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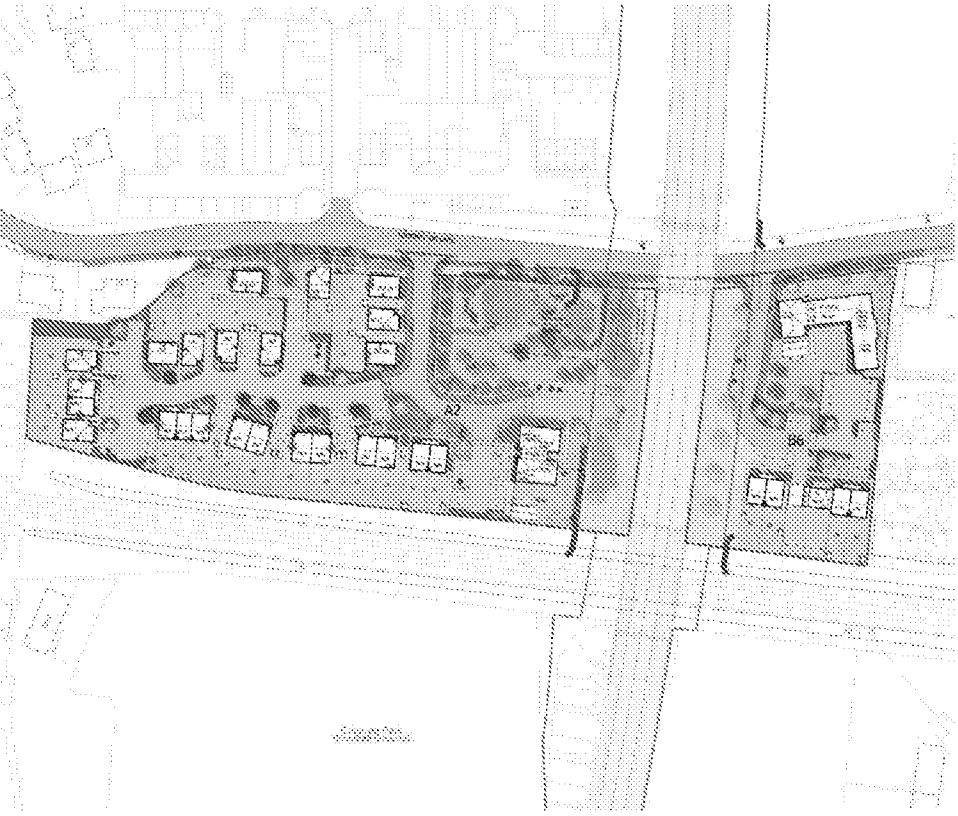
LITTLEHAMPTON PHASE 3 – PARCELS A2/B6



ENERGY STATEMENT

14th February 2020

Southern Energy Consultants

Energy & Sustainability Solutions

ARUN DISTRICT COUNCIL LU/90/20/DOC

About Southern Energy Consultants Ltd

Southern Energy Consultants Ltd are a construction consultancy specialising in sustainability, energy conservation, the application of renewable technologies and statutory utilities infrastructure design and management. As a consultancy we do not sell or have financial interest in any products so are able to take an objective view of developments to assist developers with incorporating cost effective and practical solutions.

Our services include Planning Energy Statements, energy calculations for Building Regulation compliance, Code for Sustainable Homes assessments and utilities design and management. Our team of consultants include registered SAP, SBEM and Code for Sustainable Homes assessors, Planning Specialists, Renewable Energy Specialists, CAD Specialist, Utilities Specialists and Civil Engineers.

Within SEC Ltd we have over 25 years experience working with and for National Developers, Construction and Design and Build Contractors we apply our expertise not only to assist with developers understanding of new energy and sustainability obligations but also in a way that ensures that the needs and responsibilities of all stakeholders are wholly respected.

Report prepared by: David Cook
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F - Revised to reflect Layout 544_PL_101_K

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1.0 Introduction

1.1 This Energy Statement has been commissioned by Persimmon Homes (the Applicant) and carried out by Southern Energy Consultants as part of a comprehensive analysis of available opportunities to reduce carbon dioxide emissions and energy consumption across Parcels A2 and B6 of their development at Littlehampton. The site falls under the West Sussex District Council jurisdiction and, combined, these parcels of development include 45 dwellings of mixed type and tenure.

1.2 This Statement provides a response to Planning Condition 31 of the Consent (Application Reference: LU/47/11). Condition 31 is entitled 'Energy' and states the following:

"At least 10% of the energy supply of the development shall be secured from decentralised and renewable or low carbon energy sources (as described in the glossary at Annex 2 of the National Planning Policy Framework, March 2012). Details and a timetable of how this is to be achieved for each phase or sub phase of development, including details of physical works on site, shall be submitted to and approved in writing by the Local Planning Authority before any development in that phase or sub phase begins. The development shall be implemented in accordance with the approved details and timetable and retained as operational thereafter, unless otherwise agreed in writing by the Local Planning Authority."

Strategy and Planning Background

1.3 The Applicant intends to deliver a 10% reduction in site-wide carbon dioxide emissions, with respect to the standard set by Part L1a of Building Regulations, through the adoption of best practice energy efficiency measures and installation of renewable energy technologies. The Applicant's proposed approach for minimising greenhouse gas emissions from the new dwellings in Parcels A2/B6 of the Littlehampton development is supported by national planning policy guidance and will help to reduce fuel bills for future occupants. At a national level, planning policy guidance is stimulated by the Climate Change Act (2008) and fully espoused within the National Planning Policy Framework (2019) (NPPF). The Climate Change Act requires the UK Government to *"ensure that the net UK carbon account for the year 2050 is at least 80% lower than the 1990 baseline"*. This legal commitment sets the overriding objective for sustainable energy provision in the UK: the reduction of carbon dioxide emissions.

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1.4 In 2019, the revised NPPF was published. This document asserts that:

"At the heart of the NPPF is a presumption in favour of sustainable development which should be seen as a golden thread running through both plan-making and decision-taking. For decision-taking this means:

- *Approving development proposals that accord with the development plan without delay; and*
- *Where the development plan is absent, silent or relevant, policies are out-of-date granting permission unless*
  - *Any adverse impacts of doing so would significantly and demonstrably outweigh the benefits when assessed against the policies in this Framework taken as a whole; or*
  - *Specific policies in this Framework indicate development should be restricted."*

1.5 The NPPF proceeds to state that:

"To support the move to a low carbon future, local planning authorities should:

- *Plan for new development in locations and ways which reduce greenhouse gas emissions;*
- *Actively support energy efficiency improvements to existing buildings"*

Objectives

1.6 In the light of the requirements set by Planning Condition 31 and the NPPF, this Statement will set out an array of best practice energy efficiency proposals and renewable energy installations, sufficient for the 46 dwellings proposed across Parcels A2/B6 of the Littlehampton development to deliver reductions in carbon dioxide emissions of 10% compared to a Part L1a (2013) compliant baseline.

Structure

1.7 The remainder of this Statement calculates the carbon dioxide emissions baseline using the Standard Assessment Procedure (SAP), outlines the Applicant's energy efficiency measures for complying with and bettering the baseline standard, considers the most suitable renewable energy technology for the site, and finally demonstrates how renewable energy technologies will deliver the sought after 10% reduction across Parcels A2/B6 of the Littlehampton development.

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2.0 Emissions Baseline and Energy Efficiency Proposals

Building Regulations (2013) Baseline

2.1 In order for an energy assessment to be conducted, a Building Regulation (2013) baseline for carbon dioxide emissions must first be calculated for the 45 dwellings. The predicted emissions for the dwellings include all sources from hot water, space heating and fixed electrical items. The baseline has been calculated by an accredited energy assessor using SAP (2012) methodology and Elmhurst approved software. This baseline will then be used as a standard to demonstrate the reductions that will result from energy efficiency measures and renewable energy technologies. The Building Regulation (2013) baseline for the development identifies predicted carbon dioxide emissions, relative to each dwelling type's Target Emission Rate, of **59,332 kgCO_2/year**. Table 1 below sets out the baseline emissions for each dwelling type and in aggregate, with detailed examples of SAP calculations provided in the Appendix to this Statement.

Table 1: Baseline Carbon Dioxide Emissions (kgCO_2/year) for Phases A2/B6, Littlehampton

	Number of Dwellings	Emissions (kgCO_2/year)	Total Emissions (kgCO_2/year)
Private			
Alnwick	1	1,166	1,166
Hanbury/CR	6	1,294	7,764
Ashworth	6	1,401	8,406
Hatfield	6	1,578	9,468
Derwent	1	1,578	1,578
Clayton	4	1,733	6,932
3B Coach House	1	1,512	1,512
Apartments	10	1,067	10,670
Sub-total			**47,496**
Affordable			
3BH/CR	4	1,294	5,176
Apartments	6	1,110	6,660
Sub-total			**11,836**
TOTAL			**59,332**

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2.2 In accordance with the Applicant's intentions set out in the Introduction, this Statement will now continue by detailing the range of best practice energy efficiency measures and renewable energy technologies to deliver a reduction of at least 10% compared to the baseline scenario. This amounts to a required reduction of at least **5,933 kgCO_2/year**.

Best Practice Energy Efficiency Measures

2.3 As a first energy efficiency measure, the proposed dwellings will incorporate sufficