity for lighting (calculated in Appendix L)												363.7166	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 0.69 * 1121 * 1.00) =										-618.7799		-618.7799	(233)
Total delivered energy for all uses												4264.7487	(238)

10a. Fuel costs - using BEDF prices (467)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2579.0214	3.9500	101.8713	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1812.6853	3.9500	71.6011	(247)
Mechanical ventilation fans	53.1053	18.7000	9.9307	(249)
Pumps and fans for heating	75.0000	18.7000	14.0250	(249)
Energy for lighting	363.7166	18.7000	68.0150	(250)
Additional standing charges			91.0000	(251)
Energy saving/generation technologies				
PV Unit	-618.7799	18.7000	-115.7118	(252)
Total energy cost			240.7313	(255)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2579.0214	0.2160	557.0686	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1812.6853	0.2160	391.5400	(264)
Space and water heating			948.6087	(265)
Pumps and fans	128.1053	0.5190	66.4866	(267)
Energy for lighting	363.7166	0.5190	188.7689	(268)
Energy saving/generation technologies				
PV Unit	-618.7799	0.5190	-321.1468	(269)
Total kg/year			882.7174	(272)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2579.0214	1.2200	3146.4062	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1812.6853	1.2200	2211.4761	(264)
Space and water heating			5357.8823	(265)
Pumps and fans	128.1053	3.0700	393.2832	(267)
Energy for lighting	363.7166	3.0700	1116.6101	(268)

Energy saving/generation technologies			
PV Unit	-618.7799	3.0700	-1899.6544 (269)
Primary energy kWh/year			4968.1211 (272)
Primary energy kWh/m2/year			63.7593 (273)

SAP 2012 EPC IMPROVEMENTS

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

(For testing purposes):

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

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.2	-£ 28	-180 kg (20.4%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£28	2.31 kg/m²	B 88	B 91
Total Savings	£28	2.31 kg/m²		

Potential energy efficiency rating: B 88
Potential environmental impact rating: B 91

Fuel prices for cost data on this page from database revision number 467 TEST (29 Oct 2020)
Recommendation texts revision number 4.9c (22 Feb 2014)

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

	Current	Potential	Saving
Electricity	£92	£101	-£9
Mains gas	£264	£227	£38
Space heating	£217	£217	£0
Water heating	£72	£43	£28
Lighting	£68	£68	£0
Generated (PV)	-£116	-£116	£0
Total cost of fuels	£240	£212	£29
Total cost of uses	£241	£212	£28
Delivered energy	55 kWh/m²	43 kWh/m²	12 kWh/m²
Carbon dioxide emissions	0.9 tonnes	0.7 tonnes	0.2 tonnes
CO2 emissions per m²	11 kg/m²	9 kg/m²	2 kg/m²
Primary energy	64 kWh/m²	51 kWh/m²	13 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	38.9600	(1b)	x 2.3900	(2b) =	93.1144	(1b) - (3b)
First floor	38.9600	(1c)	x 2.7600	(2c) =	107.5296	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	77.9200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		200.6440	(5)

2. Ventilation rate

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

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0.0000	/ (5) =	0.0000	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.2505	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.2505	(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	0.3194	0.3131	0.3069	0.2756	0.2693	0.2380	0.2380	0.2317	0.2505	0.2693	0.2818	0.2943	(22b)
Mechanical extract ventilation - decentralised													
If mechanical ventilation:												0.5000	(23a)
Effective ac	0.5694	0.5631	0.5569	0.5256	0.5193	0.5000	0.5000	0.5000	0.5005	0.5193	0.5318	0.5443	(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	
Solid Door			1.9800	1.3000	2.5740			(26)
Window (Uw = 1.40)			7.6900	1.3258	10.1951			(27)
French Door (Uw = 1.40)			3.1500	1.3258	4.1761			(27)
Ground Floor			38.9600	0.1300	5.0648	75.0000	2922.0000	(28a)
125mm Cavity	133.8000	12.8200	120.9800	0.2400	29.0352	60.0000	7258.8000	(29a)
400mm Mineral Wool	38.9600		38.9600	0.1100	4.2856	9.0000	350.6400	(30)
Total net area of external elements Aum(A, m2)			211.7200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		55.3308			(33)
Timber GF			51.8600			9.0000	466.7400	(32c)
Timber FF			99.8900			9.0000	899.0100	(32c)
Internal Floor			38.9600			18.0000	701.2800	(32d)
Internal Ceiling			38.9600			18.0000	701.2800	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	13299.7500 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		170.6847 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		7.8675 (36)
Total fabric heat loss	(33) + (36) =	63.1983 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	37.7006	37.2859	36.8713	34.7980	34.3833	33.1063	33.1063	33.1063	33.1394	34.3833	35.2126	36.0420	(38)
Heat transfer coeff	100.8989	100.4842	100.0696	97.9963	97.5816	96.3046	96.3046	96.3046	96.3377	97.5816	98.4109	99.2403	(39)
Average = Sum(39)m / 12 =												98.1262	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2949	1.2896	1.2843	1.2577	1.2523	1.2359	1.2359	1.2359	1.2364	1.2523	1.2630	1.2736	(40)
HLP (average)												1.2593	(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	2.4222	(42)
Average daily hot water use (litres/day)	91.7275	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	100.9002	97.2311	93.5620	89.8929	86.2238	82.5547	82.5547	86.2238	89.8929	93.5620	97.2311	100.9002	(44)
Energy conte	149.6321	130.8692	135.0453	117.7358	112.9703	97.4848	90.3340	103.6595	104.8976	122.2480	133.4432	144.9107	(45)
Energy content (annual)										Total = Sum(45)m =		1443.2304	(45)
Distribution loss (46)m = 0.15 x (45)m													
	22.4448	19.6304	20.2568	17.6604	16.9455	14.6227	13.5501	15.5489	15.7346	18.3372	20.0165	21.7366	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1157	12.7307	14.0598	13.5668	13.9903	13.5059	13.9355	13.9711	13.5391	14.0311	13.6242	14.1043	(61)
Total heat required for water heating calculated for each month													
	163.7478	143.5999	149.1051	131.3026	126.9606	110.9907	104.2695	117.6306	118.4367	136.2791	147.0674	159.0151	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1079.5246	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1813.6014	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.2566	(H8)
Utilisation factor												0.5488	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												91.7275	(H14)
Volume ratio Veff/V												0.8176	(H15)
Solar storage volume factor												0.9597	(H16)
Solar input												-839.8810	(H17)
Solar input	-24.3549	-40.6413	-69.2168	-92.7641	-114.6022	-112.6723	-111.1832	-97.1414	-76.0812	-51.9545	-28.8884	-20.3809	(63)
								Solar input (sum of months) = Sum(63)m =				-839.8810	(63)
Output from w/h													
	139.3929	102.9586	79.8883	38.5385	12.3584	0.0000	0.0000	20.4892	42.3555	84.3246	118.1790	138.6342	(64)
								Total per year (kWh/year) = Sum(64)m =				777.1193	(64)
Heat gains from water heating, kWh/month													
	53.2816	46.6967	48.4175	42.5388	41.0602	35.7902	33.5199	37.9596	38.2632	44.1552	47.7759	51.7089	(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	145.3326	145.3326	145.3326	145.3326	145.3326	145.3326	145.3326	145.3326	145.3326	145.3326	145.3326	145.3326	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	51.4879	45.7311	37.1910	28.1560	21.0469	17.7687	19.1997	24.9565	33.4966	42.5316	49.6406	52.9189	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	320.9530	324.2835	315.8907	298.0236	275.4696	254.2720	240.1107	236.7802	245.1730	263.0401	285.5941	306.7917	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	51.9555	51.9555	51.9555	51.9555	51.9555	51.9555	51.9555	51.9555	51.9555	51.9555	51.9555	51.9555	(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)													
	-96.8884	-96.8884	-96.8884	-96.8884	-96.8884	-96.8884	-96.8884	-96.8884	-96.8884	-96.8884	-96.8884	-96.8884	(71)
Water heating gains (Table 5)													
	71.6151	69.4891	65.0773	59.0817	55.1884	49.7086	45.0537	51.0209	53.1434	59.3484	66.3555	69.5012	(72)
Total internal gains													
	547.4555	542.9033	521.5587	488.6610	455.1046	425.1489	407.7637	416.1573	435.2125	468.3197	504.9898	532.6114	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	3.8200	10.6334	0.7200	0.7000	0.7700	14.1873	(74)
South	3.3600	46.7521	0.7200	0.7000	0.7700	54.8661	(78)
West	0.5100	19.6403	0.7200	0.7000	0.7700	3.4985	(80)
South	3.1500	46.7521	0.7200	0.7000	0.7700	51.4369	(78)

Solar gains	123.9888	208.0533	279.1103	341.0862	381.0215	378.6993	364.8612	334.4171	300.1641	228.1746	147.8694	106.5598	(83)
Total gains	671.4443	750.9566	800.6690	829.7472	836.1262	803.8482	772.6249	750.5745	735.3766	696.4944	652.8592	639.1712	(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	36.6146	36.7657	36.9181	37.6991	37.8593	38.3614	38.3614	38.3614	38.3482	37.8593	37.5403	37.2266	
alpha	3.4410	3.4510	3.4612	3.5133	3.5240	3.5574	3.5574	3.5574	3.5565	3.5240	3.5027	3.4818	
util living area													
	0.9742	0.9608	0.9384	0.8930	0.8097	0.6677	0.5172	0.5495	0.7395	0.8982	0.9594	0.9778	(86)
MIT	19.3980	19.6054	19.9100	20.3027	20.6382	20.8745	20.9619	20.9518	20.8095	20.3890	19.8388	19.3722	(87)
Th 2	19.8448	19.8490	19.8532	19.8742	19.8784	19.8914	19.8914	19.8914	19.8910	19.8784	19.8700	19.8616	(88)
util rest of house													
	0.9684	0.9521	0.9242	0.8668	0.7605	0.5815	0.3999	0.4334	0.6629	0.8682	0.9488	0.9728	(89)
MIT 2	17.7548	18.0551	18.4926	19.0563	19.5054	19.7941	19.8729	19.8661	19.7285	19.1871	18.4086	17.7285	(90)
Living area fraction									fLA = Living area / (4) =			0.2669	(91)
MIT	18.1935	18.4690	18.8710	19.3890	19.8078	20.0825	20.1636	20.1559	20.0171	19.5079	18.7904	18.1673	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.0435	18.3190	18.7210	19.2390	19.6578	19.9325	20.0136	20.0059	19.8671	19.3579	18.6404	18.0173	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9557	0.9365	0.9061	0.8489	0.7493	0.5850	0.4136	0.4462	0.6610	0.8510	0.9333	0.9613	(94)
Useful gains	641.7023	703.2959	725.4900	704.3777	626.5179	470.2578	319.5231	334.8699	486.1033	592.6911	609.3444	614.4367	(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	1386.6995	1348.3940	1222.9469	1013.1865	776.5347	513.5449	328.7468	347.2656	555.5864	854.6112	1135.6984	1371.2281	(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	554.2779	433.5059	370.1079	222.3424	111.6125	0.0000	0.0000	0.0000	0.0000	194.8685	378.9748	563.0528	(98)
Space heating												2828.7427	(98)
Space heating per m2											(98) / (4) =	36.3032	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3125.6825	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	554.2779	433.5059	370.1079	222.3424	111.6125	0.0000	0.0000	0.0000	0.0000	194.8685	378.9748	563.0528	(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)	612.4618	479.0121	408.9590	245.6822	123.3287	0.0000	0.0000	0.0000	0.0000	215.3244	418.7567	622.1577	(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	139.3929	102.9586	79.8883	38.5385	12.3584	0.0000	0.0000	20.4892	42.3555	84.3246	118.1790	138.6342	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8383	89.8678	89.9149	90.0126	90.1705	87.3000	87.3000	87.3000	87.3000	89.5090	89.7183	89.8493	(217)
Fuel for water heating, kWh/month	155.1599	114.5667	88.8489	42.8145	13.7056	0.0000	0.0000	23.4699	48.5172	94.2079	131.7224	154.2963	(219)
Water heating fuel used												867.3093	(219)
Annual totals kWh/year													
Space heating fuel - main system												3125.6825	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
(MEVDecentralised, Database: total watage = 8.0270, total flow = 37.0000, SFP = 0.2169)													
mechanical ventilation fans (SFP = 0.2169)												53.1053	(230a)
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												178.1053	(231)
Electricity for lighting (calculated in Appendix L)												363.7166	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 0.69 * 1068 * 1.00) =										-589.5749		-589.5749	(233)
Total delivered energy for all uses												3945.2388	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3125.6825	3.4800	108.7738	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	867.3093	3.4800	30.1824	(247)
Mechanical ventilation fans	53.1053	13.1900	7.0046	(249)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	363.7166	13.1900	47.9742	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-589.5749	13.1900	-77.7649	(252)
Total energy cost			252.6575	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):	0.4200	(256)
Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] =	0.8633	(257)
SAP value	87.9570	
SAP rating (Section 12)	88	(258)
SAP band	B	

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3125.6825	0.2160	675.1474	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	867.3093	0.2160	187.3388	(264)
Space and water heating			862.4862	(265)
Pumps and fans	178.1053	0.5190	92.4366	(267)
Energy for lighting	363.7166	0.5190	188.7689	(268)
Energy saving/generation technologies				
PV Unit	-589.5749	0.5190	-305.9894	(269)
Total kg/year			837.7024	(272)
CO2 emissions per m2			10.7500	(273)
EI value			90.8679	
EI rating			91	(274)
EI band			B	

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

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	38.9600 (1b)	x	2.3900 (2b)	=	93.1144	(1b) - (3b)
First floor	38.9600 (1c)	x	2.7600 (2c)	=	107.5296	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	77.9200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	200.6440	(5)

2. Ventilation rate

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

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0.0000	/ (5) =	0.0000	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.2505	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.2505	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.2630	0.2505	0.2505	0.2317	0.2317	0.2067	0.2129	0.2004	0.2067	0.2192	0.2192	0.2380	(22b)
Mechanical extract ventilation - decentralised													
If mechanical ventilation:												0.5000	(23a)
Effective ac	0.5130	0.5005	0.5005	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			1.9800	1.3000	2.5740			(26)
Window (Uw = 1.40)			7.6900	1.3258	10.1951			(27)
French Door (Uw = 1.40)			3.1500	1.3258	4.1761			(27)
Ground Floor			38.9600	0.1300	5.0648	75.0000	2922.0000	(28a)
125mm Cavity	133.8000	12.8200	120.9800	0.2400	29.0352	60.0000	7258.8000	(29a)
400mm Mineral Wool	38.9600		38.9600	0.1100	4.2856	9.0000	350.6400	(30)
Total net area of external elements Aum(A, m2)			211.7200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	55.3308			(33)
Timber GF			51.8600			9.0000	466.7400	(32c)
Timber FF			99.8900			9.0000	899.0100	(32c)
Internal Floor			38.9600			18.0000	701.2800	(32d)
Internal Ceiling			38.9600			18.0000	701.2800	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	13299.7500 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		170.6847 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		7.8675 (36)
Total fabric heat loss	(33) + (36) =	63.1983 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	33.9687	33.1394	33.1394	33.1063	33.1063	33.1063	33.1063	33.1063	33.1063	33.1063	33.1063	33.1063	(38)
Heat transfer coeff	97.1670	96.3377	96.3377	96.3046	96.3046	96.3046	96.3046	96.3046	96.3046	96.3046	96.3046	96.3046	(39)
Average = Sum(39)m / 12 =												96.3819	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2470	1.2364	1.2364	1.2359	1.2359	1.2359	1.2359	1.2359	1.2359	1.2359	1.2359	1.2359	(40)
HLP (average)												1.2369	(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	2.4222 (42)
Average daily hot water use (litres/day)	91.7275 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												

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

	100.9002	97.2311	93.5620	89.8929	86.2238	82.5547	82.5547	86.2238	89.8929	93.5620	97.2311	100.9002	(44)
Energy conte	149.6321	130.8692	135.0453	117.7358	112.9703	97.4848	90.3340	103.6595	104.8976	122.2480	133.4432	144.9107	(45)
Energy content (annual)										Total = Sum(45)m =		1443.2304	(45)
Distribution loss (46)m = 0.15 x (45)m													
	22.4448	19.6304	20.2568	17.6604	16.9455	14.6227	13.5501	15.5489	15.7346	18.3372	20.0165	21.7366	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1157	12.7307	14.0598	13.5668	13.9903	13.5059	13.9355	13.9711	13.5391	14.0311	13.6242	14.1043	(61)
Total heat required for water heating calculated for each month													
	163.7478	143.5999	149.1051	131.3026	126.9606	110.9907	104.2695	117.6306	118.4367	136.2791	147.0674	159.0151	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1140.0998	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1915.3676	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.3271	(H8)
Utilisation factor												0.5293	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												91.7275	(H14)
Volume ratio Veff/V												0.8176	(H15)
Solar storage volume factor												0.9597	(H16)
Solar input												-855.5105	(H17)
Solar input	-26.3322	-39.5772	-66.6531	-92.1349	-110.9614	-116.7821	-113.9779	-101.7830	-79.4420	-54.0429	-32.0075	-21.8164	(63)
										Solar input (sum of months) = Sum(63)m =		-855.5105	(63)
Output from w/h													
	137.4156	104.0227	82.4521	39.1677	15.9992	0.0000	0.0000	15.8476	38.9947	82.2362	115.0600	137.1987	(64)
										Total per year (kWh/year) = Sum(64)m =		768.3943	(64)
Heat gains from water heating, kWh/month													
	53.2816	46.6967	48.4175	42.5388	41.0602	35.7902	33.5199	37.9596	38.2632	44.1552	47.7759	51.7089	(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	145.3326	145.3326	145.3326	145.3326	145.3326	145.3326	145.3326	145.3326	145.3326	145.3326	145.3326	145.3326	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	51.4879	45.7311	37.1910	28.1560	21.0469	17.7687	19.1997	24.9565	33.4966	42.5316	49.6406	52.9189	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	320.9530	324.2835	315.8907	298.0236	275.4696	254.2720	240.1107	236.7802	245.1730	263.0401	285.5941	306.7917	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	51.9555	51.9555	51.9555	51.9555	51.9555	51.9555	51.9555	51.9555	51.9555	51.9555	51.9555	51.9555	(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)													
	-96.8884	-96.8884	-96.8884	-96.8884	-96.8884	-96.8884	-96.8884	-96.8884	-96.8884	-96.8884	-96.8884	-96.8884	(71)
Water heating gains (Table 5)													
	71.6151	69.4891	65.0773	59.0817	55.1884	49.7086	45.0537	51.0209	53.1434	59.3484	66.3555	69.5012	(72)
Total internal gains													
	547.4555	542.9033	521.5587	488.6610	455.1046	425.1489	407.7637	416.1573	435.2125	468.3197	504.9898	532.6114	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	3.8200	11.9814	0.7200	0.7000	0.7700	15.9859	(74)
South	3.3600	50.9848	0.7200	0.7000	0.7700	59.8334	(78)
West	0.5100	22.3313	0.7200	0.7000	0.7700	3.9778	(80)
South	3.1500	50.9848	0.7200	0.7000	0.7700	56.0938	(78)

Solar gains	135.8910	205.1210	272.4473	345.4011	378.5026	403.8691	384.3798	358.2066	318.2944	240.2892	165.9944	115.6959	(83)
Total gains	683.3465	748.0243	794.0060	834.0621	833.6073	829.0180	792.1435	774.3639	753.5069	708.6090	670.9843	648.3073	(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	38.0209	38.3482	38.3482	38.3614	38.3614	38.3614	38.3614	38.3614	38.3614	38.3614	38.3614	38.3614	
alpha	3.5347	3.5565	3.5565	3.5574	3.5574	3.5574	3.5574	3.5574	3.5574	3.5574	3.5574	3.5574	
util living area													
	0.9680	0.9546	0.9261	0.8658	0.7488	0.5424	0.3695	0.3888	0.6525	0.8648	0.9464	0.9723	(86)
MIT	19.6114	19.7874	20.0942	20.4534	20.7696	20.9497	20.9908	20.9888	20.8945	20.5392	20.0278	19.5804	(87)
Th 2	19.8826	19.8910	19.8910	19.8914	19.8914	19.8914	19.8914	19.8914	19.8914	19.8914	19.8914	19.8914	(88)
util rest of house													
	0.9607	0.9444	0.9087	0.8327	0.6845	0.4369	0.2409	0.2585	0.5565	0.8246	0.9322	0.9659	(89)
MIT 2	18.0873	18.3440	18.7791	19.2734	19.6766	19.8625	19.8892	19.8885	19.8164	19.3971	18.6919	18.0489	(90)
Living area fraction										fLA = Living area / (4) =		0.2669	(91)
MIT	18.4941	18.7293	19.1301	19.5884	19.9684	20.1527	20.1833	20.1822	20.1042	19.7020	19.0485	18.4577	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.3441	18.5793	18.9801	19.4384	19.8184	20.0027	20.0333	20.0322	19.9542	19.5520	18.8985	18.3077	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9469	0.9285	0.8908	0.8166	0.6798	0.4481	0.2578	0.2755	0.5624	0.8098	0.9156	0.9532	(94)
Useful gains	647.0849	694.5365	707.3011	681.1019	566.6680	371.5220	204.1882	213.3409	423.8050	573.8474	614.3321	617.9945	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	1286.8928	1250.3956	1115.6032	918.5931	656.6401	385.4776	205.4418	214.9720	457.8507	765.8092	1049.5775	1271.9651	(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	476.0171	373.5373	303.7767	170.9937	66.9392	0.0000	0.0000	0.0000	0.0000	142.8196	313.3767	486.5541	(98)
Space heating												2334.0144	(98)
Space heating per m2											(98) / (4) =	29.9540	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2579.0214	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	476.0171	373.5373	303.7767	170.9937	66.9392	0.0000	0.0000	0.0000	0.0000	142.8196	313.3767	486.5541	(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)	525.9857	412.7484	335.6649	188.9433	73.9660	0.0000	0.0000	0.0000	0.0000	157.8117	346.2726	537.6288	(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	137.4156	104.0227	82.4521	39.1677	15.9992	0.0000	0.0000	15.8476	38.9947	82.2362	115.0600	137.1987	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7629	89.7831	89.7973	89.8860	89.8646	87.3000	87.3000	87.3000	87.3000	89.3039	89.6178	89.7762	(217)
Fuel for water heating, kWh/month	153.0872	115.8599	91.8202	43.5748	17.8037	0.0000	0.0000	18.1531	44.6675	92.0858	128.3897	152.8230	(219)
Water heating fuel used												858.2648	(219)
Annual totals kWh/year													
Space heating fuel - main system												2579.0214	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
(MEVDecentralised, Database: total watage = 8.0270, total flow = 37.0000, SFP = 0.2169)													
mechanical ventilation fans (SFP = 0.2169)												53.1053	(230a)
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												178.1053	(231)
Electricity for lighting (calculated in Appendix L)												363.7166	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 0.69 * 1121 * 1.00) =										-618.7799		-618.7799	(233)
Total delivered energy for all uses												3360.3283	(238)

10a. Fuel costs - using BEDF prices (467)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2579.0214	3.9500	101.8713	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	858.2648	3.9500	33.9015	(247)
Mechanical ventilation fans	53.1053	18.7000	9.9307	(249)
Pumps and fans for heating	75.0000	18.7000	14.0250	(249)
Pump for solar water heating	50.0000	18.7000	9.3500	(249)
Energy for lighting	363.7166	18.7000	68.0150	(250)
Additional standing charges			91.0000	(251)
Energy saving/generation technologies				
PV Unit	-618.7799	18.7000	-115.7118	(252)
Total energy cost			212.3817	(255)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2579.0214	0.2160	557.0686	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	858.2648	0.2160	185.3852	(264)

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

Space and water heating			742.4538 (265)
Pumps and fans	178.1053	0.5190	92.4366 (267)
Energy for lighting	363.7166	0.5190	188.7689 (268)
Energy saving/generation technologies			
PV Unit	-618.7799	0.5190	-321.1468 (269)
Total kg/year			702.5126 (272)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Space heating - main system 1	2579.0214	1.2200	3146.4062 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	858.2648	1.2200	1047.0831 (264)
Space and water heating			4193.4893 (265)
Pumps and fans	178.1053	3.0700	546.7832 (267)
Energy for lighting	363.7166	3.0700	1116.6101 (268)
Energy saving/generation technologies			
PV Unit	-618.7799	3.0700	-1899.6544 (269)
Primary energy kWh/year			3957.2281 (272)
Primary energy kWh/m2/year			50.7858 (273)

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

Overheating Calculation Input Data

Dwelling type	Detached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	North
Overshading	Average or unknown
Thermal mass parameter	170.7 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	264.85 (P1)
Transmission heat loss coefficient	63.20 (37)
Summer heat loss coefficient	328.05 (P2)

Overhangs

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

Solar shading

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

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North	3.8200	81.1852	0.7200	0.7000	0.9000	126.6064
South	3.3600	112.2060	0.7200	0.7000	0.9000	153.9114
West	0.5100	117.5071	0.7200	0.7000	0.9000	24.4653
South	3.1500	112.2060	0.7200	0.7000	0.9000	144.2920
total:						449.2751

	Jun	Jul	Aug	
Solar gains	472	449	419	(P3)
Internal gains	422	405	413	
Total summer gains	894	854	832	(P5)
Summer gain/loss ratio	2.73	2.60	2.54	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 170.7)	0.81	0.81	0.81	
Threshold temperature	19.53	21.31	21.14	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight

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

AES Sustainability Consultants

Property Reference	4907-0026-4282-180	**Issued on Date**	16/02/2021
Assessment Reference	180	**Prop Type Ref**	Fletcher - Det (As)
Property	Plot 180, 5 Bed, K, U, WC, B, 2ES		

SAP Rating	88 B	**DER**	12.55	**TER**	15.54
Environmental	88 B	**% DER<TER**	19.22		
CO_2 Emissions (t/year)	1.69	**DFEE**	48.86	**TFEE**	56.33
General Requirements Compliance	Pass	**% DFEE<TFEE**	13.25		

Assessor Details	Mr. Silvio Junges, Silvio Junges, Tel: 01884 242050, silvio.junges@aessouthern.co.uk	**Assessor ID**	P637-0001
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 171 m²

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

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 15.54 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 12.55 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)56.3 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)48.9 kWh/m²/yrOK

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2 Fabric U-values

Element	Average	Highest	
External wall	0.23 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.13 (max. 0.25)	0.13 (max. 0.70)	OK
Roof	0.15 (max. 0.20)	0.25 (max. 0.35)	OK
Openings	1.40 (max. 2.00)	1.50 (max. 3.30)	OK

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

---
3 Air permeability
Air permeability at 50 pascals: 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 SYSTEM s18

Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

---
5 Cylinder insulation
Hot water storage: Measured cylinder loss: 1.48 kWh/day
Permitted by DBSCG 2.30 OK
Primary pipework insulated: Yes OK

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

Hot water controls: Cylinderstat OK
Independent timer for DHW OK

Boiler interlock: Yes OK

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

---
8 Mechanical ventilation
Continuous extract system (decentralised)
Specific fan power: 0.1900 0.1800 0.1600
Maximum: 0.7 OK

---
9 Summertime temperature
Overheating risk (Thames Valley): Slight OK
Based on:
Overshading: Average
Windows facing North: 10.63 m², No overhang
Windows facing East: 0.69 m², No overhang
Windows facing South: 8.99 m², No overhang
Windows facing West: 0.69 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

---
10 Key features
External wall U-value: 0.14 W/m²K
Party wall U-value: 0.00 W/m²K
Roof U-value: 0.11 W/m²K
Thermal bridging y-value: 0.039 W/m²K
Photovoltaic array: 1.04 kW

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	65.2700 (1b)	x	2.3800 (2b)	=	155.3426	(1b) - (3b)
First floor	64.0600 (1c)	x	2.6900 (2c)	=	172.3214	(1c) - (3c)
Second floor	41.8900 (1d)	x	2.4000 (2d)	=	100.5360	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	171.2200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	428.2000	(5)

2. Ventilation rate

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

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			0.0000 / (5) =	0.0000	(8)
Pressure test				Yes	
Measured/design AP50				5.0100	
Infiltration rate				0.2505	(18)
Number of sides sheltered				0	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.2505	(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	0.3194	0.3131	0.3069	0.2756	0.2693	0.2380	0.2380	0.2317	0.2505	0.2693	0.2818	0.2943	(22b)
Mechanical extract ventilation - decentralised													
If mechanical ventilation:												0.5000	(23a)
Effective ac	0.5694	0.5631	0.5569	0.5256	0.5193	0.5000	0.5000	0.5000	0.5005	0.5193	0.5318	0.5443	(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	
Solid Door			1.9800	1.3000	2.5740			(26)
Half Glaze			1.9800	1.5000	2.9700			(26a)
Window (Uw = 1.40)			17.8500	1.3258	23.6648			(27)
French Door (Uw = 1.40)			3.1500	1.3258	4.1761			(27)
Ground Floor			65.2700	0.1300	8.4851	75.0000	4895.2500	(28a)
125mm Cavity	193.4500	21.4800	171.9700	0.2400	41.2728	52.8000	9080.0160	(29a)
Wall to Void	28.5800		28.5800	0.1400	4.0012	9.0000	257.2200	(29a)
Dormer Cheek	13.5800	3.4800	10.1000	0.2500	2.5250	9.0000	90.9000	(29a)
400mm Mineral Wool	16.9100		16.9100	0.1100	1.8601	9.0000	152.1900	(30)
Sloping	21.5900		21.5900	0.2000	4.3180	9.0000	194.3100	(30)
Ceiling to Void	22.1700		22.1700	0.1400	3.1038	9.0000	199.5300	(30)
Bay Flat Roof	1.2100		1.2100	0.2500	0.3025	9.0000	10.8900	(30)
Total net area of external elements Aum(A, m2)			362.7600					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	99.2534			(33)
Timber GF			77.7200			9.0000	699.4800	(32c)
Timber 1F			144.8200			9.0000	1303.3800	(32c)
Timber 2F			57.5000			9.0000	517.5000	(32c)
Masonry GF			42.4900			39.0000	1657.1100	(32c)
Internal Floor			64.0600			18.0000	1153.0800	(32d)
Internal Floor			41.8900			18.0000	754.0200	(32d)
Internal Ceiling			64.0600			18.0000	1153.0800	(32e)
Internal Ceiling			41.8900			18.0000	754.0200	(32e)
Heat capacity Cm = Sum(A x k)				(28)...(30) + (32) + (32a)...(32e) =			22871.9760	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							133.5824	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							14.3174	(36)
Total fabric heat loss					(33) + (36) =		113.5708	(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	80.4579	79.5729	78.6880	74.2634	73.3784	70.6530	70.6530	70.6530	70.7237	73.3784	75.1483	76.9182	(38)
Heat transfer coeff	194.0287	193.1437	192.2588	187.8342	186.9492	184.2238	184.2238	184.2238	184.2944	186.9492	188.7191	190.4889	(39)
Average = Sum(39)m / 12 =												188.1115	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1332	1.1280	1.1229	1.0970	1.0919	1.0759	1.0759	1.0759	1.0764	1.0919	1.1022	1.1125	(40)
HLP (average)												1.0987	(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												2.9642	(42)
Average daily hot water use (litres/day)												104.5998	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	115.0598	110.8758	106.6918	102.5078	98.3239	94.1399	94.1399	98.3239	102.5078	106.6918	110.8758	115.0598	(44)
Energy conte	170.6304	149.2344	153.9966	134.2579	128.8237	111.1651	103.0108	118.2064	119.6181	139.4034	152.1697	165.2464	(45)
Energy content (annual)										Total = Sum(45)m =		1645.7628	(45)
Distribution loss (46)m = 0.15 x (45)m													
	25.5946	22.3852	23.0995	20.1387	19.3236	16.6748	15.4516	17.7310	17.9427	20.9105	22.8255	24.7870	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.4800	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.7992	(55)
Total storage loss													
	24.7752	22.3776	24.7752	23.9760	24.7752	23.9760	24.7752	24.7752	23.9760	24.7752	23.9760	24.7752	(56)
If cylinder contains dedicated solar storage													
	24.7752	22.3776	24.7752	23.9760	24.7752	23.9760	24.7752	24.7752	23.9760	24.7752	23.9760	24.7752	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	218.6680	192.6232	202.0342	180.7459	176.8613	157.6531	151.0484	166.2440	166.1061	187.4410	198.6577	213.2840	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	218.6680	192.6232	202.0342	180.7459	176.8613	157.6531	151.0484	166.2440	166.1061	187.4410	198.6577	213.2840	(64)
								Total per year (kWh/year) = Sum(64)m =				2211.3668	(64)
Heat gains from water heating, kWh/month													
	95.1647	84.3315	89.6339	81.8312	81.2640	74.1528	72.6812	77.7337	76.9634	84.7817	87.7868	93.3745	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	148.2102	148.2102	148.2102	148.2102	148.2102	148.2102	148.2102	148.2102	148.2102	148.2102	148.2102	148.2102	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	33.7569	29.9826	24.3835	18.4599	13.7990	11.6497	12.5879	16.3622	21.9613	27.8849	32.5458	34.6951	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	342.7919	346.3490	337.3852	318.3023	294.2137	271.5737	256.4488	252.8917	261.8555	280.9383	305.0270	327.6670	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.8210	37.8210	37.8210	37.8210	37.8210	37.8210	37.8210	37.8210	37.8210	37.8210	37.8210	37.8210	(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)													
	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	(71)
Water heating gains (Table 5)													
	127.9095	125.4933	120.4757	113.6544	109.2258	102.9900	97.6897	104.4808	106.8936	113.9539	121.9261	125.5034	(72)
Total internal gains													
	574.9214	572.2879	552.7075	520.8797	487.7014	456.6764	437.1895	444.1977	461.1735	493.2402	529.9621	558.3286	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	10.6300	10.6334	0.7200	0.7000	0.7700	39.4792	(74)
East	0.6900	19.6403	0.7200	0.7000	0.7700	4.7333	(76)
South	5.8400	46.7521	0.7200	0.7000	0.7700	95.3625	(78)
West	0.6900	19.6403	0.7200	0.7000	0.7700	4.7333	(80)
South	3.1500	46.7521	0.7200	0.7000	0.7700	51.4369	(78)

Solar gains	195.7452	334.3850	464.9519	596.5360	692.6018	699.8826	669.5336	594.9650	509.5271	371.0985	234.5137	167.5448	(83)
Total gains	770.6665	906.6729	1017.6594	1117.4157	1180.3033	1156.5590	1106.7231	1039.1627	970.7006	864.3387	764.4758	725.8734	(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	32.7443	32.8943	33.0457	33.8241	33.9842	34.4870	34.4870	34.4870	34.4738	33.9842	33.6655	33.3527	
alpha	3.1830	3.1930	3.2030	3.2549	3.2656	3.2991	3.2991	3.2991	3.2983	3.2656	3.2444	3.2235	
util living area													
	0.9921	0.9861	0.9745	0.9470	0.8879	0.7747	0.6373	0.6840	0.8586	0.9594	0.9870	0.9935	(86)
MIT	18.8405	19.0645	19.4286	19.9293	20.3902	20.7490	20.9067	20.8788	20.6114	20.0156	19.3552	18.8245	(87)
Th 2	19.9738	19.9780	19.9822	20.0033	20.0075	20.0205	20.0205	20.0205	20.0202	20.0075	19.9990	19.9906	(88)
util rest of house													
	0.9905	0.9833	0.9690	0.9345	0.8580	0.7082	0.5274	0.5793	0.8100	0.9475	0.9839	0.9922	(89)
MIT 2	17.0637	17.3925	17.9242	18.6587	19.3088	19.7874	19.9602	19.9361	19.6243	18.7923	17.8304	17.0502	(90)
Living area fraction									fLA = Living area / (4) =			0.1121	(91)
MIT	17.2629	17.5800	18.0929	18.8012	19.4300	19.8952	20.0663	20.0418	19.7350	18.9294	18.0014	17.2492	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.1129	17.4300	17.9429	18.6512	19.2800	19.7452	19.9163	19.8918	19.5850	18.7794	17.8514	17.0992	(93)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9833	0.9723	0.9527	0.9111	0.8302	0.6861	0.5143	0.5635	0.7826	0.9260	0.9733	0.9861	(94)
Useful gains	757.7849	881.5942	969.4845	1018.0592	979.8469	793.5680	569.1520	585.5709	759.7186	800.4087	744.0765	715.7752	(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	2486.0702	2420.0817	2200.0033	1831.6103	1417.0802	947.8669	610.9446	643.2762	1010.8525	1529.1390	2028.9966	2457.1490	(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	1285.8442	1033.8636	915.5060	585.7568	325.3016	0.0000	0.0000	0.0000	0.0000	542.1754	925.1425	1295.5821	(98)
Space heating												6909.1721	(98)
Space heating per m2											(98) / (4) =	40.3526	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.6000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	7626.0178	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1285.8442	1033.8636	915.5060	585.7568	325.3016	0.0000	0.0000	0.0000	0.0000	542.1754	925.1425	1295.5821	(98)
Space heating efficiency (main heating system 1)	90.6000	90.6000	90.6000	90.6000	90.6000	0.0000	0.0000	0.0000	0.0000	90.6000	90.6000	90.6000	(210)
Space heating fuel (main heating system)	1419.2541	1141.1298	1010.4922	646.5307	359.0525	0.0000	0.0000	0.0000	0.0000	598.4276	1021.1286	1430.0023	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	218.6680	192.6232	202.0342	180.7459	176.8613	157.6531	151.0484	166.2440	166.1061	187.4410	198.6577	213.2840	(64)
Efficiency of water heater												79.9000	(216)
(217)m	88.8703	88.7337	88.4584	87.8266	86.5193	79.9000	79.9000	79.9000	79.9000	87.5867	88.5048	88.9168	(217)
Fuel for water heating, kWh/month	246.0531	217.0800	228.3946	205.7987	204.4184	197.3130	189.0468	208.0650	207.8925	214.0063	224.4597	239.8691	(219)
Water heating fuel used												2582.3972	(219)
Annual totals kWh/year													
Space heating fuel - main system												7626.0178	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
(MEVDecentralised, Database: total watage = 10.9710, total flow = 53.0000, SFP = 0.2070)													
mechanical ventilation fans (SFP = 0.2070)												108.1376	(230a)
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												183.1376	(231)
Electricity for lighting (calculated in Appendix L)												596.1578	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.04 * 1068 * 1.00) =										-888.6346		-888.6346	(233)
Total delivered energy for all uses												10099.0758	(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	7626.0178	0.2160	1647.2198	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2582.3972	0.2160	557.7978	(264)
Space and water heating			2205.0176	(265)
Pumps and fans	183.1376	0.5190	95.0484	(267)
Energy for lighting	596.1578	0.5190	309.4059	(268)
Energy saving/generation technologies				
PV Unit	-888.6346	0.5190	-461.2014	(269)
Total CO2, kg/year			2148.2706	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			12.5500	(273)

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

DER		12.5500	ZC1
Total Floor Area	TFA	171.2200	
Assumed number of occupants	N	2.9642	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		11.8638	ZC2
CO2 emissions from cooking, equation (L16)		1.1105	ZC3
Total CO2 emissions		25.5243	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		25.5243	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	65.2700 (1b)	x	2.3800 (2b)	=	155.3426 (1b) - (3b)	
First floor	64.0600 (1c)	x	2.6900 (2c)	=	172.3214 (1c) - (3c)	
Second floor	41.8900 (1d)	x	2.4000 (2d)	=	100.5360 (1d) - (3d)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	171.2200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	428.2000	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							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) =	0.0934	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.3434	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3434	(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	0.4379	0.4293	0.4207	0.3778	0.3692	0.3262	0.3262	0.3177	0.3434	0.3692	0.3863	0.4035	(22b)
Effective ac	0.5959	0.5921	0.5885	0.5713	0.5681	0.5532	0.5532	0.5505	0.5590	0.5681	0.5746	0.5814	(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			1.9800	1.0000	1.9800			(26)
TER Semi-glazed door			1.9800	1.2000	2.3760			(26a)
TER Opening Type (Uw = 1.40)			21.0000	1.3258	27.8409			(27)
Ground Floor			65.2700	0.1300	8.4851			(28a)
125mm Cavity	193.4500	21.4800	171.9700	0.1800	30.9546			(29a)
Wall to Void	28.5800		28.5800	0.1800	5.1444			(29a)
Dormer Cheek	13.5800	3.4800	10.1000	0.1800	1.8180			(29a)
400mm Mineral Wool	16.9100		16.9100	0.1300	2.1983			(30)
Sloping	21.5900		21.5900	0.1300	2.8067			(30)
Ceiling to Void	22.1700		22.1700	0.1300	2.8821			(30)
Bay Flat Roof	1.2100		1.2100	0.1300	0.1573			(30)
Total net area of external elements Aum(A, m2)			362.7600					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		86.6434			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		16.0444	(36)
Total fabric heat loss	(33) + (36) =	102.6878	(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	84.1983	83.6723	83.1567	80.7351	80.2821	78.1729	78.1729	77.7824	78.9853	80.2821	81.1986	82.1568	(38)
Heat transfer coeff	186.8861	186.3601	185.8445	183.4229	182.9699	180.8608	180.8608	180.4702	181.6732	182.9699	183.8864	184.8447	(39)
Average = Sum(39)m / 12 =												183.4208	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0915	1.0884	1.0854	1.0713	1.0686	1.0563	1.0563	1.0540	1.0611	1.0686	1.0740	1.0796	(40)
HLP (average)												1.0713	(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	2.9642	(42)
Average daily hot water use (litres/day)	104.5998	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	115.0598	110.8758	106.6918	102.5078	98.3239	94.1399	94.1399	98.3239	102.5078	106.6918	110.8758	115.0598	(44)
Energy conte	170.6304	149.2344	153.9966	134.2579	128.8237	111.1651	103.0108	118.2064	119.6181	139.4034	152.1697	165.2464	(45)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Energy content (annual)											Total = Sum(45)m =	1645.7628	(45)
Distribution loss (46)m = 0.15 x (45)m													
	25.5946	22.3852	23.0995	20.1387	19.3236	16.6748	15.4516	17.7310	17.9427	20.9105	22.8255	24.7870	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.7016	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.9188	(55)
Total storage loss													
	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(56)
If cylinder contains dedicated solar storage													
	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	222.3770	195.9733	205.7432	184.3353	180.5703	161.2424	154.7574	169.9529	169.6955	191.1500	202.2470	216.9930	(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													
	222.3770	195.9733	205.7432	184.3353	180.5703	161.2424	154.7574	169.9529	169.6955	191.1500	202.2470	216.9930	(64)
									Total per year (kWh/year) = Sum(64)m =			2255.0372	(64)
Heat gains from water heating, kWh/month													
	98.1319	87.0115	92.6011	84.7026	84.2312	77.0243	75.6484	80.7009	79.8349	87.7489	90.6583	96.3417	(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	148.2102	148.2102	148.2102	148.2102	148.2102	148.2102	148.2102	148.2102	148.2102	148.2102	148.2102	148.2102	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	33.7569	29.9826	24.3835	18.4599	13.7990	11.6497	12.5879	16.3622	21.9613	27.8849	32.5458	34.6951	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	342.7919	346.3490	337.3852	318.3023	294.2137	271.5737	256.4488	252.8917	261.8555	280.9383	305.0270	327.6670	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.8210	37.8210	37.8210	37.8210	37.8210	37.8210	37.8210	37.8210	37.8210	37.8210	37.8210	37.8210	(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)													
	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	(71)
Water heating gains (Table 5)													
	131.8977	129.4815	124.4639	117.6426	113.2139	106.9781	101.6779	108.4689	110.8818	117.9421	125.9143	129.4915	(72)
Total internal gains													
	578.9096	576.2761	556.6956	524.8678	491.6896	460.6646	441.1776	448.1859	465.1617	497.2284	533.9502	562.3167	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	10.6300	10.6334	0.6300	0.7000	0.7700	34.5443	(74)
East	0.6900	19.6403	0.6300	0.7000	0.7700	4.1416	(76)
South	8.9900	46.7521	0.6300	0.7000	0.7700	128.4495	(78)
West	0.6900	19.6403	0.6300	0.7000	0.7700	4.1416	(80)

Solar gains	171.2770	292.5868	406.8329	521.9690	606.0266	612.3973	585.8419	520.5944	445.8362	324.7112	205.1995	146.6017	(83)
Total gains	750.1866	868.8629	963.5285	1046.8369	1097.7162	1073.0618	1027.0195	968.7803	910.9979	821.9396	739.1497	708.9185	(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	63.6231	63.8027	63.9797	64.8244	64.9849	65.7427	65.7427	65.8850	65.4487	64.9849	64.6610	64.3258	
alpha	5.2415	5.2535	5.2653	5.3216	5.3323	5.3828	5.3828	5.3923	5.3632	5.3323	5.3107	5.2884	
util living area													
	0.9996	0.9989	0.9971	0.9902	0.9634	0.8734	0.7199	0.7719	0.9432	0.9935	0.9990	0.9997	(86)
MIT	19.6854	19.8171	20.0376	20.3418	20.6414	20.8771	20.9685	20.9540	20.7802	20.3952	19.9890	19.6683	(87)
Th 2	20.0078	20.0103	20.0128	20.0244	20.0265	20.0367	20.0367	20.0386	20.0328	20.0265	20.0221	20.0175	(88)
util rest of house													
	0.9994	0.9986	0.9960	0.9858	0.9443	0.8043	0.5885	0.6486	0.9044	0.9899	0.9986	0.9996	(89)
MIT 2	18.2328	18.4273	18.7514	19.2024	19.6295	19.9384	20.0227	20.0154	19.8254	19.2835	18.6877	18.2148	(90)
Living area fraction										fLA = Living area / (4) =		0.1121	(91)
MIT	18.3957	18.5831	18.8956	19.3302	19.7430	20.0437	20.1287	20.1206	19.9325	19.4082	18.8336	18.3778	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.3957	18.5831	18.8956	19.3302	19.7430	20.0437	20.1287	20.1206	19.9325	19.4082	18.8336	18.3778	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9990	0.9977	0.9941	0.9813	0.9369	0.8049	0.6023	0.6605	0.8990	0.9863	0.9978	0.9993	(94)
Useful gains	749.4443	866.8582	957.8107	1027.2503	1028.4678	863.6870	618.6071	639.8862	819.0246	810.6708	737.5043	708.4046	(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													
	2634.2948	2549.9912	2303.6633	1913.1324	1471.6228	984.5445	638.2091	671.4638	1059.6049	1611.6301	2157.6490	2620.6912	(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													
	1402.3288	1131.0654	1001.3143	637.8351	329.7073	0.0000	0.0000	0.0000	0.0000	595.9137	1022.5042	1422.7413	(98)
Space heating												7543.4100	(98)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Space heating per m2 (98) / (4) = 44.0568 (99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												8067.8182	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1402.3288	1131.0654	1001.3143	637.8351	329.7073	0.0000	0.0000	0.0000	0.0000	595.9137	1022.5042	1422.7413	(98)
Space heating efficiency (main heating system 1)													
	93.5000	93.5000	93.5000	93.5000	93.5000	0.0000	0.0000	0.0000	0.0000	93.5000	93.5000	93.5000	(210)
Space heating fuel (main heating system)													
	1499.8169	1209.6956	1070.9244	682.1766	352.6282	0.0000	0.0000	0.0000	0.0000	637.3408	1093.5873	1521.6484	(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													
	222.3770	195.9733	205.7432	184.3353	180.5703	161.2424	154.7574	169.9529	169.6955	191.1500	202.2470	216.9930	(64)
Efficiency of water heater												79.8000	(216)
(217)m	88.8690	88.7428	88.4779	87.8587	86.4004	79.8000	79.8000	79.8000	79.8000	87.6459	88.5396	88.9222	(217)
Fuel for water heating, kWh/month													
	250.2300	220.8330	232.5363	209.8087	208.9923	202.0581	193.9315	212.9736	212.6510	218.0936	228.4256	244.0258	(219)
Water heating fuel used												2634.5596	(219)
Annual totals kWh/year													
Space heating fuel - main system												8067.8182	(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)												596.1578	(232)
Total delivered energy for all uses												11373.5356	(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	8067.8182	0.2160	1742.6487	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2634.5596	0.2160	569.0649	(264)
Space and water heating			2311.7136	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	596.1578	0.5190	309.4059	(268)
Total CO2, kg/m2/year			2660.0445	(272)
Emissions per m2 for space and water heating			13.5014	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			1.8071	(272b)
Emissions per m2 for pumps and fans			0.2273	(272c)
Target Carbon Dioxide Emission Rate (TER) = (13.5014 * 1.00) + 1.8071 + 0.2273, rounded to 2 d.p.			15.5400	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	65.2700 (1b)	x	2.3800 (2b)	=	155.3426	(1b) - (3b)
First floor	64.0600 (1c)	x	2.6900 (2c)	=	172.3214	(1c) - (3c)
Second floor	41.8900 (1d)	x	2.4000 (2d)	=	100.5360	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	171.2200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	428.2000	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							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) =	0.0934	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3439	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3439	(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	0.4385	0.4299	0.4213	0.3783	0.3697	0.3267	0.3267	0.3181	0.3439	0.3697	0.3869	0.4041	(22b)
Effective ac	0.5961	0.5924	0.5887	0.5716	0.5683	0.5534	0.5534	0.5506	0.5591	0.5683	0.5748	0.5816	(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	
Solid Door			1.9800	1.3000	2.5740			(26)
Half Glaze			1.9800	1.5000	2.9700			(26a)
Window (Uw = 1.40)			17.8500	1.3258	23.6648			(27)
French Door (Uw = 1.40)			3.1500	1.3258	4.1761			(27)
Ground Floor			65.2700	0.1300	8.4851	75.0000	4895.2500	(28a)
125mm Cavity	193.4500	21.4800	171.9700	0.2400	41.2728	52.8000	9080.0160	(29a)
Wall to Void	28.5800		28.5800	0.1400	4.0012	9.0000	257.2200	(29a)
Dormer Cheek	13.5800	3.4800	10.1000	0.2500	2.5250	9.0000	90.9000	(29a)
400mm Mineral Wool	16.9100		16.9100	0.1100	1.8601	9.0000	152.1900	(30)
Sloping	21.5900		21.5900	0.2000	4.3180	9.0000	194.3100	(30)
Ceiling to Void	22.1700		22.1700	0.1400	3.1038	9.0000	199.5300	(30)
Bay Flat Roof	1.2100		1.2100	0.2500	0.3025	9.0000	10.8900	(30)
Total net area of external elements Aum(A, m2)			362.7600					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	99.2534			(33)
Timber GF			77.7200			9.0000	699.4800	(32c)
Timber 1F			144.8200			9.0000	1303.3800	(32c)
Timber 2F			57.5000			9.0000	517.5000	(32c)
Masonry GF			42.4900			39.0000	1657.1100	(32c)
Internal Floor			64.0600			18.0000	1153.0800	(32d)
Internal Floor			41.8900			18.0000	754.0200	(32d)
Internal Ceiling			64.0600			9.0000	576.5400	(32e)
Internal Ceiling			41.8900			9.0000	377.0100	(32e)
Heat capacity Cm = Sum(A x k)				(28)...(30) + (32) + (32a)...(32e) =			21918.4260	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							128.0132	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							14.3174	(36)
Total fabric heat loss					(33) + (36) =		113.5708	(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	84.2377	83.7102	83.1932	80.7645	80.3101	78.1949	78.1949	77.8031	79.0096	80.3101	81.2294	82.1904	(38)
Heat transfer coeff	197.8085	197.2810	196.7640	194.3353	193.8809	191.7656	191.7656	191.3739	192.5804	193.8809	194.8001	195.7612	(39)
Average = Sum(39)m / 12 =												194.3331	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1553	1.1522	1.1492	1.1350	1.1323	1.1200	1.1200	1.1177	1.1248	1.1323	1.1377	1.1433	(40)
HLP (average)												1.1350	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.9642	(42)
Average daily hot water use (litres/day)												104.5998	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	115.0598	110.8758	106.6918	102.5078	98.3239	94.1399	94.1399	98.3239	102.5078	106.6918	110.8758	115.0598	(44)
Energy conte	170.6304	149.2344	153.9966	134.2579	128.8237	111.1651	103.0108	118.2064	119.6181	139.4034	152.1697	165.2464	(45)
Energy content (annual)										Total = Sum(45)m =		1645.7628	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month	36.2590	31.7123	32.7243	28.5298	27.3750	23.6226	21.8898	25.1189	25.4188	29.6232	32.3361	35.1149	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	148.2102	148.2102	148.2102	148.2102	148.2102	148.2102	148.2102	148.2102	148.2102	148.2102	148.2102	148.2102	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	33.7569	29.9826	24.3835	18.4599	13.7990	11.6497	12.5879	16.3622	21.9613	27.8849	32.5458	34.6951	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	342.7919	346.3490	337.3852	318.3023	294.2137	271.5737	256.4488	252.8917	261.8555	280.9383	305.0270	327.6670	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.8210	37.8210	37.8210	37.8210	37.8210	37.8210	37.8210	37.8210	37.8210	37.8210	37.8210	37.8210	(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)	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	(71)
Water heating gains (Table 5)	48.7352	47.1909	43.9842	39.6247	36.7944	32.8091	29.4218	33.7619	35.3040	39.8162	44.9112	47.1974	(72)
Total internal gains	492.7470	490.9856	473.2160	443.8500	412.2701	383.4956	365.9215	370.4789	386.5838	416.1025	449.9471	477.0226	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	10.6300	10.6334	0.7200	0.7000	0.7700	39.4792	(74)
East	0.6900	19.6403	0.7200	0.7000	0.7700	4.7333	(76)
South	5.8400	46.7521	0.7200	0.7000	0.7700	95.3625	(78)
West	0.6900	19.6403	0.7200	0.7000	0.7700	4.7333	(80)
South	3.1500	46.7521	0.7200	0.7000	0.7700	51.4369	(78)

Solar gains	195.7452	334.3850	464.9519	596.5360	692.6018	699.8826	669.5336	594.9650	509.5271	371.0985	234.5137	167.5448	(83)
Total gains	688.4922	825.3706	938.1679	1040.3860	1104.8719	1083.3782	1035.4551	965.4438	896.1109	787.2010	684.4608	644.5674	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	30.7795	30.8618	30.9429	31.3296	31.4030	31.7494	31.7494	31.8144	31.6151	31.4030	31.2549	31.1014	
alpha	3.0520	3.0575	3.0629	3.0886	3.0935	3.1166	3.1166	3.1210	3.1077	3.0935	3.0837	3.0734	
util living area	0.9934	0.9879	0.9775	0.9534	0.9016	0.8020	0.6749	0.7213	0.8806	0.9661	0.9892	0.9946	(86)
MIT	18.6646	18.8933	19.2708	19.7806	20.2757	20.6771	20.8694	20.8342	20.5145	19.8726	19.1801	18.6310	(87)
Th 2	19.9559	19.9584	19.9609	19.9723	19.9745	19.9845	19.9845	19.9864	19.9807	19.9745	19.9701	19.9656	(88)
util rest of house	0.9921	0.9855	0.9727	0.9423	0.8745	0.7386	0.5629	0.6171	0.8368	0.9560	0.9867	0.9936	(89)
MIT 2	17.8038	18.0333	18.4103	18.9217	19.4018	19.7752	19.9249	19.9047	19.6364	19.0185	18.3285	17.7772	(90)
Living area fraction									fLA = Living area / (4) =			0.1121	(91)
MIT	17.9004	18.1297	18.5068	19.0180	19.4998	19.8763	20.0308	20.0089	19.7349	19.1143	18.4240	17.8729	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.9004	18.1297	18.5068	19.0180	19.4998	19.8763	20.0308	20.0089	19.7349	19.1143	18.4240	17.8729	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9883	0.9796	0.9635	0.9288	0.8589	0.7306	0.5687	0.6197	0.8235	0.9444	0.9812	0.9904	(94)
Useful gains	680.4605	808.5069	903.9427	966.3100	949.0271	791.5405	588.8804	598.3236	737.9413	743.4187	671.5650	638.3934	(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	2690.2673	2609.9720	2362.4978	1966.2814	1512.2280	1011.8141	657.9177	690.6548	1085.1620	1650.7566	2205.9088	2676.6316	(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	1495.2963	1210.5846	1085.1650	719.9794	419.0215	0.0000	0.0000	0.0000	0.0000	675.0594	1104.7276	1516.4493	(98)
Space heating												8226.2831	(98)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Space heating per m2 (98) / (4) = 48.0451 (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	1802.5971	1419.0658	1454.4419	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.6548	0.7353	0.7014	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1180.2674	1043.4810	1020.1253	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1400.3453	1341.2561	1262.5648	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	158.4561	221.5447	180.3750	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												560.3758	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	39.6140	55.3862	45.0938	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												140.0939	(107)
Space cooling per m2												0.8182	(108)
Energy for space heating												48.0451	(99)
Energy for space cooling												0.8182	(108)
Total												48.8633	(109)
Dwelling Fabric Energy Efficiency (DFEE)												48.9	(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	65.2700 (1b)	x	2.3800 (2b)	=	155.3426	(1b) - (3b)
First floor	64.0600 (1c)	x	2.6900 (2c)	=	172.3214	(1c) - (3c)
Second floor	41.8900 (1d)	x	2.4000 (2d)	=	100.5360	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	171.2200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	428.2000	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							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) =	0.0934	(8)
Pressure test				Yes	
Measured/design AP50				5.0000	
Infiltration rate				0.3434	(18)
Number of sides sheltered				0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =			1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =			0.3434	(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	0.4379	0.4293	0.4207	0.3778	0.3692	0.3262	0.3262	0.3177	0.3434	0.3692	0.3863	0.4035	(22b)
Effective ac	0.5959	0.5921	0.5885	0.5713	0.5681	0.5532	0.5532	0.5505	0.5590	0.5681	0.5746	0.5814	(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			1.9800	1.0000	1.9800			(26)
TER Semi-glazed door			1.9800	1.2000	2.3760			(26a)
TER Opening Type (Uw = 1.40)			21.0000	1.3258	27.8409			(27)
Ground Floor			65.2700	0.1300	8.4851			(28a)
125mm Cavity	193.4500	21.4800	171.9700	0.1800	30.9546			(29a)
Wall to Void	28.5800		28.5800	0.1800	5.1444			(29a)
Dormer Cheek	13.5800	3.4800	10.1000	0.1800	1.8180			(29a)
400mm Mineral Wool	16.9100		16.9100	0.1300	2.1983			(30)
Sloping	21.5900		21.5900	0.1300	2.8067			(30)
Ceiling to Void	22.1700		22.1700	0.1300	2.8821			(30)
Bay Flat Roof	1.2100		1.2100	0.1300	0.1573			(30)
Total net area of external elements Aum(A, m2)			362.7600					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		86.6434			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		16.0444	(36)
Total fabric heat loss	(33) + (36) =	102.6878	(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	84.1983	83.6723	83.1567	80.7351	80.2821	78.1729	78.1729	77.7824	78.9853	80.2821	81.1986	82.1568	(38)
Heat transfer coeff	186.8861	186.3601	185.8445	183.4229	182.9699	180.8608	180.8608	180.4702	181.6732	182.9699	183.8864	184.8447	(39)
Average = Sum(39)m / 12 =												183.4208	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0915	1.0884	1.0854	1.0713	1.0686	1.0563	1.0563	1.0540	1.0611	1.0686	1.0740	1.0796	(40)
HLP (average)												1.0713	(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	2.9642	(42)
Average daily hot water use (litres/day)	104.5998	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	115.0598	110.8758	106.6918	102.5078	98.3239	94.1399	94.1399	98.3239	102.5078	106.6918	110.8758	115.0598	(44)
Energy conte	170.6304	149.2344	153.9966	134.2579	128.8237	111.1651	103.0108	118.2064	119.6181	139.4034	152.1697	165.2464	(45)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy content (annual)											Total = Sum(45)m =	1645.7628	(45)
Distribution loss (46)m = 0.15 x (45)m													
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)	
Water storage loss:													
Total storage loss													
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)	
If cylinder contains dedicated solar storage													
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)	
Primary loss 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)	
Heat gains from water heating, kWh/month													
36.2590	31.7123	32.7243	28.5298	27.3750	23.6226	21.8898	25.1189	25.4188	29.6232	32.3361	35.1149	(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	148.2102	148.2102	148.2102	148.2102	148.2102	148.2102	148.2102	148.2102	148.2102	148.2102	148.2102	148.2102	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	33.7569	29.9826	24.3835	18.4599	13.7990	11.6497	12.5879	16.3622	21.9613	27.8849	32.5458	34.6951	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	342.7919	346.3490	337.3852	318.3023	294.2137	271.5737	256.4488	252.8917	261.8555	280.9383	305.0270	327.6670	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.8210	37.8210	37.8210	37.8210	37.8210	37.8210	37.8210	37.8210	37.8210	37.8210	37.8210	37.8210	(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)													
	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	(71)
Water heating gains (Table 5)													
	48.7352	47.1909	43.9842	39.6247	36.7944	32.8091	29.4218	33.7619	35.3040	39.8162	44.9112	47.1974	(72)
Total internal gains													
	492.7470	490.9856	473.2160	443.8500	412.2701	383.4956	365.9215	370.4789	386.5838	416.1025	449.9471	477.0226	(73)

---

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	10.6300	10.6334	0.6300	0.7000	0.7700	34.5443	(74)
East	0.6900	19.6403	0.6300	0.7000	0.7700	4.1416	(76)
South	8.9900	46.7521	0.6300	0.7000	0.7700	128.4495	(78)
West	0.6900	19.6403	0.6300	0.7000	0.7700	4.1416	(80)

Solar gains	171.2770	292.5868	406.8329	521.9690	606.0266	612.3973	585.8419	520.5944	445.8362	324.7112	205.1995	146.6017	(83)
Total gains	664.0240	783.5724	880.0489	965.8190	1018.2967	995.8928	951.7634	891.0732	832.4200	740.8137	655.1466	623.6243	(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	63.6231	63.8027	63.9797	64.8244	64.9849	65.7427	65.7427	65.8850	65.4487	64.9849	64.6610	64.3258	
alpha	5.2415	5.2535	5.2653	5.3216	5.3323	5.3828	5.3828	5.3923	5.3632	5.3323	5.3107	5.2884	
util living area													
	0.9998	0.9994	0.9981	0.9932	0.9730	0.8993	0.7593	0.8122	0.9596	0.9960	0.9995	0.9998	(86)
MIT	19.6377	19.7700	19.9919	20.2987	20.6042	20.8538	20.9592	20.9406	20.7465	20.3514	19.9425	19.6210	(87)
Th 2	20.0078	20.0103	20.0128	20.0244	20.0265	20.0367	20.0367	20.0386	20.0328	20.0265	20.0221	20.0175	(88)
util rest of house													
	0.9997	0.9991	0.9974	0.9901	0.9580	0.8379	0.6286	0.6934	0.9294	0.9937	0.9992	0.9998	(89)
MIT 2	18.7483	18.8825	19.1061	19.4210	19.7215	19.9536	20.0237	20.0169	19.8632	19.4761	19.0646	18.7394	(90)
Living area fraction									fLA = Living area / (4) =			0.1121	(91)
MIT	18.8480	18.9820	19.2054	19.5194	19.8205	20.0546	20.1286	20.1205	19.9622	19.5742	19.1630	18.8383	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8480	18.9820	19.2054	19.5194	19.8205	20.0546	20.1286	20.1205	19.9622	19.5742	19.1630	18.8383	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9995	0.9988	0.9965	0.9878	0.9538	0.8393	0.6427	0.7052	0.9264	0.9921	0.9989	0.9997	(94)
Useful gains	663.7137	782.6119	876.9870	954.0331	971.2674	835.8679	611.6576	628.4085	771.1582	734.9421	654.4361	623.4199	(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													
	2718.8223	2624.3247	2361.2335	1947.8465	1485.7985	986.5191	638.1825	671.4330	1065.0096	1642.0165	2218.2280	2705.8057	(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													
	1529.0008	1237.6310	1104.2794	715.5457	382.8111	0.0000	0.0000	0.0000	0.0000	674.8634	1125.9302	1549.2950	(98)
Space heating												8319.3566	(98)
Space heating per m2											(98) / (4) =	48.5887	(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												

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	1700.0911	1338.3696	1371.5733	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7121	0.8107	0.7721	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1210.6183	1085.0462	1058.9253	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1298.0897	1243.4346	1175.6381	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	62.9795	117.8410	86.8343	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												267.6548	(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	15.7449	29.4603	21.7086	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												66.9137	(107)
Space cooling per m2												0.3908	(108)
Energy for space heating												48.5887	(99)
Energy for space cooling												0.3908	(108)
Total												48.9795	(109)
Target Fabric Energy Efficiency (TFEE)												56.3	(109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	65.2700 (1b)	x	2.3800 (2b)	=	155.3426	(1b) - (3b)
First floor	64.0600 (1c)	x	2.6900 (2c)	=	172.3214	(1c) - (3c)
Second floor	41.8900 (1d)	x	2.4000 (2d)	=	100.5360	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	171.2200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	428.2000	(5)

2. Ventilation rate

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

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0.0000 / (5)	=	0.0000	(8)	
Pressure test			Yes		
Measured/design AP50			5.0100		
Infiltration rate			0.2505	(18)	
Number of sides sheltered			0	(19)	
Shelter factor	(20) = 1 - [0.075 x (19)]	=	1.0000	(20)	
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.2505	(21)	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.2630	0.2505	0.2505	0.2317	0.2317	0.2067	0.2129	0.2004	0.2067	0.2192	0.2192	0.2380	(22b)
Mechanical extract ventilation - decentralised													
If mechanical ventilation:												0.5000	(23a)
Effective ac	0.5130	0.5005	0.5005	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			1.9800	1.3000	2.5740			(26)
Half Glaze			1.9800	1.5000	2.9700			(26a)
Window (Uw = 1.40)			17.8500	1.3258	23.6648			(27)
French Door (Uw = 1.40)			3.1500	1.3258	4.1761			(27)
Ground Floor			65.2700	0.1300	8.4851	75.0000	4895.2500	(28a)
125mm Cavity	193.4500	21.4800	171.9700	0.2400	41.2728	52.8000	9080.0160	(29a)
Wall to Void	28.5800		28.5800	0.1400	4.0012	9.0000	257.2200	(29a)
Dormer Cheek	13.5800	3.4800	10.1000	0.2500	2.5250	9.0000	90.9000	(29a)
400mm Mineral Wool	16.9100		16.9100	0.1100	1.8601	9.0000	152.1900	(30)
Sloping	21.5900		21.5900	0.2000	4.3180	9.0000	194.3100	(30)
Ceiling to Void	22.1700		22.1700	0.1400	3.1038	9.0000	199.5300	(30)
Bay Flat Roof	1.2100		1.2100	0.2500	0.3025	9.0000	10.8900	(30)
Total net area of external elements Aum(A, m2)			362.7600					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	99.2534			(33)
Timber GF			77.7200			9.0000	699.4800	(32c)
Timber 1F			144.8200			9.0000	1303.3800	(32c)
Timber 2F			57.5000			9.0000	517.5000	(32c)
Masonry GF			42.4900			39.0000	1657.1100	(32c)
Internal Floor			64.0600			18.0000	1153.0800	(32d)
Internal Floor			41.8900			18.0000	754.0200	(32d)
Internal Ceiling			64.0600			18.0000	1153.0800	(32e)
Internal Ceiling			41.8900			18.0000	754.0200	(32e)
Heat capacity Cm = Sum(A x k)				(28)...(30) + (32) + (32a)...(32e) =			22871.9760	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							133.5824	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							14.3174	(36)
Total fabric heat loss						(33) + (36) =	113.5708	(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	72.4935	70.7237	70.7237	70.6530	70.6530	70.6530	70.6530	70.6530	70.6530	70.6530	70.6530	70.6530	(38)
Heat transfer coeff	186.0643	184.2944	184.2944	184.2238	184.2238	184.2238	184.2238	184.2238	184.2238	184.2238	184.2238	184.2238	(39)
Average = Sum(39)m / 12 =												184.3889	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0867	1.0764	1.0764	1.0759	1.0759	1.0759	1.0759	1.0759	1.0759	1.0759	1.0759	1.0759	(40)
HLP (average)												1.0769	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF HEAT DEMAND 09 Jan 2014

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4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.9642	(42)
Average daily hot water use (litres/day)												104.5998	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	115.0598	110.8758	106.6918	102.5078	98.3239	94.1399	94.1399	98.3239	102.5078	106.6918	110.8758	115.0598	(44)
Energy conte	170.6304	149.2344	153.9966	134.2579	128.8237	111.1651	103.0108	118.2064	119.6181	139.4034	152.1697	165.2464	(45)
Energy content (annual)										Total = Sum(45)m =		1645.7628	(45)
Distribution loss (46)m = 0.15 x (45)m													
	25.5946	22.3852	23.0995	20.1387	19.3236	16.6748	15.4516	17.7310	17.9427	20.9105	22.8255	24.7870	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.4800	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.7992	(55)
Total storage loss													
	24.7752	22.3776	24.7752	23.9760	24.7752	23.9760	24.7752	24.7752	23.9760	24.7752	23.9760	24.7752	(56)
If cylinder contains dedicated solar storage													
	24.7752	22.3776	24.7752	23.9760	24.7752	23.9760	24.7752	24.7752	23.9760	24.7752	23.9760	24.7752	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	218.6680	192.6232	202.0342	180.7459	176.8613	157.6531	151.0484	166.2440	166.1061	187.4410	198.6577	213.2840	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	218.6680	192.6232	202.0342	180.7459	176.8613	157.6531	151.0484	166.2440	166.1061	187.4410	198.6577	213.2840	(64)
								Total per year (kWh/year) = Sum(64)m =				2211.3668	(64)
RHI water heating demand												2211	(64)
Heat gains from water heating, kWh/month													
	95.1647	84.3315	89.6339	81.8312	81.2640	74.1528	72.6812	77.7337	76.9634	84.7817	87.7868	93.3745	(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	177.8522	177.8522	177.8522	177.8522	177.8522	177.8522	177.8522	177.8522	177.8522	177.8522	177.8522	177.8522	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	84.3923	74.9565	60.9587	46.1497	34.4974	29.1242	31.4697	40.9055	54.9033	69.7123	81.3646	86.7378	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	511.6297	516.9388	503.5600	475.0781	439.1249	405.3339	382.7594	377.4503	390.8291	419.3110	455.2642	489.0552	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.7494	55.7494	55.7494	55.7494	55.7494	55.7494	55.7494	55.7494	55.7494	55.7494	55.7494	55.7494	(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)													
	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	(71)
Water heating gains (Table 5)													
	127.9095	125.4933	120.4757	113.6544	109.2258	102.9900	97.6897	104.4808	106.8936	113.9539	121.9261	125.5034	(72)
Total internal gains													
	841.9650	835.4221	803.0279	752.9157	700.8815	655.4815	629.9523	640.8701	670.6595	721.0107	776.5885	819.3299	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	10.6300	11.9814	0.7200	0.7000	0.7700	44.4842	(74)
East	0.6900	22.3313	0.7200	0.7000	0.7700	5.3818	(76)
South	5.8400	50.9848	0.7200	0.7000	0.7700	103.9962	(78)
West	0.6900	22.3313	0.7200	0.7000	0.7700	5.3818	(80)
South	3.1500	50.9848	0.7200	0.7000	0.7700	56.0938	(78)

Solar gains	215.3379	331.4135	457.2246	609.1577	693.2274	751.4324	710.3809	642.5209	544.6637	393.1969	264.3557	182.5173	(83)
Total gains	1057.3029	1166.8356	1260.2526	1362.0734	1394.1089	1406.9140	1340.3332	1283.3910	1215.3232	1114.2076	1040.9442	1001.8472	(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	34.1459	34.4738	34.4738	34.4870	34.4870	34.4870	34.4870	34.4870	34.4870	34.4870	34.4870	34.4870	
alpha	3.2764	3.2983	3.2983	3.2991	3.2991	3.2991	3.2991	3.2991	3.2991	3.2991	3.2991	3.2991	
util living area													
	0.9777	0.9679	0.9457	0.8942	0.7883	0.5880	0.4110	0.4396	0.7158	0.9020	0.9628	0.9807	(86)
MIT	19.2981	19.4845	19.8341	20.2665	20.6675	20.9168	20.9821	20.9775	20.8239	20.3555	19.7647	19.2733	(87)
Th 2	20.0117	20.0202	20.0202	20.0205	20.0205	20.0205	20.0205	20.0205	20.0205	20.0205	20.0205	20.0205	(88)
util rest of house													
	0.9733	0.9617	0.9346	0.8709	0.7378	0.4944	0.2879	0.3137	0.6363	0.8754	0.9543	0.9769	(89)
MIT 2	17.7513	18.0258	18.5289	19.1394	19.6766	19.9619	20.0143	20.0121	19.8715	19.2724	18.4341	17.7211	(90)
Living area fraction										fLA = Living area / (4) =		0.1121	(91)
MIT	17.9247	18.1893	18.6753	19.2658	19.7877	20.0690	20.1229	20.1204	19.9783	19.3938	18.5833	17.8951	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.7747	18.0393	18.5253	19.1158	19.6377	19.9190	19.9729	19.9704	19.8283	19.2438	18.4333	17.7451	(93)

CALCULATION OF HEAT DEMAND 09 Jan 2014

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9588	0.9440	0.9117	0.8438	0.7148	0.4838	0.2817	0.3069	0.6184	0.8481	0.9347	0.9638	(94)
Useful gains	1013.7853	1101.4863	1148.9796	1149.3772	996.5433	680.7272	377.5126	393.9250	751.5944	944.9113	972.9818	965.5978	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	2358.3171	2292.4998	2050.3271	1697.7636	1222.8235	721.9742	381.8701	399.8368	852.6390	1408.1742	1922.0688	2329.5333	(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	1000.3317	800.3610	670.6026	394.8382	168.3525	0.0000	0.0000	0.0000	0.0000	344.6676	683.3426	1014.7681	(98)
Space heating												5077.2642	(98)
RHI space heating demand												5077	(98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	65.2700 (1b)	x	2.3800 (2b)	=	155.3426	(1b) - (3b)
First floor	64.0600 (1c)	x	2.6900 (2c)	=	172.3214	(1c) - (3c)
Second floor	41.8900 (1d)	x	2.4000 (2d)	=	100.5360	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	171.2200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	428.2000	(5)

2. Ventilation rate

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

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			0.0000 / (5) =	0.0000	(8)
Pressure test				Yes	
Measured/design AP50				5.0100	
Infiltration rate				0.2505	(18)
Number of sides sheltered				0	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.2505	(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	0.3194	0.3131	0.3069	0.2756	0.2693	0.2380	0.2380	0.2317	0.2505	0.2693	0.2818	0.2943	(22b)
Mechanical extract ventilation - decentralised													
If mechanical ventilation:												0.5000	(23a)
Effective ac	0.5694	0.5631	0.5569	0.5256	0.5193	0.5000	0.5000	0.5000	0.5005	0.5193	0.5318	0.5443	(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	
Solid Door			1.9800	1.3000	2.5740			(26)
Half Glaze			1.9800	1.5000	2.9700			(26a)
Window (Uw = 1.40)			17.8500	1.3258	23.6648			(27)
French Door (Uw = 1.40)			3.1500	1.3258	4.1761			(27)
Ground Floor			65.2700	0.1300	8.4851	75.0000	4895.2500	(28a)
125mm Cavity	193.4500	21.4800	171.9700	0.2400	41.2728	52.8000	9080.0160	(29a)
Wall to Void	28.5800		28.5800	0.1400	4.0012	9.0000	257.2200	(29a)
Dormer Cheek	13.5800	3.4800	10.1000	0.2500	2.5250	9.0000	90.9000	(29a)
400mm Mineral Wool	16.9100		16.9100	0.1100	1.8601	9.0000	152.1900	(30)
Sloping	21.5900		21.5900	0.2000	4.3180	9.0000	194.3100	(30)
Ceiling to Void	22.1700		22.1700	0.1400	3.1038	9.0000	199.5300	(30)
Bay Flat Roof	1.2100		1.2100	0.2500	0.3025	9.0000	10.8900	(30)
Total net area of external elements Aum(A, m2)			362.7600					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	99.2534			(33)
Timber GF			77.7200			9.0000	699.4800	(32c)
Timber 1F			144.8200			9.0000	1303.3800	(32c)
Timber 2F			57.5000			9.0000	517.5000	(32c)
Masonry GF			42.4900			39.0000	1657.1100	(32c)
Internal Floor			64.0600			18.0000	1153.0800	(32d)
Internal Floor			41.8900			18.0000	754.0200	(32d)
Internal Ceiling			64.0600			18.0000	1153.0800	(32e)
Internal Ceiling			41.8900			18.0000	754.0200	(32e)
Heat capacity Cm = Sum(A x k)				(28)...(30) + (32) + (32a)...(32e) =			22871.9760	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							133.5824	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							14.3174	(36)
Total fabric heat loss						(33) + (36) =	113.5708	(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	80.4579	79.5729	78.6880	74.2634	73.3784	70.6530	70.6530	70.6530	70.7237	73.3784	75.1483	76.9182	(38)
Heat transfer coeff	194.0287	193.1437	192.2588	187.8342	186.9492	184.2238	184.2238	184.2238	184.2944	186.9492	188.7191	190.4889	(39)
Average = Sum(39)m / 12 =												188.1115	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1332	1.1280	1.1229	1.0970	1.0919	1.0759	1.0759	1.0759	1.0764	1.0919	1.1022	1.1125	(40)
HLP (average)												1.0987	(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												2.9642	(42)
Average daily hot water use (litres/day)												104.5998	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	115.0598	110.8758	106.6918	102.5078	98.3239	94.1399	94.1399	98.3239	102.5078	106.6918	110.8758	115.0598	(44)
Energy conte	170.6304	149.2344	153.9966	134.2579	128.8237	111.1651	103.0108	118.2064	119.6181	139.4034	152.1697	165.2464	(45)
Energy content (annual)										Total = Sum(45)m =		1645.7628	(45)
Distribution loss (46)m = 0.15 x (45)m	25.5946	22.3852	23.0995	20.1387	19.3236	16.6748	15.4516	17.7310	17.9427	20.9105	22.8255	24.7870	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.4800	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.7992	(55)
Total storage loss	24.7752	22.3776	24.7752	23.9760	24.7752	23.9760	24.7752	24.7752	23.9760	24.7752	23.9760	24.7752	(56)
If cylinder contains dedicated solar storage	24.7752	22.3776	24.7752	23.9760	24.7752	23.9760	24.7752	24.7752	23.9760	24.7752	23.9760	24.7752	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month	218.6680	192.6232	202.0342	180.7459	176.8613	157.6531	151.0484	166.2440	166.1061	187.4410	198.6577	213.2840	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h	218.6680	192.6232	202.0342	180.7459	176.8613	157.6531	151.0484	166.2440	166.1061	187.4410	198.6577	213.2840	(64)
								Total per year (kWh/year) = Sum(64)m =				2211.3668	(64)
Heat gains from water heating, kWh/month	95.1647	84.3315	89.6339	81.8312	81.2640	74.1528	72.6812	77.7337	76.9634	84.7817	87.7868	93.3745	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	177.8522	177.8522	177.8522	177.8522	177.8522	177.8522	177.8522	177.8522	177.8522	177.8522	177.8522	177.8522	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	84.3923	74.9565	60.9587	46.1497	34.4974	29.1242	31.4697	40.9055	54.9033	69.7123	81.3646	86.7378	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	511.6297	516.9388	503.5600	475.0781	439.1249	405.3339	382.7594	377.4503	390.8291	419.3110	455.2642	489.0552	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.7494	55.7494	55.7494	55.7494	55.7494	55.7494	55.7494	55.7494	55.7494	55.7494	55.7494	55.7494	(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)	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	(71)
Water heating gains (Table 5)	127.9095	125.4933	120.4757	113.6544	109.2258	102.9900	97.6897	104.4808	106.8936	113.9539	121.9261	125.5034	(72)
Total internal gains	841.9650	835.4221	803.0279	752.9157	700.8815	655.4815	629.9523	640.8701	670.6595	721.0107	776.5885	819.3299	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	10.6300	10.6334	0.7200	0.7000	0.7700	39.4792	(74)
East	0.6900	19.6403	0.7200	0.7000	0.7700	4.7333	(76)
South	5.8400	46.7521	0.7200	0.7000	0.7700	95.3625	(78)
West	0.6900	19.6403	0.7200	0.7000	0.7700	4.7333	(80)
South	3.1500	46.7521	0.7200	0.7000	0.7700	51.4369	(78)

Solar gains	195.7452	334.3850	464.9519	596.5360	692.6018	699.8826	669.5336	594.9650	509.5271	371.0985	234.5137	167.5448	(83)
Total gains	1037.7102	1169.8070	1267.9799	1349.4517	1393.4834	1355.3641	1299.4859	1235.8351	1180.1866	1092.1092	1011.1022	986.8748	(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	32.7443	32.8943	33.0457	33.8241	33.9842	34.4870	34.4870	34.4870	34.4738	33.9842	33.6655	33.3527	
alpha	3.1830	3.1930	3.2030	3.2549	3.2656	3.2991	3.2991	3.2991	3.2983	3.2656	3.2444	3.2235	
util living area	0.9817	0.9720	0.9546	0.9165	0.8422	0.7114	0.5668	0.6084	0.7951	0.9271	0.9716	0.9843	(86)
MIT	19.0622	19.2768	19.6200	20.0867	20.5012	20.8094	20.9344	20.9152	20.7044	20.1774	19.5558	19.0441	(87)
Th 2	19.9738	19.9780	19.9822	20.0033	20.0075	20.0205	20.0205	20.0205	20.0202	20.0075	19.9990	19.9906	(88)
util rest of house	0.9783	0.9668	0.9456	0.8985	0.8053	0.6399	0.4609	0.5048	0.7364	0.9080	0.9654	0.9813	(89)
MIT 2	17.3853	17.6988	18.1970	18.8760	19.4502	19.8500	19.9800	19.9644	19.7318	19.0155	18.1191	17.3693	(90)
Living area fraction										fLA = Living area / (4) =		0.1121	(91)
MIT	17.5734	17.8757	18.3566	19.0118	19.5680	19.9576	20.0870	20.0710	19.8409	19.1458	18.2802	17.5571	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.4234	17.7257	18.2066	18.8618	19.4180	19.8076	19.9370	19.9210	19.6909	18.9958	18.1302	17.4071	(93)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9652	0.9498	0.9237	0.8719	0.7787	0.6223	0.4511	0.4932	0.7128	0.8818	0.9482	0.9697	(94)
Useful gains	1001.5527	1111.0254	1171.1958	1176.5828	1085.1369	843.4919	586.1981	609.4569	841.2806	962.9937	958.7075	956.9305	(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	2546.3116	2477.2090	2250.6979	1871.1581	1442.8833	959.3643	614.7580	648.6603	1030.3658	1569.5919	2081.6155	2515.7992	(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	1149.3006	918.0754	803.1496	500.0943	266.1634	0.0000	0.0000	0.0000	0.0000	451.3091	808.4938	1159.7983	(98)
Space heating												6056.3844	(98)
Space heating per m2											(98) / (4) =	35.3719	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.6000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	6684.7510	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1149.3006	918.0754	803.1496	500.0943	266.1634	0.0000	0.0000	0.0000	0.0000	451.3091	808.4938	1159.7983	(98)
Space heating efficiency (main heating system 1)	90.6000	90.6000	90.6000	90.6000	90.6000	0.0000	0.0000	0.0000	0.0000	90.6000	90.6000	90.6000	(210)
Space heating fuel (main heating system)	1268.5437	1013.3283	886.4785	551.9804	293.7786	0.0000	0.0000	0.0000	0.0000	498.1336	892.3772	1280.1306	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	218.6680	192.6232	202.0342	180.7459	176.8613	157.6531	151.0484	166.2440	166.1061	187.4410	198.6577	213.2840	(64)
Efficiency of water heater												79.9000	(216)
(217)m	88.7012	88.5436	88.2253	87.4896	86.0022	79.9000	79.9000	79.9000	79.9000	87.1742	88.2684	88.7538	(217)
Fuel for water heating, kWh/month	246.5220	217.5462	228.9980	206.5914	205.6474	197.3130	189.0468	208.0650	207.8925	215.0188	225.0609	240.3098	(219)
Water heating fuel used												2588.0118	(219)
Annual totals kWh/year													
Space heating fuel - main system												6684.7510	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
(MEVDecentralised, Database: total watage = 10.9710, total flow = 53.0000, SFP = 0.2070)													
mechanical ventilation fans (SFP = 0.2070)												108.1376	(230a)
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												183.1376	(231)
Electricity for lighting (calculated in Appendix L)												596.1578	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.04 * 1068 * 1.00) =										-888.6346		-888.6346	(233)
Total delivered energy for all uses												9163.4236	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	6684.7510	3.4800	232.6293	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2588.0118	3.4800	90.0628	(247)
Mechanical ventilation fans	108.1376	13.1900	14.2634	(249)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	596.1578	13.1900	78.6332	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-888.6346	13.1900	-117.2109	(252)
Total energy cost			428.2703	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):	0.4200	(256)
Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] =	0.8319	(257)
SAP value	88.3950	
SAP rating (Section 12)	88	(258)
SAP band	B	

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

CALCULATION OF ENERGY RATINGS 09 Jan 2014

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	6684.7510	0.2160	1443.9062	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2588.0118	0.2160	559.0105	(264)
Space and water heating			2002.9168	(265)
Pumps and fans	183.1376	0.5190	95.0484	(267)
Energy for lighting	596.1578	0.5190	309.4059	(268)
Energy saving/generation technologies				
PV Unit	-888.6346	0.5190	-461.2014	(269)
Total kg/year			1946.1697	(272)
CO2 emissions per m2			11.3700	(273)
EI value			87.9388	
EI rating			88	(274)
EI band			B	

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9060 = 3.841, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9060 = 0.2384, stars = 4
Water heating energy efficiency	3.48 / 0.8523 = 4.083, stars = 4
Water heating environmental impact	0.216 / 0.8523 = 0.2534, stars = 4

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

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	65.2700 (1b)	x	2.3800 (2b)	=	155.3426	(1b) - (3b)
First floor	64.0600 (1c)	x	2.6900 (2c)	=	172.3214	(1c) - (3c)
Second floor	41.8900 (1d)	x	2.4000 (2d)	=	100.5360	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	171.2200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	428.2000	(5)

2. Ventilation rate

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

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.2505	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2505	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.2630	0.2505	0.2505	0.2317	0.2317	0.2067	0.2129	0.2004	0.2067	0.2192	0.2192	0.2380	(22b)
Mechanical extract ventilation - decentralised													
If mechanical ventilation:												0.5000	(23a)
Effective ac	0.5130	0.5005	0.5005	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			1.9800	1.3000	2.5740			(26)
Half Glaze			1.9800	1.5000	2.9700			(26a)
Window (Uw = 1.40)			17.8500	1.3258	23.6648			(27)
French Door (Uw = 1.40)			3.1500	1.3258	4.1761			(27)
Ground Floor			65.2700	0.1300	8.4851	75.0000	4895.2500	(28a)
125mm Cavity	193.4500	21.4800	171.9700	0.2400	41.2728	52.8000	9080.0160	(29a)
Wall to Void	28.5800		28.5800	0.1400	4.0012	9.0000	257.2200	(29a)
Dormer Cheek	13.5800	3.4800	10.1000	0.2500	2.5250	9.0000	90.9000	(29a)
400mm Mineral Wool	16.9100		16.9100	0.1100	1.8601	9.0000	152.1900	(30)
Sloping	21.5900		21.5900	0.2000	4.3180	9.0000	194.3100	(30)
Ceiling to Void	22.1700		22.1700	0.1400	3.1038	9.0000	199.5300	(30)
Bay Flat Roof	1.2100		1.2100	0.2500	0.3025	9.0000	10.8900	(30)
Total net area of external elements Aum(A, m2)			362.7600					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	99.2534			(33)
Timber GF			77.7200			9.0000	699.4800	(32c)
Timber 1F			144.8200			9.0000	1303.3800	(32c)
Timber 2F			57.5000			9.0000	517.5000	(32c)
Masonry GF			42.4900			39.0000	1657.1100	(32c)
Internal Floor			64.0600			18.0000	1153.0800	(32d)
Internal Floor			41.8900			18.0000	754.0200	(32d)
Internal Ceiling			64.0600			18.0000	1153.0800	(32e)
Internal Ceiling			41.8900			18.0000	754.0200	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	22871.9760 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		133.5824 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		14.3174 (36)
Total fabric heat loss	(33) + (36) =	113.5708 (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	72.4935	70.7237	70.7237	70.6530	70.6530	70.6530	70.6530	70.6530	70.6530	70.6530	70.6530	70.6530	(38)
Heat transfer coeff	186.0643	184.2944	184.2944	184.2238	184.2238	184.2238	184.2238	184.2238	184.2238	184.2238	184.2238	184.2238	(39)
Average = Sum(39)m / 12 =												184.3889	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0867	1.0764	1.0764	1.0759	1.0759	1.0759	1.0759	1.0759	1.0759	1.0759	1.0759	1.0759	(40)
HLP (average)												1.0769	(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												2.9642	(42)
Average daily hot water use (litres/day)												104.5998	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	115.0598	110.8758	106.6918	102.5078	98.3239	94.1399	94.1399	98.3239	102.5078	106.6918	110.8758	115.0598	(44)
Energy conte	170.6304	149.2344	153.9966	134.2579	128.8237	111.1651	103.0108	118.2064	119.6181	139.4034	152.1697	165.2464	(45)
Energy content (annual)										Total = Sum(45)m =		1645.7628	(45)
Distribution loss (46)m = 0.15 x (45)m													
	25.5946	22.3852	23.0995	20.1387	19.3236	16.6748	15.4516	17.7310	17.9427	20.9105	22.8255	24.7870	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.4800	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.7992	(55)
Total storage loss													
	24.7752	22.3776	24.7752	23.9760	24.7752	23.9760	24.7752	24.7752	23.9760	24.7752	23.9760	24.7752	(56)
If cylinder contains dedicated solar storage													
	24.7752	22.3776	24.7752	23.9760	24.7752	23.9760	24.7752	24.7752	23.9760	24.7752	23.9760	24.7752	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	218.6680	192.6232	202.0342	180.7459	176.8613	157.6531	151.0484	166.2440	166.1061	187.4410	198.6577	213.2840	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	218.6680	192.6232	202.0342	180.7459	176.8613	157.6531	151.0484	166.2440	166.1061	187.4410	198.6577	213.2840	(64)
									Total per year (kWh/year) = Sum(64)m =			2211.3668	(64)
Heat gains from water heating, kWh/month													
	95.1647	84.3315	89.6339	81.8312	81.2640	74.1528	72.6812	77.7337	76.9634	84.7817	87.7868	93.3745	(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	177.8522	177.8522	177.8522	177.8522	177.8522	177.8522	177.8522	177.8522	177.8522	177.8522	177.8522	177.8522	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	84.3923	74.9565	60.9587	46.1497	34.4974	29.1242	31.4697	40.9055	54.9033	69.7123	81.3646	86.7378	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	511.6297	516.9388	503.5600	475.0781	439.1249	405.3339	382.7594	377.4503	390.8291	419.3110	455.2642	489.0552	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.7494	55.7494	55.7494	55.7494	55.7494	55.7494	55.7494	55.7494	55.7494	55.7494	55.7494	55.7494	(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)													
	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	(71)
Water heating gains (Table 5)													
	127.9095	125.4933	120.4757	113.6544	109.2258	102.9900	97.6897	104.4808	106.8936	113.9539	121.9261	125.5034	(72)
Total internal gains													
	841.9650	835.4221	803.0279	752.9157	700.8815	655.4815	629.9523	640.8701	670.6595	721.0107	776.5885	819.3299	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	10.6300	11.9814	0.7200	0.7000	0.7700	44.4842	(74)
East	0.6900	22.3313	0.7200	0.7000	0.7700	5.3818	(76)
South	5.8400	50.9848	0.7200	0.7000	0.7700	103.9962	(78)
West	0.6900	22.3313	0.7200	0.7000	0.7700	5.3818	(80)
South	3.1500	50.9848	0.7200	0.7000	0.7700	56.0938	(78)

Solar gains	215.3379	331.4135	457.2246	609.1577	693.2274	751.4324	710.3809	642.5209	544.6637	393.1969	264.3557	182.5173	(83)
Total gains	1057.3029	1166.8356	1260.2526	1362.0734	1394.1089	1406.9140	1340.3332	1283.3910	1215.3232	1114.2076	1040.9442	1001.8472	(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	34.1459	34.4738	34.4738	34.4870	34.4870	34.4870	34.4870	34.4870	34.4870	34.4870	34.4870	34.4870	
alpha	3.2764	3.2983	3.2983	3.2991	3.2991	3.2991	3.2991	3.2991	3.2991	3.2991	3.2991	3.2991	
util living area													
	0.9777	0.9679	0.9457	0.8942	0.7883	0.5880	0.4110	0.4396	0.7158	0.9020	0.9628	0.9807	(86)
MIT	19.2981	19.4845	19.8341	20.2665	20.6675	20.9168	20.9821	20.9775	20.8239	20.3555	19.7647	19.2733	(87)
Th 2	20.0117	20.0202	20.0202	20.0205	20.0205	20.0205	20.0205	20.0205	20.0205	20.0205	20.0205	20.0205	(88)
util rest of house													
	0.9733	0.9617	0.9346	0.8709	0.7378	0.4944	0.2879	0.3137	0.6363	0.8754	0.9543	0.9769	(89)
MIT 2	17.7513	18.0258	18.5289	19.1394	19.6766	19.9619	20.0143	20.0121	19.8715	19.2724	18.4341	17.7211	(90)
Living area fraction									fLA = Living area / (4) =			0.1121	(91)
MIT	17.9247	18.1893	18.6753	19.2658	19.7877	20.0690	20.1229	20.1204	19.9783	19.3938	18.5833	17.8951	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.7747	18.0393	18.5253	19.1158	19.6377	19.9190	19.9729	19.9704	19.8283	19.2438	18.4333	17.7451	(93)

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

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9588	0.9440	0.9117	0.8438	0.7148	0.4838	0.2817	0.3069	0.6184	0.8481	0.9347	0.9638	(94)
Useful gains	1013.7853	1101.4863	1148.9796	1149.3772	996.5433	680.7272	377.5126	393.9250	751.5944	944.9113	972.9818	965.5978	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	2358.3171	2292.4998	2050.3271	1697.7636	1222.8235	721.9742	381.8701	399.8368	852.6390	1408.1742	1922.0688	2329.5333	(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	1000.3317	800.3610	670.6026	394.8382	168.3525	0.0000	0.0000	0.0000	0.0000	344.6676	683.3426	1014.7681	(98)
Space heating												5077.2642	(98)
Space heating per m2											(98) / (4) =	29.6535	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.6000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	5604.0444	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1000.3317	800.3610	670.6026	394.8382	168.3525	0.0000	0.0000	0.0000	0.0000	344.6676	683.3426	1014.7681	(98)
Space heating efficiency (main heating system 1)	90.6000	90.6000	90.6000	90.6000	90.6000	0.0000	0.0000	0.0000	0.0000	90.6000	90.6000	90.6000	(210)
Space heating fuel (main heating system)	1104.1188	883.4007	740.1794	435.8038	185.8195	0.0000	0.0000	0.0000	0.0000	380.4278	754.2413	1120.0530	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	218.6680	192.6232	202.0342	180.7459	176.8613	157.6531	151.0484	166.2440	166.1061	187.4410	198.6577	213.2840	(64)
Efficiency of water heater												79.9000	(216)
(217)m	88.4746	88.3060	87.8754	86.9438	84.7831	79.9000	79.9000	79.9000	79.9000	86.5186	87.9473	88.5407	(217)
Fuel for water heating, kWh/month	247.1534	218.1315	229.9097	207.8884	208.6044	197.3130	189.0468	208.0650	207.8925	216.6482	225.8828	240.8881	(219)
Water heating fuel used												2597.4238	(219)
Annual totals kWh/year													
Space heating fuel - main system												5604.0444	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
(MEVDecentralised, Database: total watage = 10.9710, total flow = 53.0000, SFP = 0.2070)													
mechanical ventilation fans (SFP = 0.2070)												108.1376	(230a)
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												183.1376	(231)
Electricity for lighting (calculated in Appendix L)												596.1578	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.04 * 1121 * 1.00) =												-932.6538	(233)
Total delivered energy for all uses												8048.1098	(238)

10a. Fuel costs - using BEDF prices (467)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	5604.0444	3.9500	221.3598	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2597.4238	3.9500	102.5982	(247)
Mechanical ventilation fans	108.1376	18.7000	20.2217	(249)
Pumps and fans for heating	75.0000	18.7000	14.0250	(249)
Energy for lighting	596.1578	18.7000	111.4815	(250)
Additional standing charges			91.0000	(251)
Energy saving/generation technologies				
PV Unit	-932.6538	18.7000	-174.4063	(252)
Total energy cost			386.2800	(255)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	5604.0444	0.2160	1210.4736	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2597.4238	0.2160	561.0435	(264)
Space and water heating			1771.5171	(265)
Pumps and fans	183.1376	0.5190	95.0484	(267)
Energy for lighting	596.1578	0.5190	309.4059	(268)
Energy saving/generation technologies				

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

PV Unit	-932.6538	0.5190	-484.0473 (269)
Total kg/year			1691.9241 (272)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	5604.0444	1.2200	6836.9342	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2597.4238	1.2200	3168.8570	(264)
Space and water heating			10005.7912	(265)
Pumps and fans	183.1376	3.0700	562.2325	(267)
Energy for lighting	596.1578	3.0700	1830.2045	(268)
Energy saving/generation technologies				
PV Unit	-932.6538	3.0700	-2863.2472	(269)
Primary energy kWh/year			9534.9810	(272)
Primary energy kWh/m2/year			55.6885	(273)

SAP 2012 EPC IMPROVEMENTS

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

(For testing purposes):

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

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.1	-£ 44	-263 kg (15.6%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£44	1.54 kg/m²	B 89	B 90
Total Savings	£44	1.54 kg/m²		

Potential energy efficiency rating: B 89
Potential environmental impact rating: B 90

Fuel prices for cost data on this page from database revision number 467 TEST (29 Oct 2020)
Recommendation texts revision number 4.9c (22 Feb 2014)

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

	Current	Potential	Saving
Electricity	£146	£155	-£9
Mains gas	£415	£362	£53
Space heating	£347	£348	-£2
Water heating	£103	£58	£45
Lighting	£111	£111	£0
Generated (PV)	-£174	-£174	£0
Total cost of fuels	£387	£343	£44
Total cost of uses	£387	£343	£43
Delivered energy	47 kWh/m²	39 kWh/m²	8 kWh/m²

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

Carbon dioxide emissions	1.7 tonnes	1.4 tonnes	0.3 tonnes
CO2 emissions per m²	10 kg/m²	8 kg/m²	2 kg/m²
Primary energy	56 kWh/m²	47 kWh/m²	9 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	65.2700	(1b)	x 2.3800	(2b) =	155.3426	(1b) - (3b)
First floor	64.0600	(1c)	x 2.6900	(2c) =	172.3214	(1c) - (3c)
Second floor	41.8900	(1d)	x 2.4000	(2d) =	100.5360	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	171.2200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		428.2000	(5)

2. Ventilation rate

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

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			0.0000 / (5) =	0.0000	(8)
Pressure test				Yes	
Measured/design AP50				5.0100	
Infiltration rate				0.2505	(18)
Number of sides sheltered				0	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.2505	(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	0.3194	0.3131	0.3069	0.2756	0.2693	0.2380	0.2380	0.2317	0.2505	0.2693	0.2818	0.2943	(22b)
Mechanical extract ventilation - decentralised													
If mechanical ventilation:												0.5000	(23a)
Effective ac	0.5694	0.5631	0.5569	0.5256	0.5193	0.5000	0.5000	0.5000	0.5005	0.5193	0.5318	0.5443	(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	
Solid Door			1.9800	1.3000	2.5740			(26)
Half Glaze			1.9800	1.5000	2.9700			(26a)
Window (Uw = 1.40)			17.8500	1.3258	23.6648			(27)
French Door (Uw = 1.40)			3.1500	1.3258	4.1761			(27)
Ground Floor			65.2700	0.1300	8.4851	75.0000	4895.2500	(28a)
125mm Cavity	193.4500	21.4800	171.9700	0.2400	41.2728	52.8000	9080.0160	(29a)
Wall to Void	28.5800		28.5800	0.1400	4.0012	9.0000	257.2200	(29a)
Dormer Cheek	13.5800	3.4800	10.1000	0.2500	2.5250	9.0000	90.9000	(29a)
400mm Mineral Wool	16.9100		16.9100	0.1100	1.8601	9.0000	152.1900	(30)
Sloping	21.5900		21.5900	0.2000	4.3180	9.0000	194.3100	(30)
Ceiling to Void	22.1700		22.1700	0.1400	3.1038	9.0000	199.5300	(30)
Bay Flat Roof	1.2100		1.2100	0.2500	0.3025	9.0000	10.8900	(30)
Total net area of external elements Aum(A, m2)			362.7600					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	99.2534			(33)
Timber GF			77.7200			9.0000	699.4800	(32c)
Timber 1F			144.8200			9.0000	1303.3800	(32c)
Timber 2F			57.5000			9.0000	517.5000	(32c)
Masonry GF			42.4900			39.0000	1657.1100	(32c)
Internal Floor			64.0600			18.0000	1153.0800	(32d)
Internal Floor			41.8900			18.0000	754.0200	(32d)
Internal Ceiling			64.0600			18.0000	1153.0800	(32e)
Internal Ceiling			41.8900			18.0000	754.0200	(32e)
Heat capacity Cm = Sum(A x k)				(28)...(30) + (32) + (32a)...(32e) =			22871.9760	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							133.5824	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							14.3174	(36)
Total fabric heat loss						(33) + (36) =	113.5708	(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	80.4579	79.5729	78.6880	74.2634	73.3784	70.6530	70.6530	70.6530	70.7237	73.3784	75.1483	76.9182	(38)
Heat transfer coeff	194.0287	193.1437	192.2588	187.8342	186.9492	184.2238	184.2238	184.2238	184.2944	186.9492	188.7191	190.4889	(39)
Average = Sum(39)m / 12 =												188.1115	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1332	1.1280	1.1229	1.0970	1.0919	1.0759	1.0759	1.0759	1.0764	1.0919	1.1022	1.1125	(40)
HLP (average)												1.0987	(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												2.9642	(42)
Average daily hot water use (litres/day)												104.5998	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	115.0598	110.8758	106.6918	102.5078	98.3239	94.1399	94.1399	98.3239	102.5078	106.6918	110.8758	115.0598	(44)
Energy conte	170.6304	149.2344	153.9966	134.2579	128.8237	111.1651	103.0108	118.2064	119.6181	139.4034	152.1697	165.2464	(45)
Energy content (annual)										Total = Sum(45)m =		1645.7628	(45)
Distribution loss (46)m = 0.15 x (45)m													
	25.5946	22.3852	23.0995	20.1387	19.3236	16.6748	15.4516	17.7310	17.9427	20.9105	22.8255	24.7870	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.4800	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.7992	(55)
Total storage loss													
	24.7752	22.3776	24.7752	23.9760	24.7752	23.9760	24.7752	24.7752	23.9760	24.7752	23.9760	24.7752	(56)
If cylinder contains dedicated solar storage													
	15.9269	14.3856	15.9269	15.4131	15.9269	15.4131	15.9269	15.9269	15.4131	15.9269	15.4131	15.9269	(57)
Primary loss	23.2624	21.0112	21.8667	15.7584	10.4681	9.9053	10.2355	11.1660	17.1091	21.8667	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	209.8197	184.6312	191.7901	165.4295	155.2187	136.4835	129.1731	145.2992	152.1404	177.1970	190.0948	204.4357	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1079.5246	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1813.6014	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.1020	(H8)
Utilisation factor												0.5965	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												115.5000	(H13)
Daily hot water demand												104.5998	(H14)
Volume ratio Veff/V												1.1042	(H15)
Solar storage volume factor												1.0000	(H16)
Solar input												-951.1520	(H17)
Solar input	-27.5815	-46.0256	-78.3869	-105.0539	-129.7852	-127.5995	-125.9133	-110.0111	-86.1607	-58.8376	-32.7156	-23.0810	(63)
								Solar input (sum of months) = Sum(63)m =				-951.1520	(63)
Output from w/h													
	182.2382	138.6056	113.4032	60.3756	25.4335	8.8839	3.2599	35.2882	65.9797	118.3593	157.3792	181.3547	(64)
								Total per year (kWh/year) = Sum(64)m =				1090.5610	(64)
Heat gains from water heating, kWh/month													
	88.0861	77.9379	81.4387	69.5780	63.9499	57.2171	55.1810	60.9779	65.7908	76.5865	80.9365	86.2959	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	177.8522	177.8522	177.8522	177.8522	177.8522	177.8522	177.8522	177.8522	177.8522	177.8522	177.8522	177.8522	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	84.3923	74.9565	60.9587	46.1497	34.4974	29.1242	31.4697	40.9055	54.9033	69.7123	81.3646	86.7378	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	511.6297	516.9388	503.5600	475.0781	439.1249	405.3339	382.7594	377.4503	390.8291	419.3110	455.2642	489.0552	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.7494	55.7494	55.7494	55.7494	55.7494	55.7494	55.7494	55.7494	55.7494	55.7494	55.7494	55.7494	(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)													
	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	(71)
Water heating gains (Table 5)													
	118.3952	115.9790	109.4606	96.6361	85.9541	79.4682	74.1680	81.9596	91.3762	102.9388	112.4119	115.9891	(72)
Total internal gains													
	832.4507	825.9078	792.0129	735.8974	677.6099	631.9598	606.4306	618.3489	655.1420	709.9956	767.0742	809.8157	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	10.6300	10.6334	0.7200	0.7000	0.7700	39.4792	(74)
East	0.6900	19.6403	0.7200	0.7000	0.7700	4.7333	(76)
South	5.8400	46.7521	0.7200	0.7000	0.7700	95.3625	(78)
West	0.6900	19.6403	0.7200	0.7000	0.7700	4.7333	(80)
South	3.1500	46.7521	0.7200	0.7000	0.7700	51.4369	(78)

Solar gains	195.7452	334.3850	464.9519	596.5360	692.6018	699.8826	669.5336	594.9650	509.5271	371.0985	234.5137	167.5448	(83)
Total gains	1028.1959	1160.2928	1256.9648	1332.4334	1370.2118	1331.8424	1275.9642	1213.3138	1164.6691	1081.0941	1001.5879	977.3605	(84)

7. Mean internal temperature (heating season)

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

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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	32.7443	32.8943	33.0457	33.8241	33.9842	34.4870	34.4870	34.4870	34.4738	33.9842	33.6655	33.3527	
alpha	3.1830	3.1930	3.2030	3.2549	3.2656	3.2991	3.2991	3.2991	3.2983	3.2656	3.2444	3.2235	
util living area	0.9822	0.9726	0.9556	0.9189	0.8474	0.7187	0.5748	0.6165	0.7999	0.9289	0.9723	0.9847	(86)
MIT	19.0544	19.2693	19.6119	20.0758	20.4901	20.8032	20.9316	20.9118	20.6984	20.1700	19.5483	19.0362	(87)
Th 2	19.9738	19.9780	19.9822	20.0033	20.0075	20.0205	20.0205	20.0205	20.0202	20.0075	19.9990	19.9906	(88)
util rest of house	0.9788	0.9675	0.9467	0.9013	0.8111	0.6476	0.4682	0.5125	0.7417	0.9101	0.9662	0.9818	(89)
MIT 2	17.3742	17.6880	18.1856	18.8611	19.4363	19.8437	19.9781	19.9618	19.7250	19.0055	18.1084	17.3579	(90)
Living area fraction									fLA = Living area / (4) =			0.1121	(91)
MIT	17.5626	17.8654	18.3455	18.9973	19.5544	19.9513	20.0850	20.0684	19.8342	19.1361	18.2699	17.5461	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.4126	17.7154	18.1955	18.8473	19.4044	19.8013	19.9350	19.9184	19.6842	18.9861	18.1199	17.3961	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9659	0.9507	0.9250	0.8749	0.7843	0.6295	0.4581	0.5005	0.7178	0.8840	0.9493	0.9704	(94)
Useful gains	993.1423	1103.0477	1162.7447	1165.6993	1074.6575	838.3974	584.5152	607.2484	836.0508	955.7111	950.7842	948.3963	(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	2544.2162	2475.2081	2248.5634	1868.4453	1440.3378	958.2063	614.3843	648.1675	1029.1327	1567.7782	2079.6574	2513.7070	(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	1153.9990	922.0918	807.8491	505.9771	272.0662	0.0000	0.0000	0.0000	0.0000	455.3779	812.7888	1164.5912	(98)
Space heating												6094.7410	(98)
Space heating per m2											(98) / (4) =	35.5960	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.6000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	6727.0872	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1153.9990	922.0918	807.8491	505.9771	272.0662	0.0000	0.0000	0.0000	0.0000	455.3779	812.7888	1164.5912	(98)
Space heating efficiency (main heating system 1)	90.6000	90.6000	90.6000	90.6000	90.6000	0.0000	0.0000	0.0000	0.0000	90.6000	90.6000	90.6000	(210)
Space heating fuel (main heating system)	1273.7296	1017.7614	891.6657	558.4736	300.2938	0.0000	0.0000	0.0000	0.0000	502.6246	897.1178	1285.4207	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	182.2382	138.6056	113.4032	60.3756	25.4335	8.8839	3.2599	35.2882	65.9797	118.3593	157.3792	181.3547	(64)
Efficiency of water heater												79.9000	(216)
(217)m	88.9750	89.0418	89.1307	89.3248	89.5745	79.9000	79.9000	79.9000	79.9000	88.1643	88.6737	88.9942	(217)
Fuel for water heating, kWh/month	204.8196	155.6635	127.2325	67.5911	28.3936	11.1188	4.0799	44.1654	82.5778	134.2485	177.4813	203.7827	(219)
Water heating fuel used												1241.1549	(219)
Annual totals kWh/year													
Space heating fuel - main system												6727.0872	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
(MEVDecentralised, Database: total watage = 10.9710, total flow = 53.0000, SFP = 0.2070)													
mechanical ventilation fans (SFP = 0.2070)												108.1376	(230a)
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												233.1376	(231)
Electricity for lighting (calculated in Appendix L)												596.1578	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.04 * 1068 * 1.00) =										-888.6346		-888.6346	(233)
Total delivered energy for all uses												7908.9029	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	6727.0872	3.4800	234.1026	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1241.1549	3.4800	43.1922	(247)
Mechanical ventilation fans	108.1376	13.1900	14.2634	(249)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	596.1578	13.1900	78.6332	(250)
Additional standing charges			120.0000	(251)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Energy saving/generation technologies				
PV Unit	-888.6346	13.1900	-117.2109	(252)
Total energy cost			389.4680	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):			0.4200	(256)
Energy cost factor (ECF)		[(255) x (256)] / [(4) + 45.0] =	0.7565	(257)
SAP value			89.4464	
SAP rating (Section 12)			89	(258)
SAP band			B	

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	6727.0872	0.2160	1453.0508	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1241.1549	0.2160	268.0895	(264)
Space and water heating			1721.1403	(265)
Pumps and fans	233.1376	0.5190	120.9984	(267)
Energy for lighting	596.1578	0.5190	309.4059	(268)
Energy saving/generation technologies				
PV Unit	-888.6346	0.5190	-461.2014	(269)
Total kg/year			1690.3433	(272)
CO2 emissions per m2			9.8700	(273)
EI value			89.5243	
EI rating			90	(274)
EI band			B	

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	65.2700 (1b)	x	2.3800 (2b)	=	155.3426	(1b) - (3b)
First floor	64.0600 (1c)	x	2.6900 (2c)	=	172.3214	(1c) - (3c)
Second floor	41.8900 (1d)	x	2.4000 (2d)	=	100.5360	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	171.2200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	428.2000	(5)

2. Ventilation rate

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

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			0.0000 / (5) =	0.0000	(8)
Pressure test				Yes	
Measured/design AP50				5.0100	
Infiltration rate				0.2505	(18)
Number of sides sheltered				0	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.2505	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.2630	0.2505	0.2505	0.2317	0.2317	0.2067	0.2129	0.2004	0.2067	0.2192	0.2192	0.2380	(22b)
Mechanical extract ventilation - decentralised													
If mechanical ventilation:												0.5000	(23a)
Effective ac	0.5130	0.5005	0.5005	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			1.9800	1.3000	2.5740			(26)
Half Glaze			1.9800	1.5000	2.9700			(26a)
Window (Uw = 1.40)			17.8500	1.3258	23.6648			(27)
French Door (Uw = 1.40)			3.1500	1.3258	4.1761			(27)
Ground Floor			65.2700	0.1300	8.4851	75.0000	4895.2500	(28a)
125mm Cavity	193.4500	21.4800	171.9700	0.2400	41.2728	52.8000	9080.0160	(29a)
Wall to Void	28.5800		28.5800	0.1400	4.0012	9.0000	257.2200	(29a)
Dormer Cheek	13.5800	3.4800	10.1000	0.2500	2.5250	9.0000	90.9000	(29a)
400mm Mineral Wool	16.9100		16.9100	0.1100	1.8601	9.0000	152.1900	(30)
Sloping	21.5900		21.5900	0.2000	4.3180	9.0000	194.3100	(30)
Ceiling to Void	22.1700		22.1700	0.1400	3.1038	9.0000	199.5300	(30)
Bay Flat Roof	1.2100		1.2100	0.2500	0.3025	9.0000	10.8900	(30)
Total net area of external elements Aum(A, m2)			362.7600					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	99.2534			(33)
Timber GF			77.7200			9.0000	699.4800	(32c)
Timber 1F			144.8200			9.0000	1303.3800	(32c)
Timber 2F			57.5000			9.0000	517.5000	(32c)
Masonry GF			42.4900			39.0000	1657.1100	(32c)
Internal Floor			64.0600			18.0000	1153.0800	(32d)
Internal Floor			41.8900			18.0000	754.0200	(32d)
Internal Ceiling			64.0600			18.0000	1153.0800	(32e)
Internal Ceiling			41.8900			18.0000	754.0200	(32e)
Heat capacity Cm = Sum(A x k)				(28)...(30) + (32) + (32a)...(32e) =			22871.9760	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							133.5824	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							14.3174	(36)
Total fabric heat loss						(33) + (36) =	113.5708	(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	72.4935	70.7237	70.7237	70.6530	70.6530	70.6530	70.6530	70.6530	70.6530	70.6530	70.6530	70.6530	(38)
Heat transfer coeff	186.0643	184.2944	184.2944	184.2238	184.2238	184.2238	184.2238	184.2238	184.2238	184.2238	184.2238	184.2238	(39)
Average = Sum(39)m / 12 =												184.3889	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0867	1.0764	1.0764	1.0759	1.0759	1.0759	1.0759	1.0759	1.0759	1.0759	1.0759	1.0759	(40)
HLP (average)												1.0769	(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												2.9642	(42)
Average daily hot water use (litres/day)												104.5998	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	115.0598	110.8758	106.6918	102.5078	98.3239	94.1399	94.1399	98.3239	102.5078	106.6918	110.8758	115.0598	(44)
Energy conte	170.6304	149.2344	153.9966	134.2579	128.8237	111.1651	103.0108	118.2064	119.6181	139.4034	152.1697	165.2464	(45)
Energy content (annual)										Total = Sum(45)m =		1645.7628	(45)
Distribution loss (46)m = 0.15 x (45)m													
	25.5946	22.3852	23.0995	20.1387	19.3236	16.6748	15.4516	17.7310	17.9427	20.9105	22.8255	24.7870	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.4800	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.7992	(55)
Total storage loss													
	24.7752	22.3776	24.7752	23.9760	24.7752	23.9760	24.7752	24.7752	23.9760	24.7752	23.9760	24.7752	(56)
If cylinder contains dedicated solar storage													
	15.9269	14.3856	15.9269	15.4131	15.9269	15.4131	15.9269	15.9269	15.4131	15.9269	15.4131	15.9269	(57)
Primary loss	23.2624	21.0112	21.8667	15.7584	10.4681	9.9053	10.2355	11.1660	17.1091	21.8667	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	209.8197	184.6312	191.7901	165.4295	155.2187	136.4835	129.1731	145.2992	152.1404	177.1970	190.0948	204.4357	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1140.0998	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1915.3676	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.1638	(H8)
Utilisation factor												0.5765	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												115.5000	(H13)
Daily hot water demand												104.5998	(H14)
Volume ratio Veff/V												1.1042	(H15)
Solar storage volume factor												1.0000	(H16)
Solar input												-970.9523	(H17)
Solar input	-29.8854	-44.9177	-75.6472	-104.5675	-125.9345	-132.5405	-129.3580	-115.5175	-90.1618	-61.3354	-36.3265	-24.7603	(63)
								Solar input (sum of months) = Sum(63)m =				-970.9523	(63)
Output from w/h													
	179.9343	139.7135	116.1430	60.8620	29.2842	3.9429	0.0000	29.7818	61.9786	115.8616	153.7683	179.6755	(64)
								Total per year (kWh/year) = Sum(64)m =				1070.9456	(64)
Heat gains from water heating, kWh/month													
	88.0861	77.9379	81.4387	69.5780	63.9499	57.2171	55.1810	60.9779	65.7908	76.5865	80.9365	86.2959	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	177.8522	177.8522	177.8522	177.8522	177.8522	177.8522	177.8522	177.8522	177.8522	177.8522	177.8522	177.8522	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	84.3923	74.9565	60.9587	46.1497	34.4974	29.1242	31.4697	40.9055	54.9033	69.7123	81.3646	86.7378	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	511.6297	516.9388	503.5600	475.0781	439.1249	405.3339	382.7594	377.4503	390.8291	419.3110	455.2642	489.0552	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.7494	55.7494	55.7494	55.7494	55.7494	55.7494	55.7494	55.7494	55.7494	55.7494	55.7494	55.7494	(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)													
	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	(71)
Water heating gains (Table 5)													
	118.3952	115.9790	109.4606	96.6361	85.9541	79.4682	74.1680	81.9596	91.3762	102.9388	112.4119	115.9891	(72)
Total internal gains													
	832.4507	825.9078	792.0129	735.8974	677.6099	631.9598	606.4306	618.3489	655.1420	709.9956	767.0742	809.8157	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	10.6300	11.9814	0.7200	0.7000	0.7700	44.4842	(74)
East	0.6900	22.3313	0.7200	0.7000	0.7700	5.3818	(76)
South	5.8400	50.9848	0.7200	0.7000	0.7700	103.9962	(78)
West	0.6900	22.3313	0.7200	0.7000	0.7700	5.3818	(80)
South	3.1500	50.9848	0.7200	0.7000	0.7700	56.0938	(78)

Solar gains	215.3379	331.4135	457.2246	609.1577	693.2274	751.4324	710.3809	642.5209	544.6637	393.1969	264.3557	182.5173	(83)
Total gains	1047.7886	1157.3213	1249.2375	1345.0551	1370.8373	1383.3922	1316.8115	1260.8698	1199.8057	1103.1925	1031.4299	992.3329	(84)

7. Mean internal temperature (heating season)

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

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

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	34.1459	34.4738	34.4738	34.4870	34.4870	34.4870	34.4870	34.4870	34.4870	34.4870	34.4870	34.4870	
alpha	3.2764	3.2983	3.2983	3.2991	3.2991	3.2991	3.2991	3.2991	3.2991	3.2991	3.2991	3.2991	
util living area	0.9782	0.9686	0.9469	0.8971	0.7944	0.5954	0.4176	0.4465	0.7211	0.9042	0.9637	0.9812	(86)
MIT	19.2904	19.4771	19.8262	20.2565	20.6586	20.9136	20.9813	20.9764	20.8197	20.3488	19.7574	19.2655	(87)
Th 2	20.0117	20.0202	20.0202	20.0205	20.0205	20.0205	20.0205	20.0205	20.0205	20.0205	20.0205	20.0205	(88)
util rest of house	0.9740	0.9626	0.9360	0.8742	0.7446	0.5014	0.2929	0.3190	0.6420	0.8780	0.9554	0.9776	(89)
MIT 2	17.7402	18.0151	18.5178	19.1260	19.6663	19.9594	20.0140	20.0117	19.8674	19.2636	18.4238	17.7098	(90)
Living area fraction									fLA = Living area / (4) =			0.1121	(91)
MIT	17.9140	18.1790	18.6645	19.2528	19.7776	20.0664	20.1225	20.1199	19.9742	19.3853	18.5733	17.8842	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.7640	18.0290	18.5145	19.1028	19.6276	19.9164	19.9725	19.9699	19.8242	19.2353	18.4233	17.7342	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9597	0.9450	0.9133	0.8472	0.7212	0.4905	0.2865	0.3121	0.6237	0.8507	0.9360	0.9646	(94)
Useful gains	1005.5751	1093.6934	1140.9122	1139.5922	988.6122	678.5798	377.2138	393.5292	748.3171	938.4856	965.4336	957.2488	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	2356.3209	2290.6027	2048.3452	1695.3694	1220.9627	721.5010	381.7989	399.7437	851.8909	1406.5964	1920.2240	2327.5240	(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	1004.9549	804.3230	675.1302	400.1596	172.8688	0.0000	0.0000	0.0000	0.0000	348.2744	687.4491	1019.4848	(98)
Space heating												5112.6448	(98)
Space heating per m2											(98) / (4) =	29.8601	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.6000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	5643.0959	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1004.9549	804.3230	675.1302	400.1596	172.8688	0.0000	0.0000	0.0000	0.0000	348.2744	687.4491	1019.4848	(98)
Space heating efficiency (main heating system 1)	90.6000	90.6000	90.6000	90.6000	90.6000	0.0000	0.0000	0.0000	0.0000	90.6000	90.6000	90.6000	(210)
Space heating fuel (main heating system)	1109.2217	887.7738	745.1768	441.6773	190.8044	0.0000	0.0000	0.0000	0.0000	384.4088	758.7738	1125.2591	(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	179.9343	139.7135	116.1430	60.8620	29.2842	3.9429	0.0000	29.7818	61.9786	115.8616	153.7683	179.6755	(64)
Efficiency of water heater												79.9000	(216)
(217)m	88.7942	88.8393	88.8535	89.0261	88.8759	79.9000	79.9000	79.9000	79.9000	87.6693	88.4352	88.8178	(217)
Fuel for water heating, kWh/month	202.6418	157.2655	130.7130	68.3642	32.9496	4.9348	0.0000	37.2738	77.5702	132.1576	173.8769	202.2966	(219)
Water heating fuel used												1220.0439	(219)
Annual totals kWh/year													
Space heating fuel - main system												5643.0959	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
(MEVDecentralised, Database: total watage = 10.9710, total flow = 53.0000, SFP = 0.2070)													
mechanical ventilation fans (SFP = 0.2070)												108.1376	(230a)
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												233.1376	(231)
Electricity for lighting (calculated in Appendix L)												596.1578	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.04 * 1121 * 1.00) =										-932.6538		-932.6538	(233)
Total delivered energy for all uses												6759.7814	(238)

10a. Fuel costs - using BEDF prices (467)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	5643.0959	3.9500	222.9023	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1220.0439	3.9500	48.1917	(247)
Mechanical ventilation fans	108.1376	18.7000	20.2217	(249)
Pumps and fans for heating	75.0000	18.7000	14.0250	(249)
Pump for solar water heating	50.0000	18.7000	9.3500	(249)
Energy for lighting	596.1578	18.7000	111.4815	(250)
Additional standing charges			91.0000	(251)

Energy saving/generation technologies			
PV Unit	-932.6538	18.7000	-174.4063 (252)
Total energy cost			342.7660 (255)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	5643.0959	0.2160	1218.9087	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1220.0439	0.2160	263.5295	(264)
Space and water heating			1482.4382	(265)
Pumps and fans	233.1376	0.5190	120.9984	(267)
Energy for lighting	596.1578	0.5190	309.4059	(268)
Energy saving/generation technologies				
PV Unit	-932.6538	0.5190	-484.0473	(269)
Total kg/year			1428.7952	(272)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	5643.0959	1.2200	6884.5769	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1220.0439	1.2200	1488.4536	(264)
Space and water heating			8373.0305	(265)
Pumps and fans	233.1376	3.0700	715.7325	(267)
Energy for lighting	596.1578	3.0700	1830.2045	(268)
Energy saving/generation technologies				
PV Unit	-932.6538	3.0700	-2863.2472	(269)
Primary energy kWh/year			8055.7203	(272)
Primary energy kWh/m2/year			47.0489	(273)

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

Overheating Calculation Input Data

Dwelling type	Detached House
Number of storeys	3
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	North
Overshading	Average or unknown
Thermal mass parameter	133.6 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient		565.22 (P1)
Transmission heat loss coefficient		113.57 (37)
Summer heat loss coefficient		678.79 (P2)

Overhangs

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

Solar shading

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

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North	10.6300	81.1852	0.7200	0.7000	0.9000	352.3105
East	0.6900	117.5071	0.7200	0.7000	0.9000	33.1000
South	5.8400	112.2060	0.7200	0.7000	0.9000	267.5127
West	0.6900	117.5071	0.7200	0.7000	0.9000	33.1000
South	3.1500	112.2060	0.7200	0.7000	0.9000	144.2920
total:						830.3153

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

	Jun	Jul	Aug	
Solar gains	878	830	751	(P3)
Internal gains	652	627	638	
Total summer gains	1531	1457	1389	(P5)
Summer gain/loss ratio	2.26	2.15	2.05	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 133.6)	1.06	1.06	1.06	
Threshold temperature	19.32	21.11	20.91	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight

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

AES Sustainability Consultants

Property Reference	4907-0026-4282-181	**Issued on Date**	16/02/2021
Assessment Reference	181	**Prop Type Ref**	Fletcher - Det (Op)
Property	Plot 181, 5 Bed, K, U, WC, B, 2ES		

SAP Rating	88 B	**DER**	12.55	**TER**	15.54
Environmental	88 B	**% DER<TER**	19.22		
CO_2 Emissions (t/year)	1.69	**DFEE**	48.86	**TFEE**	56.33
General Requirements Compliance	Pass	**% DFEE<TFEE**	13.25		

Assessor Details	Mr. Silvio Junges, Silvio Junges, Tel: 01884 242050, silvio.junges@aessouthern.co.uk	**Assessor ID**	P637-0001
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 171 m²

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

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 15.54 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 12.55 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)56.3 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)48.9 kWh/m²/yrOK

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2 Fabric U-values

Element	Average	Highest	
External wall	0.23 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.13 (max. 0.25)	0.13 (max. 0.70)	OK
Roof	0.15 (max. 0.20)	0.25 (max. 0.35)	OK
Openings	1.40 (max. 2.00)	1.50 (max. 3.30)	OK

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

---
3 Air permeability
Air permeability at 50 pascals: 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 SYSTEM s18

Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

---
5 Cylinder insulation
Hot water storage: Measured cylinder loss: 1.48 kWh/day
Permitted by DBSCG 2.30 OK
Primary pipework insulated: Yes OK

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

Hot water controls: Cylinderstat OK
Independent timer for DHW OK

Boiler interlock: Yes OK

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

---
8 Mechanical ventilation
Continuous extract system (decentralised)
Specific fan power: 0.1900 0.1800 0.1600
Maximum: 0.7 OK

---
9 Summertime temperature
Overheating risk (Thames Valley): Slight OK
Based on:
Overshading: Average
Windows facing North: 10.63 m², No overhang
Windows facing East: 0.69 m², No overhang
Windows facing South: 8.99 m², No overhang
Windows facing West: 0.69 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

---
10 Key features
External wall U-value: 0.14 W/m²K
Party wall U-value: 0.00 W/m²K
Roof U-value: 0.11 W/m²K
Thermal bridging y-value: 0.039 W/m²K
Photovoltaic array: 1.04 kW

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	65.2700 (1b)	x	2.3800 (2b)	=	155.3426	(1b) - (3b)
First floor	64.0600 (1c)	x	2.6900 (2c)	=	172.3214	(1c) - (3c)
Second floor	41.8900 (1d)	x	2.4000 (2d)	=	100.5360	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	171.2200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	428.2000	(5)

2. Ventilation rate

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

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			0.0000 / (5) =	0.0000	(8)
Pressure test				Yes	
Measured/design AP50				5.0100	
Infiltration rate				0.2505	(18)
Number of sides sheltered				0	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.2505	(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	0.3194	0.3131	0.3069	0.2756	0.2693	0.2380	0.2380	0.2317	0.2505	0.2693	0.2818	0.2943	(22b)
Mechanical extract ventilation - decentralised													
If mechanical ventilation:												0.5000	(23a)
Effective ac	0.5694	0.5631	0.5569	0.5256	0.5193	0.5000	0.5000	0.5000	0.5005	0.5193	0.5318	0.5443	(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	
Solid Door			1.9800	1.3000	2.5740			(26)
Half Glaze			1.9800	1.5000	2.9700			(26a)
Window (Uw = 1.40)			17.8500	1.3258	23.6648			(27)
French Door (Uw = 1.40)			3.1500	1.3258	4.1761			(27)
Ground Floor			65.2700	0.1300	8.4851	75.0000	4895.2500	(28a)
125mm Cavity	193.4500	21.4800	171.9700	0.2400	41.2728	52.8000	9080.0160	(29a)
Wall to Void	28.5800		28.5800	0.1400	4.0012	9.0000	257.2200	(29a)
Dormer Cheek	13.5800	3.4800	10.1000	0.2500	2.5250	9.0000	90.9000	(29a)
400mm Mineral Wool	16.9100		16.9100	0.1100	1.8601	9.0000	152.1900	(30)
Sloping	21.5900		21.5900	0.2000	4.3180	9.0000	194.3100	(30)
Ceiling to Void	22.1700		22.1700	0.1400	3.1038	9.0000	199.5300	(30)
Bay Flat Roof	1.2100		1.2100	0.2500	0.3025	9.0000	10.8900	(30)
Total net area of external elements Aum(A, m2)			362.7600					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	99.2534			(33)
Timber GF			77.7200			9.0000	699.4800	(32c)
Timber 1F			144.8200			9.0000	1303.3800	(32c)
Timber 2F			57.5000			9.0000	517.5000	(32c)
Masonry GF			42.4900			39.0000	1657.1100	(32c)
Internal Floor			64.0600			18.0000	1153.0800	(32d)
Internal Floor			41.8900			18.0000	754.0200	(32d)
Internal Ceiling			64.0600			18.0000	1153.0800	(32e)
Internal Ceiling			41.8900			18.0000	754.0200	(32e)
Heat capacity Cm = Sum(A x k)				(28)...(30) + (32) + (32a)...(32e) =			22871.9760	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							133.5824	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							14.3174	(36)
Total fabric heat loss					(33) + (36) =		113.5708	(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	80.4579	79.5729	78.6880	74.2634	73.3784	70.6530	70.6530	70.6530	70.7237	73.3784	75.1483	76.9182	(38)
Heat transfer coeff	194.0287	193.1437	192.2588	187.8342	186.9492	184.2238	184.2238	184.2238	184.2944	186.9492	188.7191	190.4889	(39)
Average = Sum(39)m / 12 =												188.1115	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1332	1.1280	1.1229	1.0970	1.0919	1.0759	1.0759	1.0759	1.0764	1.0919	1.1022	1.1125	(40)
HLP (average)												1.0987	(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												2.9642	(42)
Average daily hot water use (litres/day)												104.5998	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	115.0598	110.8758	106.6918	102.5078	98.3239	94.1399	94.1399	98.3239	102.5078	106.6918	110.8758	115.0598	(44)
Energy conte	170.6304	149.2344	153.9966	134.2579	128.8237	111.1651	103.0108	118.2064	119.6181	139.4034	152.1697	165.2464	(45)
Energy content (annual)										Total = Sum(45)m =		1645.7628	(45)
Distribution loss (46)m = 0.15 x (45)m													
	25.5946	22.3852	23.0995	20.1387	19.3236	16.6748	15.4516	17.7310	17.9427	20.9105	22.8255	24.7870	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.4800	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.7992	(55)
Total storage loss													
	24.7752	22.3776	24.7752	23.9760	24.7752	23.9760	24.7752	24.7752	23.9760	24.7752	23.9760	24.7752	(56)
If cylinder contains dedicated solar storage													
	24.7752	22.3776	24.7752	23.9760	24.7752	23.9760	24.7752	24.7752	23.9760	24.7752	23.9760	24.7752	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	218.6680	192.6232	202.0342	180.7459	176.8613	157.6531	151.0484	166.2440	166.1061	187.4410	198.6577	213.2840	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	218.6680	192.6232	202.0342	180.7459	176.8613	157.6531	151.0484	166.2440	166.1061	187.4410	198.6577	213.2840	(64)
								Total per year (kWh/year) = Sum(64)m =				2211.3668	(64)
Heat gains from water heating, kWh/month													
	95.1647	84.3315	89.6339	81.8312	81.2640	74.1528	72.6812	77.7337	76.9634	84.7817	87.7868	93.3745	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	148.2102	148.2102	148.2102	148.2102	148.2102	148.2102	148.2102	148.2102	148.2102	148.2102	148.2102	148.2102	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	33.7569	29.9826	24.3835	18.4599	13.7990	11.6497	12.5879	16.3622	21.9613	27.8849	32.5458	34.6951	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	342.7919	346.3490	337.3852	318.3023	294.2137	271.5737	256.4488	252.8917	261.8555	280.9383	305.0270	327.6670	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.8210	37.8210	37.8210	37.8210	37.8210	37.8210	37.8210	37.8210	37.8210	37.8210	37.8210	37.8210	(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)													
	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	(71)
Water heating gains (Table 5)													
	127.9095	125.4933	120.4757	113.6544	109.2258	102.9900	97.6897	104.4808	106.8936	113.9539	121.9261	125.5034	(72)
Total internal gains													
	574.9214	572.2879	552.7075	520.8797	487.7014	456.6764	437.1895	444.1977	461.1735	493.2402	529.9621	558.3286	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	10.6300	10.6334	0.7200	0.7000	0.7700	39.4792	(74)
East	0.6900	19.6403	0.7200	0.7000	0.7700	4.7333	(76)
South	5.8400	46.7521	0.7200	0.7000	0.7700	95.3625	(78)
West	0.6900	19.6403	0.7200	0.7000	0.7700	4.7333	(80)
South	3.1500	46.7521	0.7200	0.7000	0.7700	51.4369	(78)

Solar gains	195.7452	334.3850	464.9519	596.5360	692.6018	699.8826	669.5336	594.9650	509.5271	371.0985	234.5137	167.5448	(83)
Total gains	770.6665	906.6729	1017.6594	1117.4157	1180.3033	1156.5590	1106.7231	1039.1627	970.7006	864.3387	764.4758	725.8734	(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	32.7443	32.8943	33.0457	33.8241	33.9842	34.4870	34.4870	34.4870	34.4738	33.9842	33.6655	33.3527	
alpha	3.1830	3.1930	3.2030	3.2549	3.2656	3.2991	3.2991	3.2991	3.2983	3.2656	3.2444	3.2235	
util living area													
	0.9921	0.9861	0.9745	0.9470	0.8879	0.7747	0.6373	0.6840	0.8586	0.9594	0.9870	0.9935	(86)
MIT	18.8405	19.0645	19.4286	19.9293	20.3902	20.7490	20.9067	20.8788	20.6114	20.0156	19.3552	18.8245	(87)
Th 2	19.9738	19.9780	19.9822	20.0033	20.0075	20.0205	20.0205	20.0205	20.0202	20.0075	19.9990	19.9906	(88)
util rest of house													
	0.9905	0.9833	0.9690	0.9345	0.8580	0.7082	0.5274	0.5793	0.8100	0.9475	0.9839	0.9922	(89)
MIT 2	17.0637	17.3925	17.9242	18.6587	19.3088	19.7874	19.9602	19.9361	19.6243	18.7923	17.8304	17.0502	(90)
Living area fraction									fLA = Living area / (4) =			0.1121	(91)
MIT	17.2629	17.5800	18.0929	18.8012	19.4300	19.8952	20.0663	20.0418	19.7350	18.9294	18.0014	17.2492	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.1129	17.4300	17.9429	18.6512	19.2800	19.7452	19.9163	19.8918	19.5850	18.7794	17.8514	17.0992	(93)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9833	0.9723	0.9527	0.9111	0.8302	0.6861	0.5143	0.5635	0.7826	0.9260	0.9733	0.9861	(94)
Useful gains	757.7849	881.5942	969.4845	1018.0592	979.8469	793.5680	569.1520	585.5709	759.7186	800.4087	744.0765	715.7752	(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	2486.0702	2420.0817	2200.0033	1831.6103	1417.0802	947.8669	610.9446	643.2762	1010.8525	1529.1390	2028.9966	2457.1490	(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	1285.8442	1033.8636	915.5060	585.7568	325.3016	0.0000	0.0000	0.0000	0.0000	542.1754	925.1425	1295.5821	(98)
Space heating												6909.1721	(98)
Space heating per m2											(98) / (4) =	40.3526	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.6000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	7626.0178	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1285.8442	1033.8636	915.5060	585.7568	325.3016	0.0000	0.0000	0.0000	0.0000	542.1754	925.1425	1295.5821	(98)
Space heating efficiency (main heating system 1)	90.6000	90.6000	90.6000	90.6000	90.6000	0.0000	0.0000	0.0000	0.0000	90.6000	90.6000	90.6000	(210)
Space heating fuel (main heating system)	1419.2541	1141.1298	1010.4922	646.5307	359.0525	0.0000	0.0000	0.0000	0.0000	598.4276	1021.1286	1430.0023	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	218.6680	192.6232	202.0342	180.7459	176.8613	157.6531	151.0484	166.2440	166.1061	187.4410	198.6577	213.2840	(64)
Efficiency of water heater												79.9000	(216)
(217)m	88.8703	88.7337	88.4584	87.8266	86.5193	79.9000	79.9000	79.9000	79.9000	87.5867	88.5048	88.9168	(217)
Fuel for water heating, kWh/month	246.0531	217.0800	228.3946	205.7987	204.4184	197.3130	189.0468	208.0650	207.8925	214.0063	224.4597	239.8691	(219)
Water heating fuel used												2582.3972	(219)
Annual totals kWh/year													
Space heating fuel - main system												7626.0178	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
(MEVDecentralised, Database: total watage = 10.9710, total flow = 53.0000, SFP = 0.2070)													
mechanical ventilation fans (SFP = 0.2070)												108.1376	(230a)
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												183.1376	(231)
Electricity for lighting (calculated in Appendix L)												596.1578	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.04 * 1068 * 1.00) =										-888.6346		-888.6346	(233)
Total delivered energy for all uses												10099.0758	(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	7626.0178	0.2160	1647.2198	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2582.3972	0.2160	557.7978	(264)
Space and water heating			2205.0176	(265)
Pumps and fans	183.1376	0.5190	95.0484	(267)
Energy for lighting	596.1578	0.5190	309.4059	(268)
Energy saving/generation technologies				
PV Unit	-888.6346	0.5190	-461.2014	(269)
Total CO2, kg/year			2148.2706	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			12.5500	(273)

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

DER		12.5500	ZC1
Total Floor Area	TFA	171.2200	
Assumed number of occupants	N	2.9642	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		11.8638	ZC2
CO2 emissions from cooking, equation (L16)		1.1105	ZC3
Total CO2 emissions		25.5243	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		25.5243	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	65.2700 (1b)	x	2.3800 (2b)	=	155.3426 (1b) - (3b)	
First floor	64.0600 (1c)	x	2.6900 (2c)	=	172.3214 (1c) - (3c)	
Second floor	41.8900 (1d)	x	2.4000 (2d)	=	100.5360 (1d) - (3d)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	171.2200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	428.2000	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							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) =	0.0934	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.3434	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3434	(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	0.4379	0.4293	0.4207	0.3778	0.3692	0.3262	0.3262	0.3177	0.3434	0.3692	0.3863	0.4035	(22b)
Effective ac	0.5959	0.5921	0.5885	0.5713	0.5681	0.5532	0.5532	0.5505	0.5590	0.5681	0.5746	0.5814	(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			1.9800	1.0000	1.9800			(26)
TER Semi-glazed door			1.9800	1.2000	2.3760			(26a)
TER Opening Type (Uw = 1.40)			21.0000	1.3258	27.8409			(27)
Ground Floor			65.2700	0.1300	8.4851			(28a)
125mm Cavity	193.4500	21.4800	171.9700	0.1800	30.9546			(29a)
Wall to Void	28.5800		28.5800	0.1800	5.1444			(29a)
Dormer Cheek	13.5800	3.4800	10.1000	0.1800	1.8180			(29a)
400mm Mineral Wool	16.9100		16.9100	0.1300	2.1983			(30)
Sloping	21.5900		21.5900	0.1300	2.8067			(30)
Ceiling to Void	22.1700		22.1700	0.1300	2.8821			(30)
Bay Flat Roof	1.2100		1.2100	0.1300	0.1573			(30)
Total net area of external elements Aum(A, m2)			362.7600					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		86.6434			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		16.0444	(36)
Total fabric heat loss	(33) + (36) =	102.6878	(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	84.1983	83.6723	83.1567	80.7351	80.2821	78.1729	78.1729	77.7824	78.9853	80.2821	81.1986	82.1568	(38)
Heat transfer coeff	186.8861	186.3601	185.8445	183.4229	182.9699	180.8608	180.8608	180.4702	181.6732	182.9699	183.8864	184.8447	(39)
Average = Sum(39)m / 12 =												183.4208	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0915	1.0884	1.0854	1.0713	1.0686	1.0563	1.0563	1.0540	1.0611	1.0686	1.0740	1.0796	(40)
HLP (average)												1.0713	(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	2.9642	(42)
Average daily hot water use (litres/day)	104.5998	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	115.0598	110.8758	106.6918	102.5078	98.3239	94.1399	94.1399	98.3239	102.5078	106.6918	110.8758	115.0598	(44)
Energy conte	170.6304	149.2344	153.9966	134.2579	128.8237	111.1651	103.0108	118.2064	119.6181	139.4034	152.1697	165.2464	(45)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Energy content (annual)											Total = Sum(45)m =	1645.7628	(45)
Distribution loss (46)m = 0.15 x (45)m													
	25.5946	22.3852	23.0995	20.1387	19.3236	16.6748	15.4516	17.7310	17.9427	20.9105	22.8255	24.7870	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.7016	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.9188	(55)
Total storage loss													
	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(56)
If cylinder contains dedicated solar storage													
	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	222.3770	195.9733	205.7432	184.3353	180.5703	161.2424	154.7574	169.9529	169.6955	191.1500	202.2470	216.9930	(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													
	222.3770	195.9733	205.7432	184.3353	180.5703	161.2424	154.7574	169.9529	169.6955	191.1500	202.2470	216.9930	(64)
									Total per year (kWh/year) = Sum(64)m =			2255.0372	(64)
Heat gains from water heating, kWh/month													
	98.1319	87.0115	92.6011	84.7026	84.2312	77.0243	75.6484	80.7009	79.8349	87.7489	90.6583	96.3417	(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	148.2102	148.2102	148.2102	148.2102	148.2102	148.2102	148.2102	148.2102	148.2102	148.2102	148.2102	148.2102	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	33.7569	29.9826	24.3835	18.4599	13.7990	11.6497	12.5879	16.3622	21.9613	27.8849	32.5458	34.6951	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	342.7919	346.3490	337.3852	318.3023	294.2137	271.5737	256.4488	252.8917	261.8555	280.9383	305.0270	327.6670	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.8210	37.8210	37.8210	37.8210	37.8210	37.8210	37.8210	37.8210	37.8210	37.8210	37.8210	37.8210	(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)													
	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	(71)
Water heating gains (Table 5)													
	131.8977	129.4815	124.4639	117.6426	113.2139	106.9781	101.6779	108.4689	110.8818	117.9421	125.9143	129.4915	(72)
Total internal gains													
	578.9096	576.2761	556.6956	524.8678	491.6896	460.6646	441.1776	448.1859	465.1617	497.2284	533.9502	562.3167	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	10.6300	10.6334	0.6300	0.7000	0.7700	34.5443	(74)
East	0.6900	19.6403	0.6300	0.7000	0.7700	4.1416	(76)
South	8.9900	46.7521	0.6300	0.7000	0.7700	128.4495	(78)
West	0.6900	19.6403	0.6300	0.7000	0.7700	4.1416	(80)

Solar gains	171.2770	292.5868	406.8329	521.9690	606.0266	612.3973	585.8419	520.5944	445.8362	324.7112	205.1995	146.6017	(83)
Total gains	750.1866	868.8629	963.5285	1046.8369	1097.7162	1073.0618	1027.0195	968.7803	910.9979	821.9396	739.1497	708.9185	(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	63.6231	63.8027	63.9797	64.8244	64.9849	65.7427	65.7427	65.8850	65.4487	64.9849	64.6610	64.3258	
alpha	5.2415	5.2535	5.2653	5.3216	5.3323	5.3828	5.3828	5.3923	5.3632	5.3323	5.3107	5.2884	
util living area													
	0.9996	0.9989	0.9971	0.9902	0.9634	0.8734	0.7199	0.7719	0.9432	0.9935	0.9990	0.9997	(86)
MIT	19.6854	19.8171	20.0376	20.3418	20.6414	20.8771	20.9685	20.9540	20.7802	20.3952	19.9890	19.6683	(87)
Th 2	20.0078	20.0103	20.0128	20.0244	20.0265	20.0367	20.0367	20.0386	20.0328	20.0265	20.0221	20.0175	(88)
util rest of house													
	0.9994	0.9986	0.9960	0.9858	0.9443	0.8043	0.5885	0.6486	0.9044	0.9899	0.9986	0.9996	(89)
MIT 2	18.2328	18.4273	18.7514	19.2024	19.6295	19.9384	20.0227	20.0154	19.8254	19.2835	18.6877	18.2148	(90)
Living area fraction										fLA = Living area / (4) =		0.1121	(91)
MIT	18.3957	18.5831	18.8956	19.3302	19.7430	20.0437	20.1287	20.1206	19.9325	19.4082	18.8336	18.3778	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.3957	18.5831	18.8956	19.3302	19.7430	20.0437	20.1287	20.1206	19.9325	19.4082	18.8336	18.3778	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9990	0.9977	0.9941	0.9813	0.9369	0.8049	0.6023	0.6605	0.8990	0.9863	0.9978	0.9993	(94)
Useful gains	749.4443	866.8582	957.8107	1027.2503	1028.4678	863.6870	618.6071	639.8862	819.0246	810.6708	737.5043	708.4046	(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													
	2634.2948	2549.9912	2303.6633	1913.1324	1471.6228	984.5445	638.2091	671.4638	1059.6049	1611.6301	2157.6490	2620.6912	(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													
	1402.3288	1131.0654	1001.3143	637.8351	329.7073	0.0000	0.0000	0.0000	0.0000	595.9137	1022.5042	1422.7413	(98)
Space heating												7543.4100	(98)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Space heating per m2 (98) / (4) = 44.0568 (99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												8067.8182	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1402.3288	1131.0654	1001.3143	637.8351	329.7073	0.0000	0.0000	0.0000	0.0000	595.9137	1022.5042	1422.7413	(98)
Space heating efficiency (main heating system 1)													
	93.5000	93.5000	93.5000	93.5000	93.5000	0.0000	0.0000	0.0000	0.0000	93.5000	93.5000	93.5000	(210)
Space heating fuel (main heating system)													
	1499.8169	1209.6956	1070.9244	682.1766	352.6282	0.0000	0.0000	0.0000	0.0000	637.3408	1093.5873	1521.6484	(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													
	222.3770	195.9733	205.7432	184.3353	180.5703	161.2424	154.7574	169.9529	169.6955	191.1500	202.2470	216.9930	(64)
Efficiency of water heater												79.8000	(216)
(217)m	88.8690	88.7428	88.4779	87.8587	86.4004	79.8000	79.8000	79.8000	79.8000	87.6459	88.5396	88.9222	(217)
Fuel for water heating, kWh/month													
	250.2300	220.8330	232.5363	209.8087	208.9923	202.0581	193.9315	212.9736	212.6510	218.0936	228.4256	244.0258	(219)
Water heating fuel used												2634.5596	(219)
Annual totals kWh/year													
Space heating fuel - main system												8067.8182	(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)												596.1578	(232)
Total delivered energy for all uses												11373.5356	(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	8067.8182	0.2160	1742.6487	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2634.5596	0.2160	569.0649	(264)
Space and water heating			2311.7136	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	596.1578	0.5190	309.4059	(268)
Total CO2, kg/m2/year			2660.0445	(272)
Emissions per m2 for space and water heating			13.5014	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			1.8071	(272b)
Emissions per m2 for pumps and fans			0.2273	(272c)
Target Carbon Dioxide Emission Rate (TER) = (13.5014 * 1.00) + 1.8071 + 0.2273, rounded to 2 d.p.			15.5400	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	65.2700 (1b)	x	2.3800 (2b)	=	155.3426	(1b) - (3b)
First floor	64.0600 (1c)	x	2.6900 (2c)	=	172.3214	(1c) - (3c)
Second floor	41.8900 (1d)	x	2.4000 (2d)	=	100.5360	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	171.2200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	428.2000	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							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) =	0.0934	(8)
Pressure test			Yes	
Measured/design AP50			5.0100	
Infiltration rate			0.3439	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3439	(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	0.4385	0.4299	0.4213	0.3783	0.3697	0.3267	0.3267	0.3181	0.3439	0.3697	0.3869	0.4041	(22b)
Effective ac	0.5961	0.5924	0.5887	0.5716	0.5683	0.5534	0.5534	0.5506	0.5591	0.5683	0.5748	0.5816	(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	
Solid Door			1.9800	1.3000	2.5740			(26)
Half Glaze			1.9800	1.5000	2.9700			(26a)
Window (Uw = 1.40)			17.8500	1.3258	23.6648			(27)
French Door (Uw = 1.40)			3.1500	1.3258	4.1761			(27)
Ground Floor			65.2700	0.1300	8.4851	75.0000	4895.2500	(28a)
125mm Cavity	193.4500	21.4800	171.9700	0.2400	41.2728	52.8000	9080.0160	(29a)
Wall to Void	28.5800		28.5800	0.1400	4.0012	9.0000	257.2200	(29a)
Dormer Cheek	13.5800	3.4800	10.1000	0.2500	2.5250	9.0000	90.9000	(29a)
400mm Mineral Wool	16.9100		16.9100	0.1100	1.8601	9.0000	152.1900	(30)
Sloping	21.5900		21.5900	0.2000	4.3180	9.0000	194.3100	(30)
Ceiling to Void	22.1700		22.1700	0.1400	3.1038	9.0000	199.5300	(30)
Bay Flat Roof	1.2100		1.2100	0.2500	0.3025	9.0000	10.8900	(30)
Total net area of external elements Aum(A, m2)			362.7600					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	99.2534			(33)
Timber GF			77.7200			9.0000	699.4800	(32c)
Timber 1F			144.8200			9.0000	1303.3800	(32c)
Timber 2F			57.5000			9.0000	517.5000	(32c)
Masonry GF			42.4900			39.0000	1657.1100	(32c)
Internal Floor			64.0600			18.0000	1153.0800	(32d)
Internal Floor			41.8900			18.0000	754.0200	(32d)
Internal Ceiling			64.0600			9.0000	576.5400	(32e)
Internal Ceiling			41.8900			9.0000	377.0100	(32e)
Heat capacity Cm = Sum(A x k)				(28)...(30) + (32) + (32a)...(32e) =			21918.4260	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							128.0132	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							14.3174	(36)
Total fabric heat loss					(33) + (36) =		113.5708	(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	84.2377	83.7102	83.1932	80.7645	80.3101	78.1949	78.1949	77.8031	79.0096	80.3101	81.2294	82.1904	(38)
Heat transfer coeff	197.8085	197.2810	196.7640	194.3353	193.8809	191.7656	191.7656	191.3739	192.5804	193.8809	194.8001	195.7612	(39)
Average = Sum(39)m / 12 =												194.3331	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1553	1.1522	1.1492	1.1350	1.1323	1.1200	1.1200	1.1177	1.1248	1.1323	1.1377	1.1433	(40)
HLP (average)												1.1350	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.9642	(42)
Average daily hot water use (litres/day)												104.5998	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	115.0598	110.8758	106.6918	102.5078	98.3239	94.1399	94.1399	98.3239	102.5078	106.6918	110.8758	115.0598	(44)
Energy conte	170.6304	149.2344	153.9966	134.2579	128.8237	111.1651	103.0108	118.2064	119.6181	139.4034	152.1697	165.2464	(45)
Energy content (annual)										Total = Sum(45)m =		1645.7628	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month	36.2590	31.7123	32.7243	28.5298	27.3750	23.6226	21.8898	25.1189	25.4188	29.6232	32.3361	35.1149	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	148.2102	148.2102	148.2102	148.2102	148.2102	148.2102	148.2102	148.2102	148.2102	148.2102	148.2102	148.2102	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	33.7569	29.9826	24.3835	18.4599	13.7990	11.6497	12.5879	16.3622	21.9613	27.8849	32.5458	34.6951	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	342.7919	346.3490	337.3852	318.3023	294.2137	271.5737	256.4488	252.8917	261.8555	280.9383	305.0270	327.6670	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.8210	37.8210	37.8210	37.8210	37.8210	37.8210	37.8210	37.8210	37.8210	37.8210	37.8210	37.8210	(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)	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	(71)
Water heating gains (Table 5)	48.7352	47.1909	43.9842	39.6247	36.7944	32.8091	29.4218	33.7619	35.3040	39.8162	44.9112	47.1974	(72)
Total internal gains	492.7470	490.9856	473.2160	443.8500	412.2701	383.4956	365.9215	370.4789	386.5838	416.1025	449.9471	477.0226	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	10.6300	10.6334	0.7200	0.7000	0.7700	39.4792	(74)
East	0.6900	19.6403	0.7200	0.7000	0.7700	4.7333	(76)
South	5.8400	46.7521	0.7200	0.7000	0.7700	95.3625	(78)
West	0.6900	19.6403	0.7200	0.7000	0.7700	4.7333	(80)
South	3.1500	46.7521	0.7200	0.7000	0.7700	51.4369	(78)

Solar gains	195.7452	334.3850	464.9519	596.5360	692.6018	699.8826	669.5336	594.9650	509.5271	371.0985	234.5137	167.5448	(83)
Total gains	688.4922	825.3706	938.1679	1040.3860	1104.8719	1083.3782	1035.4551	965.4438	896.1109	787.2010	684.4608	644.5674	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	30.7795	30.8618	30.9429	31.3296	31.4030	31.7494	31.7494	31.8144	31.6151	31.4030	31.2549	31.1014	
alpha	3.0520	3.0575	3.0629	3.0886	3.0935	3.1166	3.1166	3.1210	3.1077	3.0935	3.0837	3.0734	
util living area	0.9934	0.9879	0.9775	0.9534	0.9016	0.8020	0.6749	0.7213	0.8806	0.9661	0.9892	0.9946	(86)
MIT	18.6646	18.8933	19.2708	19.7806	20.2757	20.6771	20.8694	20.8342	20.5145	19.8726	19.1801	18.6310	(87)
Th 2	19.9559	19.9584	19.9609	19.9723	19.9745	19.9845	19.9845	19.9864	19.9807	19.9745	19.9701	19.9656	(88)
util rest of house	0.9921	0.9855	0.9727	0.9423	0.8745	0.7386	0.5629	0.6171	0.8368	0.9560	0.9867	0.9936	(89)
MIT 2	17.8038	18.0333	18.4103	18.9217	19.4018	19.7752	19.9249	19.9047	19.6364	19.0185	18.3285	17.7772	(90)
Living area fraction									fLA = Living area / (4) =			0.1121	(91)
MIT	17.9004	18.1297	18.5068	19.0180	19.4998	19.8763	20.0308	20.0089	19.7349	19.1143	18.4240	17.8729	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.9004	18.1297	18.5068	19.0180	19.4998	19.8763	20.0308	20.0089	19.7349	19.1143	18.4240	17.8729	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9883	0.9796	0.9635	0.9288	0.8589	0.7306	0.5687	0.6197	0.8235	0.9444	0.9812	0.9904	(94)
Useful gains	680.4605	808.5069	903.9427	966.3100	949.0271	791.5405	588.8804	598.3236	737.9413	743.4187	671.5650	638.3934	(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	2690.2673	2609.9720	2362.4978	1966.2814	1512.2280	1011.8141	657.9177	690.6548	1085.1620	1650.7566	2205.9088	2676.6316	(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	1495.2963	1210.5846	1085.1650	719.9794	419.0215	0.0000	0.0000	0.0000	0.0000	675.0594	1104.7276	1516.4493	(98)
Space heating												8226.2831	(98)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Space heating per m2 (98) / (4) = 48.0451 (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	1802.5971	1419.0658	1454.4419	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.6548	0.7353	0.7014	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1180.2674	1043.4810	1020.1253	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1400.3453	1341.2561	1262.5648	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	158.4561	221.5447	180.3750	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												560.3758	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	39.6140	55.3862	45.0938	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												140.0939	(107)
Space cooling per m2												0.8182	(108)
Energy for space heating												48.0451	(99)
Energy for space cooling												0.8182	(108)
Total												48.8633	(109)
Dwelling Fabric Energy Efficiency (DFEE)												48.9	(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	65.2700 (1b)	x	2.3800 (2b)	=	155.3426	(1b) - (3b)
First floor	64.0600 (1c)	x	2.6900 (2c)	=	172.3214	(1c) - (3c)
Second floor	41.8900 (1d)	x	2.4000 (2d)	=	100.5360	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	171.2200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	428.2000	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							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) =	0.0934	(8)
Pressure test				Yes	
Measured/design AP50				5.0000	
Infiltration rate				0.3434	(18)
Number of sides sheltered				0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =			1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =			0.3434	(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	0.4379	0.4293	0.4207	0.3778	0.3692	0.3262	0.3262	0.3177	0.3434	0.3692	0.3863	0.4035	(22b)
Effective ac	0.5959	0.5921	0.5885	0.5713	0.5681	0.5532	0.5532	0.5505	0.5590	0.5681	0.5746	0.5814	(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			1.9800	1.0000	1.9800			(26)
TER Semi-glazed door			1.9800	1.2000	2.3760			(26a)
TER Opening Type (Uw = 1.40)			21.0000	1.3258	27.8409			(27)
Ground Floor			65.2700	0.1300	8.4851			(28a)
125mm Cavity	193.4500	21.4800	171.9700	0.1800	30.9546			(29a)
Wall to Void	28.5800		28.5800	0.1800	5.1444			(29a)
Dormer Cheek	13.5800	3.4800	10.1000	0.1800	1.8180			(29a)
400mm Mineral Wool	16.9100		16.9100	0.1300	2.1983			(30)
Sloping	21.5900		21.5900	0.1300	2.8067			(30)
Ceiling to Void	22.1700		22.1700	0.1300	2.8821			(30)
Bay Flat Roof	1.2100		1.2100	0.1300	0.1573			(30)
Total net area of external elements Aum(A, m2)			362.7600					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		86.6434			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		16.0444	(36)
Total fabric heat loss	(33) + (36) =	102.6878	(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	84.1983	83.6723	83.1567	80.7351	80.2821	78.1729	78.1729	77.7824	78.9853	80.2821	81.1986	82.1568	(38)
Heat transfer coeff	186.8861	186.3601	185.8445	183.4229	182.9699	180.8608	180.8608	180.4702	181.6732	182.9699	183.8864	184.8447	(39)
Average = Sum(39)m / 12 =												183.4208	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0915	1.0884	1.0854	1.0713	1.0686	1.0563	1.0563	1.0540	1.0611	1.0686	1.0740	1.0796	(40)
HLP (average)												1.0713	(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	2.9642	(42)
Average daily hot water use (litres/day)	104.5998	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	115.0598	110.8758	106.6918	102.5078	98.3239	94.1399	94.1399	98.3239	102.5078	106.6918	110.8758	115.0598	(44)
Energy conte	170.6304	149.2344	153.9966	134.2579	128.8237	111.1651	103.0108	118.2064	119.6181	139.4034	152.1697	165.2464	(45)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy content (annual)											Total = Sum(45)m =	1645.7628	(45)
Distribution loss (46)m = 0.15 x (45)m													
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)	
Water storage loss:													
Total storage loss													
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)	
If cylinder contains dedicated solar storage													
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)	
Primary loss 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)	
Heat gains from water heating, kWh/month													
36.2590	31.7123	32.7243	28.5298	27.3750	23.6226	21.8898	25.1189	25.4188	29.6232	32.3361	35.1149	(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	148.2102	148.2102	148.2102	148.2102	148.2102	148.2102	148.2102	148.2102	148.2102	148.2102	148.2102	148.2102	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	33.7569	29.9826	24.3835	18.4599	13.7990	11.6497	12.5879	16.3622	21.9613	27.8849	32.5458	34.6951	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	342.7919	346.3490	337.3852	318.3023	294.2137	271.5737	256.4488	252.8917	261.8555	280.9383	305.0270	327.6670	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.8210	37.8210	37.8210	37.8210	37.8210	37.8210	37.8210	37.8210	37.8210	37.8210	37.8210	37.8210	(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)													
	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	(71)
Water heating gains (Table 5)													
	48.7352	47.1909	43.9842	39.6247	36.7944	32.8091	29.4218	33.7619	35.3040	39.8162	44.9112	47.1974	(72)
Total internal gains													
	492.7470	490.9856	473.2160	443.8500	412.2701	383.4956	365.9215	370.4789	386.5838	416.1025	449.9471	477.0226	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	10.6300	10.6334	0.6300	0.7000	0.7700	34.5443	(74)
East	0.6900	19.6403	0.6300	0.7000	0.7700	4.1416	(76)
South	8.9900	46.7521	0.6300	0.7000	0.7700	128.4495	(78)
West	0.6900	19.6403	0.6300	0.7000	0.7700	4.1416	(80)

Solar gains	171.2770	292.5868	406.8329	521.9690	606.0266	612.3973	585.8419	520.5944	445.8362	324.7112	205.1995	146.6017	(83)
Total gains	664.0240	783.5724	880.0489	965.8190	1018.2967	995.8928	951.7634	891.0732	832.4200	740.8137	655.1466	623.6243	(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	63.6231	63.8027	63.9797	64.8244	64.9849	65.7427	65.7427	65.8850	65.4487	64.9849	64.6610	64.3258	
alpha	5.2415	5.2535	5.2653	5.3216	5.3323	5.3828	5.3828	5.3923	5.3632	5.3323	5.3107	5.2884	
util living area													
	0.9998	0.9994	0.9981	0.9932	0.9730	0.8993	0.7593	0.8122	0.9596	0.9960	0.9995	0.9998	(86)
MIT	19.6377	19.7700	19.9919	20.2987	20.6042	20.8538	20.9592	20.9406	20.7465	20.3514	19.9425	19.6210	(87)
Th 2	20.0078	20.0103	20.0128	20.0244	20.0265	20.0367	20.0367	20.0386	20.0328	20.0265	20.0221	20.0175	(88)
util rest of house													
	0.9997	0.9991	0.9974	0.9901	0.9580	0.8379	0.6286	0.6934	0.9294	0.9937	0.9992	0.9998	(89)
MIT 2	18.7483	18.8825	19.1061	19.4210	19.7215	19.9536	20.0237	20.0169	19.8632	19.4761	19.0646	18.7394	(90)
Living area fraction									fLA = Living area / (4) =			0.1121	(91)
MIT	18.8480	18.9820	19.2054	19.5194	19.8205	20.0546	20.1286	20.1205	19.9622	19.5742	19.1630	18.8383	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8480	18.9820	19.2054	19.5194	19.8205	20.0546	20.1286	20.1205	19.9622	19.5742	19.1630	18.8383	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9995	0.9988	0.9965	0.9878	0.9538	0.8393	0.6427	0.7052	0.9264	0.9921	0.9989	0.9997	(94)
Useful gains	663.7137	782.6119	876.9870	954.0331	971.2674	835.8679	611.6576	628.4085	771.1582	734.9421	654.4361	623.4199	(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													
	2718.8223	2624.3247	2361.2335	1947.8465	1485.7985	986.5191	638.1825	671.4330	1065.0096	1642.0165	2218.2280	2705.8057	(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													
	1529.0008	1237.6310	1104.2794	715.5457	382.8111	0.0000	0.0000	0.0000	0.0000	674.8634	1125.9302	1549.2950	(98)
Space heating												8319.3566	(98)
Space heating per m2											(98) / (4) =	48.5887	(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												

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	1700.0911	1338.3696	1371.5733	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7121	0.8107	0.7721	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1210.6183	1085.0462	1058.9253	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1298.0897	1243.4346	1175.6381	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	62.9795	117.8410	86.8343	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												267.6548	(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	15.7449	29.4603	21.7086	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												66.9137	(107)
Space cooling per m2												0.3908	(108)
Energy for space heating												48.5887	(99)
Energy for space cooling												0.3908	(108)
Total												48.9795	(109)
Target Fabric Energy Efficiency (TFEE)												56.3	(109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	65.2700 (1b)	x	2.3800 (2b)	=	155.3426	(1b) - (3b)
First floor	64.0600 (1c)	x	2.6900 (2c)	=	172.3214	(1c) - (3c)
Second floor	41.8900 (1d)	x	2.4000 (2d)	=	100.5360	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	171.2200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	428.2000	(5)

2. Ventilation rate

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

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0.0000 / (5)	=	0.0000	(8)	
Pressure test			Yes		
Measured/design AP50			5.0100		
Infiltration rate			0.2505	(18)	
Number of sides sheltered			0	(19)	
Shelter factor	(20) = 1 - [0.075 x (19)]	=	1.0000	(20)	
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.2505	(21)	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.2630	0.2505	0.2505	0.2317	0.2317	0.2067	0.2129	0.2004	0.2067	0.2192	0.2192	0.2380	(22b)
Mechanical extract ventilation - decentralised													
If mechanical ventilation:												0.5000	(23a)
Effective ac	0.5130	0.5005	0.5005	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			1.9800	1.3000	2.5740			(26)
Half Glaze			1.9800	1.5000	2.9700			(26a)
Window (Uw = 1.40)			17.8500	1.3258	23.6648			(27)
French Door (Uw = 1.40)			3.1500	1.3258	4.1761			(27)
Ground Floor			65.2700	0.1300	8.4851	75.0000	4895.2500	(28a)
125mm Cavity	193.4500	21.4800	171.9700	0.2400	41.2728	52.8000	9080.0160	(29a)
Wall to Void	28.5800		28.5800	0.1400	4.0012	9.0000	257.2200	(29a)
Dormer Cheek	13.5800	3.4800	10.1000	0.2500	2.5250	9.0000	90.9000	(29a)
400mm Mineral Wool	16.9100		16.9100	0.1100	1.8601	9.0000	152.1900	(30)
Sloping	21.5900		21.5900	0.2000	4.3180	9.0000	194.3100	(30)
Ceiling to Void	22.1700		22.1700	0.1400	3.1038	9.0000	199.5300	(30)
Bay Flat Roof	1.2100		1.2100	0.2500	0.3025	9.0000	10.8900	(30)
Total net area of external elements Aum(A, m2)			362.7600					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	99.2534			(33)
Timber GF			77.7200			9.0000	699.4800	(32c)
Timber 1F			144.8200			9.0000	1303.3800	(32c)
Timber 2F			57.5000			9.0000	517.5000	(32c)
Masonry GF			42.4900			39.0000	1657.1100	(32c)
Internal Floor			64.0600			18.0000	1153.0800	(32d)
Internal Floor			41.8900			18.0000	754.0200	(32d)
Internal Ceiling			64.0600			18.0000	1153.0800	(32e)
Internal Ceiling			41.8900			18.0000	754.0200	(32e)
Heat capacity Cm = Sum(A x k)				(28)...(30) + (32) + (32a)...(32e) =			22871.9760	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							133.5824	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							14.3174	(36)
Total fabric heat loss						(33) + (36) =	113.5708	(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	72.4935	70.7237	70.7237	70.6530	70.6530	70.6530	70.6530	70.6530	70.6530	70.6530	70.6530	70.6530	(38)
Heat transfer coeff	186.0643	184.2944	184.2944	184.2238	184.2238	184.2238	184.2238	184.2238	184.2238	184.2238	184.2238	184.2238	(39)
Average = Sum(39)m / 12 =												184.3889	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0867	1.0764	1.0764	1.0759	1.0759	1.0759	1.0759	1.0759	1.0759	1.0759	1.0759	1.0759	(40)
HLP (average)												1.0769	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

CALCULATION OF HEAT DEMAND 09 Jan 2014

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4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.9642	(42)
Average daily hot water use (litres/day)												104.5998	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	115.0598	110.8758	106.6918	102.5078	98.3239	94.1399	94.1399	98.3239	102.5078	106.6918	110.8758	115.0598	(44)
Energy conte	170.6304	149.2344	153.9966	134.2579	128.8237	111.1651	103.0108	118.2064	119.6181	139.4034	152.1697	165.2464	(45)
Energy content (annual)										Total = Sum(45)m =		1645.7628	(45)
Distribution loss (46)m = 0.15 x (45)m													
	25.5946	22.3852	23.0995	20.1387	19.3236	16.6748	15.4516	17.7310	17.9427	20.9105	22.8255	24.7870	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.4800	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.7992	(55)
Total storage loss													
	24.7752	22.3776	24.7752	23.9760	24.7752	23.9760	24.7752	24.7752	23.9760	24.7752	23.9760	24.7752	(56)
If cylinder contains dedicated solar storage													
	24.7752	22.3776	24.7752	23.9760	24.7752	23.9760	24.7752	24.7752	23.9760	24.7752	23.9760	24.7752	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	218.6680	192.6232	202.0342	180.7459	176.8613	157.6531	151.0484	166.2440	166.1061	187.4410	198.6577	213.2840	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	218.6680	192.6232	202.0342	180.7459	176.8613	157.6531	151.0484	166.2440	166.1061	187.4410	198.6577	213.2840	(64)
								Total per year (kWh/year) = Sum(64)m =				2211.3668	(64)
RHI water heating demand												2211	(64)
Heat gains from water heating, kWh/month													
	95.1647	84.3315	89.6339	81.8312	81.2640	74.1528	72.6812	77.7337	76.9634	84.7817	87.7868	93.3745	(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	177.8522	177.8522	177.8522	177.8522	177.8522	177.8522	177.8522	177.8522	177.8522	177.8522	177.8522	177.8522	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	84.3923	74.9565	60.9587	46.1497	34.4974	29.1242	31.4697	40.9055	54.9033	69.7123	81.3646	86.7378	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	511.6297	516.9388	503.5600	475.0781	439.1249	405.3339	382.7594	377.4503	390.8291	419.3110	455.2642	489.0552	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.7494	55.7494	55.7494	55.7494	55.7494	55.7494	55.7494	55.7494	55.7494	55.7494	55.7494	55.7494	(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)													
	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	(71)
Water heating gains (Table 5)													
	127.9095	125.4933	120.4757	113.6544	109.2258	102.9900	97.6897	104.4808	106.8936	113.9539	121.9261	125.5034	(72)
Total internal gains													
	841.9650	835.4221	803.0279	752.9157	700.8815	655.4815	629.9523	640.8701	670.6595	721.0107	776.5885	819.3299	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	10.6300	11.9814	0.7200	0.7000	0.7700	44.4842	(74)
East	0.6900	22.3313	0.7200	0.7000	0.7700	5.3818	(76)
South	5.8400	50.9848	0.7200	0.7000	0.7700	103.9962	(78)
West	0.6900	22.3313	0.7200	0.7000	0.7700	5.3818	(80)
South	3.1500	50.9848	0.7200	0.7000	0.7700	56.0938	(78)

Solar gains	215.3379	331.4135	457.2246	609.1577	693.2274	751.4324	710.3809	642.5209	544.6637	393.1969	264.3557	182.5173	(83)
Total gains	1057.3029	1166.8356	1260.2526	1362.0734	1394.1089	1406.9140	1340.3332	1283.3910	1215.3232	1114.2076	1040.9442	1001.8472	(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	34.1459	34.4738	34.4738	34.4870	34.4870	34.4870	34.4870	34.4870	34.4870	34.4870	34.4870	34.4870	
alpha	3.2764	3.2983	3.2983	3.2991	3.2991	3.2991	3.2991	3.2991	3.2991	3.2991	3.2991	3.2991	
util living area													
	0.9777	0.9679	0.9457	0.8942	0.7883	0.5880	0.4110	0.4396	0.7158	0.9020	0.9628	0.9807	(86)
MIT	19.2981	19.4845	19.8341	20.2665	20.6675	20.9168	20.9821	20.9775	20.8239	20.3555	19.7647	19.2733	(87)
Th 2	20.0117	20.0202	20.0202	20.0205	20.0205	20.0205	20.0205	20.0205	20.0205	20.0205	20.0205	20.0205	(88)
util rest of house													
	0.9733	0.9617	0.9346	0.8709	0.7378	0.4944	0.2879	0.3137	0.6363	0.8754	0.9543	0.9769	(89)
MIT 2	17.7513	18.0258	18.5289	19.1394	19.6766	19.9619	20.0143	20.0121	19.8715	19.2724	18.4341	17.7211	(90)
Living area fraction										fLA = Living area / (4) =		0.1121	(91)
MIT	17.9247	18.1893	18.6753	19.2658	19.7877	20.0690	20.1229	20.1204	19.9783	19.3938	18.5833	17.8951	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.7747	18.0393	18.5253	19.1158	19.6377	19.9190	19.9729	19.9704	19.8283	19.2438	18.4333	17.7451	(93)

CALCULATION OF HEAT DEMAND 09 Jan 2014

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9588	0.9440	0.9117	0.8438	0.7148	0.4838	0.2817	0.3069	0.6184	0.8481	0.9347	0.9638	(94)
Useful gains	1013.7853	1101.4863	1148.9796	1149.3772	996.5433	680.7272	377.5126	393.9250	751.5944	944.9113	972.9818	965.5978	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	2358.3171	2292.4998	2050.3271	1697.7636	1222.8235	721.9742	381.8701	399.8368	852.6390	1408.1742	1922.0688	2329.5333	(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	1000.3317	800.3610	670.6026	394.8382	168.3525	0.0000	0.0000	0.0000	0.0000	344.6676	683.3426	1014.7681	(98)
Space heating												5077.2642	(98)
RHI space heating demand												5077	(98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	65.2700 (1b)	x	2.3800 (2b)	=	155.3426	(1b) - (3b)
First floor	64.0600 (1c)	x	2.6900 (2c)	=	172.3214	(1c) - (3c)
Second floor	41.8900 (1d)	x	2.4000 (2d)	=	100.5360	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	171.2200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	428.2000	(5)

2. Ventilation rate

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

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			0.0000 / (5) =	0.0000	(8)
Pressure test				Yes	
Measured/design AP50				5.0100	
Infiltration rate				0.2505	(18)
Number of sides sheltered				0	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.2505	(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	0.3194	0.3131	0.3069	0.2756	0.2693	0.2380	0.2380	0.2317	0.2505	0.2693	0.2818	0.2943	(22b)
Mechanical extract ventilation - decentralised													
If mechanical ventilation:												0.5000	(23a)
Effective ac	0.5694	0.5631	0.5569	0.5256	0.5193	0.5000	0.5000	0.5000	0.5005	0.5193	0.5318	0.5443	(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	
Solid Door			1.9800	1.3000	2.5740			(26)
Half Glaze			1.9800	1.5000	2.9700			(26a)
Window (Uw = 1.40)			17.8500	1.3258	23.6648			(27)
French Door (Uw = 1.40)			3.1500	1.3258	4.1761			(27)
Ground Floor			65.2700	0.1300	8.4851	75.0000	4895.2500	(28a)
125mm Cavity	193.4500	21.4800	171.9700	0.2400	41.2728	52.8000	9080.0160	(29a)
Wall to Void	28.5800		28.5800	0.1400	4.0012	9.0000	257.2200	(29a)
Dormer Cheek	13.5800	3.4800	10.1000	0.2500	2.5250	9.0000	90.9000	(29a)
400mm Mineral Wool	16.9100		16.9100	0.1100	1.8601	9.0000	152.1900	(30)
Sloping	21.5900		21.5900	0.2000	4.3180	9.0000	194.3100	(30)
Ceiling to Void	22.1700		22.1700	0.1400	3.1038	9.0000	199.5300	(30)
Bay Flat Roof	1.2100		1.2100	0.2500	0.3025	9.0000	10.8900	(30)
Total net area of external elements Aum(A, m2)			362.7600					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	99.2534			(33)
Timber GF			77.7200			9.0000	699.4800	(32c)
Timber 1F			144.8200			9.0000	1303.3800	(32c)
Timber 2F			57.5000			9.0000	517.5000	(32c)
Masonry GF			42.4900			39.0000	1657.1100	(32c)
Internal Floor			64.0600			18.0000	1153.0800	(32d)
Internal Floor			41.8900			18.0000	754.0200	(32d)
Internal Ceiling			64.0600			18.0000	1153.0800	(32e)
Internal Ceiling			41.8900			18.0000	754.0200	(32e)
Heat capacity Cm = Sum(A x k)				(28)...(30) + (32) + (32a)...(32e) =			22871.9760	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							133.5824	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							14.3174	(36)
Total fabric heat loss						(33) + (36) =	113.5708	(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	80.4579	79.5729	78.6880	74.2634	73.3784	70.6530	70.6530	70.6530	70.7237	73.3784	75.1483	76.9182	(38)
Heat transfer coeff	194.0287	193.1437	192.2588	187.8342	186.9492	184.2238	184.2238	184.2238	184.2944	186.9492	188.7191	190.4889	(39)
Average = Sum(39)m / 12 =												188.1115	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1332	1.1280	1.1229	1.0970	1.0919	1.0759	1.0759	1.0759	1.0764	1.0919	1.1022	1.1125	(40)
HLP (average)												1.0987	(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												2.9642	(42)
Average daily hot water use (litres/day)												104.5998	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	115.0598	110.8758	106.6918	102.5078	98.3239	94.1399	94.1399	98.3239	102.5078	106.6918	110.8758	115.0598	(44)
Energy conte	170.6304	149.2344	153.9966	134.2579	128.8237	111.1651	103.0108	118.2064	119.6181	139.4034	152.1697	165.2464	(45)
Energy content (annual)										Total = Sum(45)m =		1645.7628	(45)
Distribution loss (46)m = 0.15 x (45)m	25.5946	22.3852	23.0995	20.1387	19.3236	16.6748	15.4516	17.7310	17.9427	20.9105	22.8255	24.7870	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.4800	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.7992	(55)
Total storage loss	24.7752	22.3776	24.7752	23.9760	24.7752	23.9760	24.7752	24.7752	23.9760	24.7752	23.9760	24.7752	(56)
If cylinder contains dedicated solar storage	24.7752	22.3776	24.7752	23.9760	24.7752	23.9760	24.7752	24.7752	23.9760	24.7752	23.9760	24.7752	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month	218.6680	192.6232	202.0342	180.7459	176.8613	157.6531	151.0484	166.2440	166.1061	187.4410	198.6577	213.2840	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h	218.6680	192.6232	202.0342	180.7459	176.8613	157.6531	151.0484	166.2440	166.1061	187.4410	198.6577	213.2840	(64)
								Total per year (kWh/year) = Sum(64)m =				2211.3668	(64)
Heat gains from water heating, kWh/month	95.1647	84.3315	89.6339	81.8312	81.2640	74.1528	72.6812	77.7337	76.9634	84.7817	87.7868	93.3745	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	177.8522	177.8522	177.8522	177.8522	177.8522	177.8522	177.8522	177.8522	177.8522	177.8522	177.8522	177.8522	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	84.3923	74.9565	60.9587	46.1497	34.4974	29.1242	31.4697	40.9055	54.9033	69.7123	81.3646	86.7378	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	511.6297	516.9388	503.5600	475.0781	439.1249	405.3339	382.7594	377.4503	390.8291	419.3110	455.2642	489.0552	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.7494	55.7494	55.7494	55.7494	55.7494	55.7494	55.7494	55.7494	55.7494	55.7494	55.7494	55.7494	(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)	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	(71)
Water heating gains (Table 5)	127.9095	125.4933	120.4757	113.6544	109.2258	102.9900	97.6897	104.4808	106.8936	113.9539	121.9261	125.5034	(72)
Total internal gains	841.9650	835.4221	803.0279	752.9157	700.8815	655.4815	629.9523	640.8701	670.6595	721.0107	776.5885	819.3299	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	10.6300	10.6334	0.7200	0.7000	0.7700	39.4792	(74)
East	0.6900	19.6403	0.7200	0.7000	0.7700	4.7333	(76)
South	5.8400	46.7521	0.7200	0.7000	0.7700	95.3625	(78)
West	0.6900	19.6403	0.7200	0.7000	0.7700	4.7333	(80)
South	3.1500	46.7521	0.7200	0.7000	0.7700	51.4369	(78)

Solar gains	195.7452	334.3850	464.9519	596.5360	692.6018	699.8826	669.5336	594.9650	509.5271	371.0985	234.5137	167.5448	(83)
Total gains	1037.7102	1169.8070	1267.9799	1349.4517	1393.4834	1355.3641	1299.4859	1235.8351	1180.1866	1092.1092	1011.1022	986.8748	(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	32.7443	32.8943	33.0457	33.8241	33.9842	34.4870	34.4870	34.4870	34.4738	33.9842	33.6655	33.3527	
alpha	3.1830	3.1930	3.2030	3.2549	3.2656	3.2991	3.2991	3.2991	3.2983	3.2656	3.2444	3.2235	
util living area	0.9817	0.9720	0.9546	0.9165	0.8422	0.7114	0.5668	0.6084	0.7951	0.9271	0.9716	0.9843	(86)
MIT	19.0622	19.2768	19.6200	20.0867	20.5012	20.8094	20.9344	20.9152	20.7044	20.1774	19.5558	19.0441	(87)
Th 2	19.9738	19.9780	19.9822	20.0033	20.0075	20.0205	20.0205	20.0205	20.0202	20.0075	19.9990	19.9906	(88)
util rest of house	0.9783	0.9668	0.9456	0.8985	0.8053	0.6399	0.4609	0.5048	0.7364	0.9080	0.9654	0.9813	(89)
MIT 2	17.3853	17.6988	18.1970	18.8760	19.4502	19.8500	19.9800	19.9644	19.7318	19.0155	18.1191	17.3693	(90)
Living area fraction										fLA = Living area / (4) =		0.1121	(91)
MIT	17.5734	17.8757	18.3566	19.0118	19.5680	19.9576	20.0870	20.0710	19.8409	19.1458	18.2802	17.5571	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.4234	17.7257	18.2066	18.8618	19.4180	19.8076	19.9370	19.9210	19.6909	18.9958	18.1302	17.4071	(93)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9652	0.9498	0.9237	0.8719	0.7787	0.6223	0.4511	0.4932	0.7128	0.8818	0.9482	0.9697	(94)
Useful gains	1001.5527	1111.0254	1171.1958	1176.5828	1085.1369	843.4919	586.1981	609.4569	841.2806	962.9937	958.7075	956.9305	(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	2546.3116	2477.2090	2250.6979	1871.1581	1442.8833	959.3643	614.7580	648.6603	1030.3658	1569.5919	2081.6155	2515.7992	(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	1149.3006	918.0754	803.1496	500.0943	266.1634	0.0000	0.0000	0.0000	0.0000	451.3091	808.4938	1159.7983	(98)
Space heating												6056.3844	(98)
Space heating per m2											(98) / (4) =	35.3719	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.6000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	6684.7510	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1149.3006	918.0754	803.1496	500.0943	266.1634	0.0000	0.0000	0.0000	0.0000	451.3091	808.4938	1159.7983	(98)
Space heating efficiency (main heating system 1)	90.6000	90.6000	90.6000	90.6000	90.6000	0.0000	0.0000	0.0000	0.0000	90.6000	90.6000	90.6000	(210)
Space heating fuel (main heating system)	1268.5437	1013.3283	886.4785	551.9804	293.7786	0.0000	0.0000	0.0000	0.0000	498.1336	892.3772	1280.1306	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	218.6680	192.6232	202.0342	180.7459	176.8613	157.6531	151.0484	166.2440	166.1061	187.4410	198.6577	213.2840	(64)
Efficiency of water heater												79.9000	(216)
(217)m	88.7012	88.5436	88.2253	87.4896	86.0022	79.9000	79.9000	79.9000	79.9000	87.1742	88.2684	88.7538	(217)
Fuel for water heating, kWh/month	246.5220	217.5462	228.9980	206.5914	205.6474	197.3130	189.0468	208.0650	207.8925	215.0188	225.0609	240.3098	(219)
Water heating fuel used												2588.0118	(219)
Annual totals kWh/year													
Space heating fuel - main system												6684.7510	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
(MEVDecentralised, Database: total watage = 10.9710, total flow = 53.0000, SFP = 0.2070)													
mechanical ventilation fans (SFP = 0.2070)												108.1376	(230a)
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												183.1376	(231)
Electricity for lighting (calculated in Appendix L)												596.1578	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.04 * 1068 * 1.00) =										-888.6346		-888.6346	(233)
Total delivered energy for all uses												9163.4236	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	6684.7510	3.4800	232.6293	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2588.0118	3.4800	90.0628	(247)
Mechanical ventilation fans	108.1376	13.1900	14.2634	(249)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	596.1578	13.1900	78.6332	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-888.6346	13.1900	-117.2109	(252)
Total energy cost			428.2703	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):	0.4200	(256)
Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] =	0.8319	(257)
SAP value	88.3950	
SAP rating (Section 12)	88	(258)
SAP band	B	

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

CALCULATION OF ENERGY RATINGS 09 Jan 2014

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	6684.7510	0.2160	1443.9062	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2588.0118	0.2160	559.0105	(264)
Space and water heating			2002.9168	(265)
Pumps and fans	183.1376	0.5190	95.0484	(267)
Energy for lighting	596.1578	0.5190	309.4059	(268)
Energy saving/generation technologies				
PV Unit	-888.6346	0.5190	-461.2014	(269)
Total kg/year			1946.1697	(272)
CO2 emissions per m2			11.3700	(273)
EI value			87.9388	
EI rating			88	(274)
EI band			B	

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9060 = 3.841, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9060 = 0.2384, stars = 4
Water heating energy efficiency	3.48 / 0.8523 = 4.083, stars = 4
Water heating environmental impact	0.216 / 0.8523 = 0.2534, stars = 4

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

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	65.2700 (1b)	x	2.3800 (2b)	=	155.3426	(1b) - (3b)
First floor	64.0600 (1c)	x	2.6900 (2c)	=	172.3214	(1c) - (3c)
Second floor	41.8900 (1d)	x	2.4000 (2d)	=	100.5360	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	171.2200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	428.2000	(5)

2. Ventilation rate

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

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Measured/design AP50		5.0100	
Infiltration rate		0.2505	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2505	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.2630	0.2505	0.2505	0.2317	0.2317	0.2067	0.2129	0.2004	0.2067	0.2192	0.2192	0.2380	(22b)
Mechanical extract ventilation - decentralised													
If mechanical ventilation:												0.5000	(23a)
Effective ac	0.5130	0.5005	0.5005	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			1.9800	1.3000	2.5740			(26)
Half Glaze			1.9800	1.5000	2.9700			(26a)
Window (Uw = 1.40)			17.8500	1.3258	23.6648			(27)
French Door (Uw = 1.40)			3.1500	1.3258	4.1761			(27)
Ground Floor			65.2700	0.1300	8.4851	75.0000	4895.2500	(28a)
125mm Cavity	193.4500	21.4800	171.9700	0.2400	41.2728	52.8000	9080.0160	(29a)
Wall to Void	28.5800		28.5800	0.1400	4.0012	9.0000	257.2200	(29a)
Dormer Cheek	13.5800	3.4800	10.1000	0.2500	2.5250	9.0000	90.9000	(29a)
400mm Mineral Wool	16.9100		16.9100	0.1100	1.8601	9.0000	152.1900	(30)
Sloping	21.5900		21.5900	0.2000	4.3180	9.0000	194.3100	(30)
Ceiling to Void	22.1700		22.1700	0.1400	3.1038	9.0000	199.5300	(30)
Bay Flat Roof	1.2100		1.2100	0.2500	0.3025	9.0000	10.8900	(30)
Total net area of external elements Aum(A, m2)			362.7600					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	99.2534			(33)
Timber GF			77.7200			9.0000	699.4800	(32c)
Timber 1F			144.8200			9.0000	1303.3800	(32c)
Timber 2F			57.5000			9.0000	517.5000	(32c)
Masonry GF			42.4900			39.0000	1657.1100	(32c)
Internal Floor			64.0600			18.0000	1153.0800	(32d)
Internal Floor			41.8900			18.0000	754.0200	(32d)
Internal Ceiling			64.0600			18.0000	1153.0800	(32e)
Internal Ceiling			41.8900			18.0000	754.0200	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	22871.9760 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		133.5824 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		14.3174 (36)
Total fabric heat loss	(33) + (36) =	113.5708 (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	72.4935	70.7237	70.7237	70.6530	70.6530	70.6530	70.6530	70.6530	70.6530	70.6530	70.6530	70.6530	(38)
Heat transfer coeff	186.0643	184.2944	184.2944	184.2238	184.2238	184.2238	184.2238	184.2238	184.2238	184.2238	184.2238	184.2238	(39)
Average = Sum(39)m / 12 =												184.3889	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0867	1.0764	1.0764	1.0759	1.0759	1.0759	1.0759	1.0759	1.0759	1.0759	1.0759	1.0759	(40)
HLP (average)												1.0769	(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												2.9642	(42)
Average daily hot water use (litres/day)												104.5998	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	115.0598	110.8758	106.6918	102.5078	98.3239	94.1399	94.1399	98.3239	102.5078	106.6918	110.8758	115.0598	(44)
Energy conte	170.6304	149.2344	153.9966	134.2579	128.8237	111.1651	103.0108	118.2064	119.6181	139.4034	152.1697	165.2464	(45)
Energy content (annual)										Total = Sum(45)m =		1645.7628	(45)
Distribution loss (46)m = 0.15 x (45)m													
	25.5946	22.3852	23.0995	20.1387	19.3236	16.6748	15.4516	17.7310	17.9427	20.9105	22.8255	24.7870	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.4800	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.7992	(55)
Total storage loss													
	24.7752	22.3776	24.7752	23.9760	24.7752	23.9760	24.7752	24.7752	23.9760	24.7752	23.9760	24.7752	(56)
If cylinder contains dedicated solar storage													
	24.7752	22.3776	24.7752	23.9760	24.7752	23.9760	24.7752	24.7752	23.9760	24.7752	23.9760	24.7752	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	218.6680	192.6232	202.0342	180.7459	176.8613	157.6531	151.0484	166.2440	166.1061	187.4410	198.6577	213.2840	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	218.6680	192.6232	202.0342	180.7459	176.8613	157.6531	151.0484	166.2440	166.1061	187.4410	198.6577	213.2840	(64)
									Total per year (kWh/year) = Sum(64)m =			2211.3668	(64)
Heat gains from water heating, kWh/month													
	95.1647	84.3315	89.6339	81.8312	81.2640	74.1528	72.6812	77.7337	76.9634	84.7817	87.7868	93.3745	(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	177.8522	177.8522	177.8522	177.8522	177.8522	177.8522	177.8522	177.8522	177.8522	177.8522	177.8522	177.8522	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	84.3923	74.9565	60.9587	46.1497	34.4974	29.1242	31.4697	40.9055	54.9033	69.7123	81.3646	86.7378	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	511.6297	516.9388	503.5600	475.0781	439.1249	405.3339	382.7594	377.4503	390.8291	419.3110	455.2642	489.0552	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.7494	55.7494	55.7494	55.7494	55.7494	55.7494	55.7494	55.7494	55.7494	55.7494	55.7494	55.7494	(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)													
	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	(71)
Water heating gains (Table 5)													
	127.9095	125.4933	120.4757	113.6544	109.2258	102.9900	97.6897	104.4808	106.8936	113.9539	121.9261	125.5034	(72)
Total internal gains													
	841.9650	835.4221	803.0279	752.9157	700.8815	655.4815	629.9523	640.8701	670.6595	721.0107	776.5885	819.3299	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	10.6300	11.9814	0.7200	0.7000	0.7700	44.4842	(74)
East	0.6900	22.3313	0.7200	0.7000	0.7700	5.3818	(76)
South	5.8400	50.9848	0.7200	0.7000	0.7700	103.9962	(78)
West	0.6900	22.3313	0.7200	0.7000	0.7700	5.3818	(80)
South	3.1500	50.9848	0.7200	0.7000	0.7700	56.0938	(78)

Solar gains	215.3379	331.4135	457.2246	609.1577	693.2274	751.4324	710.3809	642.5209	544.6637	393.1969	264.3557	182.5173	(83)
Total gains	1057.3029	1166.8356	1260.2526	1362.0734	1394.1089	1406.9140	1340.3332	1283.3910	1215.3232	1114.2076	1040.9442	1001.8472	(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	34.1459	34.4738	34.4738	34.4870	34.4870	34.4870	34.4870	34.4870	34.4870	34.4870	34.4870	34.4870	
alpha	3.2764	3.2983	3.2983	3.2991	3.2991	3.2991	3.2991	3.2991	3.2991	3.2991	3.2991	3.2991	
util living area													
	0.9777	0.9679	0.9457	0.8942	0.7883	0.5880	0.4110	0.4396	0.7158	0.9020	0.9628	0.9807	(86)
MIT	19.2981	19.4845	19.8341	20.2665	20.6675	20.9168	20.9821	20.9775	20.8239	20.3555	19.7647	19.2733	(87)
Th 2	20.0117	20.0202	20.0202	20.0205	20.0205	20.0205	20.0205	20.0205	20.0205	20.0205	20.0205	20.0205	(88)
util rest of house													
	0.9733	0.9617	0.9346	0.8709	0.7378	0.4944	0.2879	0.3137	0.6363	0.8754	0.9543	0.9769	(89)
MIT 2	17.7513	18.0258	18.5289	19.1394	19.6766	19.9619	20.0143	20.0121	19.8715	19.2724	18.4341	17.7211	(90)
Living area fraction									fLA = Living area / (4) =			0.1121	(91)
MIT	17.9247	18.1893	18.6753	19.2658	19.7877	20.0690	20.1229	20.1204	19.9783	19.3938	18.5833	17.8951	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.7747	18.0393	18.5253	19.1158	19.6377	19.9190	19.9729	19.9704	19.8283	19.2438	18.4333	17.7451	(93)

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

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9588	0.9440	0.9117	0.8438	0.7148	0.4838	0.2817	0.3069	0.6184	0.8481	0.9347	0.9638	(94)
Useful gains	1013.7853	1101.4863	1148.9796	1149.3772	996.5433	680.7272	377.5126	393.9250	751.5944	944.9113	972.9818	965.5978	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	2358.3171	2292.4998	2050.3271	1697.7636	1222.8235	721.9742	381.8701	399.8368	852.6390	1408.1742	1922.0688	2329.5333	(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	1000.3317	800.3610	670.6026	394.8382	168.3525	0.0000	0.0000	0.0000	0.0000	344.6676	683.3426	1014.7681	(98)
Space heating												5077.2642	(98)
Space heating per m2											(98) / (4) =	29.6535	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.6000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	5604.0444	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1000.3317	800.3610	670.6026	394.8382	168.3525	0.0000	0.0000	0.0000	0.0000	344.6676	683.3426	1014.7681	(98)
Space heating efficiency (main heating system 1)	90.6000	90.6000	90.6000	90.6000	90.6000	0.0000	0.0000	0.0000	0.0000	90.6000	90.6000	90.6000	(210)
Space heating fuel (main heating system)	1104.1188	883.4007	740.1794	435.8038	185.8195	0.0000	0.0000	0.0000	0.0000	380.4278	754.2413	1120.0530	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	218.6680	192.6232	202.0342	180.7459	176.8613	157.6531	151.0484	166.2440	166.1061	187.4410	198.6577	213.2840	(64)
Efficiency of water heater												79.9000	(216)
(217)m	88.4746	88.3060	87.8754	86.9438	84.7831	79.9000	79.9000	79.9000	79.9000	86.5186	87.9473	88.5407	(217)
Fuel for water heating, kWh/month	247.1534	218.1315	229.9097	207.8884	208.6044	197.3130	189.0468	208.0650	207.8925	216.6482	225.8828	240.8881	(219)
Water heating fuel used												2597.4238	(219)
Annual totals kWh/year													
Space heating fuel - main system												5604.0444	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
(MEVDecentralised, Database: total watage = 10.9710, total flow = 53.0000, SFP = 0.2070)													
mechanical ventilation fans (SFP = 0.2070)												108.1376	(230a)
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												183.1376	(231)
Electricity for lighting (calculated in Appendix L)												596.1578	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.04 * 1121 * 1.00) =												-932.6538	(233)
Total delivered energy for all uses												8048.1098	(238)

10a. Fuel costs - using BEDF prices (467)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	5604.0444	3.9500	221.3598	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2597.4238	3.9500	102.5982	(247)
Mechanical ventilation fans	108.1376	18.7000	20.2217	(249)
Pumps and fans for heating	75.0000	18.7000	14.0250	(249)
Energy for lighting	596.1578	18.7000	111.4815	(250)
Additional standing charges			91.0000	(251)
Energy saving/generation technologies				
PV Unit	-932.6538	18.7000	-174.4063	(252)
Total energy cost			386.2800	(255)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	5604.0444	0.2160	1210.4736	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2597.4238	0.2160	561.0435	(264)
Space and water heating			1771.5171	(265)
Pumps and fans	183.1376	0.5190	95.0484	(267)
Energy for lighting	596.1578	0.5190	309.4059	(268)
Energy saving/generation technologies				

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

PV Unit	-932.6538	0.5190	-484.0473 (269)
Total kg/year			1691.9241 (272)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	5604.0444	1.2200	6836.9342	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2597.4238	1.2200	3168.8570	(264)
Space and water heating			10005.7912	(265)
Pumps and fans	183.1376	3.0700	562.2325	(267)
Energy for lighting	596.1578	3.0700	1830.2045	(268)
Energy saving/generation technologies				
PV Unit	-932.6538	3.0700	-2863.2472	(269)
Primary energy kWh/year			9534.9810	(272)
Primary energy kWh/m2/year			55.6885	(273)

SAP 2012 EPC IMPROVEMENTS

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

(For testing purposes):

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

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.1	-£ 44	-263 kg (15.6%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£44	1.54 kg/m²	B 89	B 90
Total Savings	£44	1.54 kg/m²		

Potential energy efficiency rating: B 89
Potential environmental impact rating: B 90

Fuel prices for cost data on this page from database revision number 467 TEST (29 Oct 2020)
Recommendation texts revision number 4.9c (22 Feb 2014)

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

	Current	Potential	Saving
Electricity	£146	£155	-£9
Mains gas	£415	£362	£53
Space heating	£347	£348	-£2
Water heating	£103	£58	£45
Lighting	£111	£111	£0
Generated (PV)	-£174	-£174	£0
Total cost of fuels	£387	£343	£44
Total cost of uses	£387	£343	£43
Delivered energy	47 kWh/m²	39 kWh/m²	8 kWh/m²

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

Carbon dioxide emissions	1.7 tonnes	1.4 tonnes	0.3 tonnes
CO2 emissions per m²	10 kg/m²	8 kg/m²	2 kg/m²
Primary energy	56 kWh/m²	47 kWh/m²	9 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	65.2700	(1b)	x 2.3800	(2b) =	155.3426	(1b) - (3b)
First floor	64.0600	(1c)	x 2.6900	(2c) =	172.3214	(1c) - (3c)
Second floor	41.8900	(1d)	x 2.4000	(2d) =	100.5360	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	171.2200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		428.2000	(5)

2. Ventilation rate

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

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			0.0000 / (5) =	0.0000	(8)
Pressure test				Yes	
Measured/design AP50				5.0100	
Infiltration rate				0.2505	(18)
Number of sides sheltered				0	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.2505	(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	0.3194	0.3131	0.3069	0.2756	0.2693	0.2380	0.2380	0.2317	0.2505	0.2693	0.2818	0.2943	(22b)
Mechanical extract ventilation - decentralised													
If mechanical ventilation:												0.5000	(23a)
Effective ac	0.5694	0.5631	0.5569	0.5256	0.5193	0.5000	0.5000	0.5000	0.5005	0.5193	0.5318	0.5443	(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	
Solid Door			1.9800	1.3000	2.5740			(26)
Half Glaze			1.9800	1.5000	2.9700			(26a)
Window (Uw = 1.40)			17.8500	1.3258	23.6648			(27)
French Door (Uw = 1.40)			3.1500	1.3258	4.1761			(27)
Ground Floor			65.2700	0.1300	8.4851	75.0000	4895.2500	(28a)
125mm Cavity	193.4500	21.4800	171.9700	0.2400	41.2728	52.8000	9080.0160	(29a)
Wall to Void	28.5800		28.5800	0.1400	4.0012	9.0000	257.2200	(29a)
Dormer Cheek	13.5800	3.4800	10.1000	0.2500	2.5250	9.0000	90.9000	(29a)
400mm Mineral Wool	16.9100		16.9100	0.1100	1.8601	9.0000	152.1900	(30)
Sloping	21.5900		21.5900	0.2000	4.3180	9.0000	194.3100	(30)
Ceiling to Void	22.1700		22.1700	0.1400	3.1038	9.0000	199.5300	(30)
Bay Flat Roof	1.2100		1.2100	0.2500	0.3025	9.0000	10.8900	(30)
Total net area of external elements Aum(A, m2)			362.7600					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	99.2534			(33)
Timber GF			77.7200			9.0000	699.4800	(32c)
Timber 1F			144.8200			9.0000	1303.3800	(32c)
Timber 2F			57.5000			9.0000	517.5000	(32c)
Masonry GF			42.4900			39.0000	1657.1100	(32c)
Internal Floor			64.0600			18.0000	1153.0800	(32d)
Internal Floor			41.8900			18.0000	754.0200	(32d)
Internal Ceiling			64.0600			18.0000	1153.0800	(32e)
Internal Ceiling			41.8900			18.0000	754.0200	(32e)
Heat capacity Cm = Sum(A x k)				(28)...(30) + (32) + (32a)...(32e) =			22871.9760	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							133.5824	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							14.3174	(36)
Total fabric heat loss						(33) + (36) =	113.5708	(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	80.4579	79.5729	78.6880	74.2634	73.3784	70.6530	70.6530	70.6530	70.7237	73.3784	75.1483	76.9182	(38)
Heat transfer coeff	194.0287	193.1437	192.2588	187.8342	186.9492	184.2238	184.2238	184.2238	184.2944	186.9492	188.7191	190.4889	(39)
Average = Sum(39)m / 12 =												188.1115	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1332	1.1280	1.1229	1.0970	1.0919	1.0759	1.0759	1.0759	1.0764	1.0919	1.1022	1.1125	(40)
HLP (average)												1.0987	(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												2.9642	(42)
Average daily hot water use (litres/day)												104.5998	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	115.0598	110.8758	106.6918	102.5078	98.3239	94.1399	94.1399	98.3239	102.5078	106.6918	110.8758	115.0598	(44)
Energy conte	170.6304	149.2344	153.9966	134.2579	128.8237	111.1651	103.0108	118.2064	119.6181	139.4034	152.1697	165.2464	(45)
Energy content (annual)										Total = Sum(45)m =		1645.7628	(45)
Distribution loss (46)m = 0.15 x (45)m													
	25.5946	22.3852	23.0995	20.1387	19.3236	16.6748	15.4516	17.7310	17.9427	20.9105	22.8255	24.7870	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.4800	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.7992	(55)
Total storage loss													
	24.7752	22.3776	24.7752	23.9760	24.7752	23.9760	24.7752	24.7752	23.9760	24.7752	23.9760	24.7752	(56)
If cylinder contains dedicated solar storage													
	15.9269	14.3856	15.9269	15.4131	15.9269	15.4131	15.9269	15.9269	15.4131	15.9269	15.4131	15.9269	(57)
Primary loss	23.2624	21.0112	21.8667	15.7584	10.4681	9.9053	10.2355	11.1660	17.1091	21.8667	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	209.8197	184.6312	191.7901	165.4295	155.2187	136.4835	129.1731	145.2992	152.1404	177.1970	190.0948	204.4357	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1079.5246	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1813.6014	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.1020	(H8)
Utilisation factor												0.5965	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												115.5000	(H13)
Daily hot water demand												104.5998	(H14)
Volume ratio Veff/V												1.1042	(H15)
Solar storage volume factor												1.0000	(H16)
Solar input												-951.1520	(H17)
Solar input	-27.5815	-46.0256	-78.3869	-105.0539	-129.7852	-127.5995	-125.9133	-110.0111	-86.1607	-58.8376	-32.7156	-23.0810	(63)
								Solar input (sum of months) = Sum(63)m =				-951.1520	(63)
Output from w/h													
	182.2382	138.6056	113.4032	60.3756	25.4335	8.8839	3.2599	35.2882	65.9797	118.3593	157.3792	181.3547	(64)
								Total per year (kWh/year) = Sum(64)m =				1090.5610	(64)
Heat gains from water heating, kWh/month													
	88.0861	77.9379	81.4387	69.5780	63.9499	57.2171	55.1810	60.9779	65.7908	76.5865	80.9365	86.2959	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	177.8522	177.8522	177.8522	177.8522	177.8522	177.8522	177.8522	177.8522	177.8522	177.8522	177.8522	177.8522	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	84.3923	74.9565	60.9587	46.1497	34.4974	29.1242	31.4697	40.9055	54.9033	69.7123	81.3646	86.7378	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	511.6297	516.9388	503.5600	475.0781	439.1249	405.3339	382.7594	377.4503	390.8291	419.3110	455.2642	489.0552	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.7494	55.7494	55.7494	55.7494	55.7494	55.7494	55.7494	55.7494	55.7494	55.7494	55.7494	55.7494	(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)													
	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	(71)
Water heating gains (Table 5)													
	118.3952	115.9790	109.4606	96.6361	85.9541	79.4682	74.1680	81.9596	91.3762	102.9388	112.4119	115.9891	(72)
Total internal gains													
	832.4507	825.9078	792.0129	735.8974	677.6099	631.9598	606.4306	618.3489	655.1420	709.9956	767.0742	809.8157	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	10.6300	10.6334	0.7200	0.7000	0.7700	39.4792	(74)
East	0.6900	19.6403	0.7200	0.7000	0.7700	4.7333	(76)
South	5.8400	46.7521	0.7200	0.7000	0.7700	95.3625	(78)
West	0.6900	19.6403	0.7200	0.7000	0.7700	4.7333	(80)
South	3.1500	46.7521	0.7200	0.7000	0.7700	51.4369	(78)

Solar gains	195.7452	334.3850	464.9519	596.5360	692.6018	699.8826	669.5336	594.9650	509.5271	371.0985	234.5137	167.5448	(83)
Total gains	1028.1959	1160.2928	1256.9648	1332.4334	1370.2118	1331.8424	1275.9642	1213.3138	1164.6691	1081.0941	1001.5879	977.3605	(84)

7. Mean internal temperature (heating season)

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

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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	32.7443	32.8943	33.0457	33.8241	33.9842	34.4870	34.4870	34.4870	34.4738	33.9842	33.6655	33.3527	
alpha	3.1830	3.1930	3.2030	3.2549	3.2656	3.2991	3.2991	3.2991	3.2983	3.2656	3.2444	3.2235	
util living area	0.9822	0.9726	0.9556	0.9189	0.8474	0.7187	0.5748	0.6165	0.7999	0.9289	0.9723	0.9847	(86)
MIT	19.0544	19.2693	19.6119	20.0758	20.4901	20.8032	20.9316	20.9118	20.6984	20.1700	19.5483	19.0362	(87)
Th 2	19.9738	19.9780	19.9822	20.0033	20.0075	20.0205	20.0205	20.0205	20.0202	20.0075	19.9990	19.9906	(88)
util rest of house	0.9788	0.9675	0.9467	0.9013	0.8111	0.6476	0.4682	0.5125	0.7417	0.9101	0.9662	0.9818	(89)
MIT 2	17.3742	17.6880	18.1856	18.8611	19.4363	19.8437	19.9781	19.9618	19.7250	19.0055	18.1084	17.3579	(90)
Living area fraction									fLA = Living area / (4) =			0.1121	(91)
MIT	17.5626	17.8654	18.3455	18.9973	19.5544	19.9513	20.0850	20.0684	19.8342	19.1361	18.2699	17.5461	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.4126	17.7154	18.1955	18.8473	19.4044	19.8013	19.9350	19.9184	19.6842	18.9861	18.1199	17.3961	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9659	0.9507	0.9250	0.8749	0.7843	0.6295	0.4581	0.5005	0.7178	0.8840	0.9493	0.9704	(94)
Useful gains	993.1423	1103.0477	1162.7447	1165.6993	1074.6575	838.3974	584.5152	607.2484	836.0508	955.7111	950.7842	948.3963	(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	2544.2162	2475.2081	2248.5634	1868.4453	1440.3378	958.2063	614.3843	648.1675	1029.1327	1567.7782	2079.6574	2513.7070	(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	1153.9990	922.0918	807.8491	505.9771	272.0662	0.0000	0.0000	0.0000	0.0000	455.3779	812.7888	1164.5912	(98)
Space heating												6094.7410	(98)
Space heating per m2											(98) / (4) =	35.5960	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.6000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	6727.0872	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1153.9990	922.0918	807.8491	505.9771	272.0662	0.0000	0.0000	0.0000	0.0000	455.3779	812.7888	1164.5912	(98)
Space heating efficiency (main heating system 1)	90.6000	90.6000	90.6000	90.6000	90.6000	0.0000	0.0000	0.0000	0.0000	90.6000	90.6000	90.6000	(210)
Space heating fuel (main heating system)	1273.7296	1017.7614	891.6657	558.4736	300.2938	0.0000	0.0000	0.0000	0.0000	502.6246	897.1178	1285.4207	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	182.2382	138.6056	113.4032	60.3756	25.4335	8.8839	3.2599	35.2882	65.9797	118.3593	157.3792	181.3547	(64)
Efficiency of water heater												79.9000	(216)
(217)m	88.9750	89.0418	89.1307	89.3248	89.5745	79.9000	79.9000	79.9000	79.9000	88.1643	88.6737	88.9942	(217)
Fuel for water heating, kWh/month	204.8196	155.6635	127.2325	67.5911	28.3936	11.1188	4.0799	44.1654	82.5778	134.2485	177.4813	203.7827	(219)
Water heating fuel used												1241.1549	(219)
Annual totals kWh/year													
Space heating fuel - main system												6727.0872	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
(MEVDecentralised, Database: total watage = 10.9710, total flow = 53.0000, SFP = 0.2070)													
mechanical ventilation fans (SFP = 0.2070)												108.1376	(230a)
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												233.1376	(231)
Electricity for lighting (calculated in Appendix L)												596.1578	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.04 * 1068 * 1.00) =										-888.6346		-888.6346	(233)
Total delivered energy for all uses												7908.9029	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	6727.0872	3.4800	234.1026	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1241.1549	3.4800	43.1922	(247)
Mechanical ventilation fans	108.1376	13.1900	14.2634	(249)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	596.1578	13.1900	78.6332	(250)
Additional standing charges			120.0000	(251)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Energy saving/generation technologies				
PV Unit	-888.6346	13.1900	-117.2109	(252)
Total energy cost			389.4680	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):			0.4200	(256)
Energy cost factor (ECF)		[(255) x (256)] / [(4) + 45.0] =	0.7565	(257)
SAP value			89.4464	
SAP rating (Section 12)			89	(258)
SAP band			B	

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	6727.0872	0.2160	1453.0508	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1241.1549	0.2160	268.0895	(264)
Space and water heating			1721.1403	(265)
Pumps and fans	233.1376	0.5190	120.9984	(267)
Energy for lighting	596.1578	0.5190	309.4059	(268)
Energy saving/generation technologies				
PV Unit	-888.6346	0.5190	-461.2014	(269)
Total kg/year			1690.3433	(272)
CO2 emissions per m2			9.8700	(273)
EI value			89.5243	
EI rating			90	(274)
EI band			B	

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	65.2700 (1b)	x	2.3800 (2b)	=	155.3426	(1b) - (3b)
First floor	64.0600 (1c)	x	2.6900 (2c)	=	172.3214	(1c) - (3c)
Second floor	41.8900 (1d)	x	2.4000 (2d)	=	100.5360	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	171.2200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	428.2000	(5)

2. Ventilation rate

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

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			0.0000 / (5) =	0.0000	(8)
Pressure test				Yes	
Measured/design AP50				5.0100	
Infiltration rate				0.2505	(18)
Number of sides sheltered				0	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.2505	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.2630	0.2505	0.2505	0.2317	0.2317	0.2067	0.2129	0.2004	0.2067	0.2192	0.2192	0.2380	(22b)
Mechanical extract ventilation - decentralised													
If mechanical ventilation:												0.5000	(23a)
Effective ac	0.5130	0.5005	0.5005	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			1.9800	1.3000	2.5740			(26)
Half Glaze			1.9800	1.5000	2.9700			(26a)
Window (Uw = 1.40)			17.8500	1.3258	23.6648			(27)
French Door (Uw = 1.40)			3.1500	1.3258	4.1761			(27)
Ground Floor			65.2700	0.1300	8.4851	75.0000	4895.2500	(28a)
125mm Cavity	193.4500	21.4800	171.9700	0.2400	41.2728	52.8000	9080.0160	(29a)
Wall to Void	28.5800		28.5800	0.1400	4.0012	9.0000	257.2200	(29a)
Dormer Cheek	13.5800	3.4800	10.1000	0.2500	2.5250	9.0000	90.9000	(29a)
400mm Mineral Wool	16.9100		16.9100	0.1100	1.8601	9.0000	152.1900	(30)
Sloping	21.5900		21.5900	0.2000	4.3180	9.0000	194.3100	(30)
Ceiling to Void	22.1700		22.1700	0.1400	3.1038	9.0000	199.5300	(30)
Bay Flat Roof	1.2100		1.2100	0.2500	0.3025	9.0000	10.8900	(30)
Total net area of external elements Aum(A, m2)			362.7600					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	99.2534			(33)
Timber GF			77.7200			9.0000	699.4800	(32c)
Timber 1F			144.8200			9.0000	1303.3800	(32c)
Timber 2F			57.5000			9.0000	517.5000	(32c)
Masonry GF			42.4900			39.0000	1657.1100	(32c)
Internal Floor			64.0600			18.0000	1153.0800	(32d)
Internal Floor			41.8900			18.0000	754.0200	(32d)
Internal Ceiling			64.0600			18.0000	1153.0800	(32e)
Internal Ceiling			41.8900			18.0000	754.0200	(32e)
Heat capacity Cm = Sum(A x k)				(28)...(30) + (32) + (32a)...(32e) =			22871.9760	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							133.5824	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							14.3174	(36)
Total fabric heat loss						(33) + (36) =	113.5708	(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	72.4935	70.7237	70.7237	70.6530	70.6530	70.6530	70.6530	70.6530	70.6530	70.6530	70.6530	70.6530	(38)
Heat transfer coeff	186.0643	184.2944	184.2944	184.2238	184.2238	184.2238	184.2238	184.2238	184.2238	184.2238	184.2238	184.2238	(39)
Average = Sum(39)m / 12 =												184.3889	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0867	1.0764	1.0764	1.0759	1.0759	1.0759	1.0759	1.0759	1.0759	1.0759	1.0759	1.0759	(40)
HLP (average)												1.0769	(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												2.9642	(42)
Average daily hot water use (litres/day)												104.5998	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	115.0598	110.8758	106.6918	102.5078	98.3239	94.1399	94.1399	98.3239	102.5078	106.6918	110.8758	115.0598	(44)
Energy conte	170.6304	149.2344	153.9966	134.2579	128.8237	111.1651	103.0108	118.2064	119.6181	139.4034	152.1697	165.2464	(45)
Energy content (annual)										Total = Sum(45)m =		1645.7628	(45)
Distribution loss (46)m = 0.15 x (45)m													
	25.5946	22.3852	23.0995	20.1387	19.3236	16.6748	15.4516	17.7310	17.9427	20.9105	22.8255	24.7870	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.4800	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.7992	(55)
Total storage loss													
	24.7752	22.3776	24.7752	23.9760	24.7752	23.9760	24.7752	24.7752	23.9760	24.7752	23.9760	24.7752	(56)
If cylinder contains dedicated solar storage													
	15.9269	14.3856	15.9269	15.4131	15.9269	15.4131	15.9269	15.9269	15.4131	15.9269	15.4131	15.9269	(57)
Primary loss	23.2624	21.0112	21.8667	15.7584	10.4681	9.9053	10.2355	11.1660	17.1091	21.8667	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	209.8197	184.6312	191.7901	165.4295	155.2187	136.4835	129.1731	145.2992	152.1404	177.1970	190.0948	204.4357	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1140.0998	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1915.3676	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.1638	(H8)
Utilisation factor												0.5765	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												115.5000	(H13)
Daily hot water demand												104.5998	(H14)
Volume ratio Veff/V												1.1042	(H15)
Solar storage volume factor												1.0000	(H16)
Solar input												-970.9523	(H17)
Solar input	-29.8854	-44.9177	-75.6472	-104.5675	-125.9345	-132.5405	-129.3580	-115.5175	-90.1618	-61.3354	-36.3265	-24.7603	(63)
								Solar input (sum of months) = Sum(63)m =				-970.9523	(63)
Output from w/h													
	179.9343	139.7135	116.1430	60.8620	29.2842	3.9429	0.0000	29.7818	61.9786	115.8616	153.7683	179.6755	(64)
								Total per year (kWh/year) = Sum(64)m =				1070.9456	(64)
Heat gains from water heating, kWh/month													
	88.0861	77.9379	81.4387	69.5780	63.9499	57.2171	55.1810	60.9779	65.7908	76.5865	80.9365	86.2959	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	177.8522	177.8522	177.8522	177.8522	177.8522	177.8522	177.8522	177.8522	177.8522	177.8522	177.8522	177.8522	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	84.3923	74.9565	60.9587	46.1497	34.4974	29.1242	31.4697	40.9055	54.9033	69.7123	81.3646	86.7378	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	511.6297	516.9388	503.5600	475.0781	439.1249	405.3339	382.7594	377.4503	390.8291	419.3110	455.2642	489.0552	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.7494	55.7494	55.7494	55.7494	55.7494	55.7494	55.7494	55.7494	55.7494	55.7494	55.7494	55.7494	(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)													
	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	-118.5682	(71)
Water heating gains (Table 5)													
	118.3952	115.9790	109.4606	96.6361	85.9541	79.4682	74.1680	81.9596	91.3762	102.9388	112.4119	115.9891	(72)
Total internal gains													
	832.4507	825.9078	792.0129	735.8974	677.6099	631.9598	606.4306	618.3489	655.1420	709.9956	767.0742	809.8157	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	10.6300	11.9814	0.7200	0.7000	0.7700	44.4842	(74)
East	0.6900	22.3313	0.7200	0.7000	0.7700	5.3818	(76)
South	5.8400	50.9848	0.7200	0.7000	0.7700	103.9962	(78)
West	0.6900	22.3313	0.7200	0.7000	0.7700	5.3818	(80)
South	3.1500	50.9848	0.7200	0.7000	0.7700	56.0938	(78)

Solar gains	215.3379	331.4135	457.2246	609.1577	693.2274	751.4324	710.3809	642.5209	544.6637	393.1969	264.3557	182.5173	(83)
Total gains	1047.7886	1157.3213	1249.2375	1345.0551	1370.8373	1383.3922	1316.8115	1260.8698	1199.8057	1103.1925	1031.4299	992.3329	(84)

7. Mean internal temperature (heating season)

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

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

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	34.1459	34.4738	34.4738	34.4870	34.4870	34.4870	34.4870	34.4870	34.4870	34.4870	34.4870	34.4870	
alpha	3.2764	3.2983	3.2983	3.2991	3.2991	3.2991	3.2991	3.2991	3.2991	3.2991	3.2991	3.2991	
util living area	0.9782	0.9686	0.9469	0.8971	0.7944	0.5954	0.4176	0.4465	0.7211	0.9042	0.9637	0.9812	(86)
MIT	19.2904	19.4771	19.8262	20.2565	20.6586	20.9136	20.9813	20.9764	20.8197	20.3488	19.7574	19.2655	(87)
Th 2	20.0117	20.0202	20.0202	20.0205	20.0205	20.0205	20.0205	20.0205	20.0205	20.0205	20.0205	20.0205	(88)
util rest of house	0.9740	0.9626	0.9360	0.8742	0.7446	0.5014	0.2929	0.3190	0.6420	0.8780	0.9554	0.9776	(89)
MIT 2	17.7402	18.0151	18.5178	19.1260	19.6663	19.9594	20.0140	20.0117	19.8674	19.2636	18.4238	17.7098	(90)
Living area fraction									fLA = Living area / (4) =			0.1121	(91)
MIT	17.9140	18.1790	18.6645	19.2528	19.7776	20.0664	20.1225	20.1199	19.9742	19.3853	18.5733	17.8842	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.7640	18.0290	18.5145	19.1028	19.6276	19.9164	19.9725	19.9699	19.8242	19.2353	18.4233	17.7342	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9597	0.9450	0.9133	0.8472	0.7212	0.4905	0.2865	0.3121	0.6237	0.8507	0.9360	0.9646	(94)
Useful gains	1005.5751	1093.6934	1140.9122	1139.5922	988.6122	678.5798	377.2138	393.5292	748.3171	938.4856	965.4336	957.2488	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	2356.3209	2290.6027	2048.3452	1695.3694	1220.9627	721.5010	381.7989	399.7437	851.8909	1406.5964	1920.2240	2327.5240	(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	1004.9549	804.3230	675.1302	400.1596	172.8688	0.0000	0.0000	0.0000	0.0000	348.2744	687.4491	1019.4848	(98)
Space heating												5112.6448	(98)
Space heating per m2											(98) / (4) =	29.8601	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.6000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	5643.0959	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1004.9549	804.3230	675.1302	400.1596	172.8688	0.0000	0.0000	0.0000	0.0000	348.2744	687.4491	1019.4848	(98)
Space heating efficiency (main heating system 1)	90.6000	90.6000	90.6000	90.6000	90.6000	0.0000	0.0000	0.0000	0.0000	90.6000	90.6000	90.6000	(210)
Space heating fuel (main heating system)	1109.2217	887.7738	745.1768	441.6773	190.8044	0.0000	0.0000	0.0000	0.0000	384.4088	758.7738	1125.2591	(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	179.9343	139.7135	116.1430	60.8620	29.2842	3.9429	0.0000	29.7818	61.9786	115.8616	153.7683	179.6755	(64)
Efficiency of water heater												79.9000	(216)
(217)m	88.7942	88.8393	88.8535	89.0261	88.8759	79.9000	79.9000	79.9000	79.9000	87.6693	88.4352	88.8178	(217)
Fuel for water heating, kWh/month	202.6418	157.2655	130.7130	68.3642	32.9496	4.9348	0.0000	37.2738	77.5702	132.1576	173.8769	202.2966	(219)
Water heating fuel used												1220.0439	(219)
Annual totals kWh/year													
Space heating fuel - main system												5643.0959	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
(MEVDecentralised, Database: total watage = 10.9710, total flow = 53.0000, SFP = 0.2070)													
mechanical ventilation fans (SFP = 0.2070)												108.1376	(230a)
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												233.1376	(231)
Electricity for lighting (calculated in Appendix L)												596.1578	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.04 * 1121 * 1.00) =										-932.6538		-932.6538	(233)
Total delivered energy for all uses												6759.7814	(238)

10a. Fuel costs - using BEDF prices (467)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	5643.0959	3.9500	222.9023	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1220.0439	3.9500	48.1917	(247)
Mechanical ventilation fans	108.1376	18.7000	20.2217	(249)
Pumps and fans for heating	75.0000	18.7000	14.0250	(249)
Pump for solar water heating	50.0000	18.7000	9.3500	(249)
Energy for lighting	596.1578	18.7000	111.4815	(250)
Additional standing charges			91.0000	(251)

Energy saving/generation technologies			
PV Unit	-932.6538	18.7000	-174.4063 (252)
Total energy cost			342.7660 (255)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	5643.0959	0.2160	1218.9087	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1220.0439	0.2160	263.5295	(264)
Space and water heating			1482.4382	(265)
Pumps and fans	233.1376	0.5190	120.9984	(267)
Energy for lighting	596.1578	0.5190	309.4059	(268)
Energy saving/generation technologies				
PV Unit	-932.6538	0.5190	-484.0473	(269)
Total kg/year			1428.7952	(272)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	5643.0959	1.2200	6884.5769	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1220.0439	1.2200	1488.4536	(264)
Space and water heating			8373.0305	(265)
Pumps and fans	233.1376	3.0700	715.7325	(267)
Energy for lighting	596.1578	3.0700	1830.2045	(268)
Energy saving/generation technologies				
PV Unit	-932.6538	3.0700	-2863.2472	(269)
Primary energy kWh/year			8055.7203	(272)
Primary energy kWh/m2/year			47.0489	(273)

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

Overheating Calculation Input Data

Dwelling type	Detached House
Number of storeys	3
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	North
Overshading	Average or unknown
Thermal mass parameter	133.6 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient		565.22 (P1)
Transmission heat loss coefficient		113.57 (37)
Summer heat loss coefficient		678.79 (P2)

Overhangs

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

Solar shading

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

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North	10.6300	81.1852	0.7200	0.7000	0.9000	352.3105
East	0.6900	117.5071	0.7200	0.7000	0.9000	33.1000
South	5.8400	112.2060	0.7200	0.7000	0.9000	267.5127
West	0.6900	117.5071	0.7200	0.7000	0.9000	33.1000
South	3.1500	112.2060	0.7200	0.7000	0.9000	144.2920
total:						830.3153

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

	Jun	Jul	Aug	
Solar gains	878	830	751	(P3)
Internal gains	652	627	638	
Total summer gains	1531	1457	1389	(P5)
Summer gain/loss ratio	2.26	2.15	2.05	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 133.6)	1.06	1.06	1.06	
Threshold temperature	19.32	21.11	20.91	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight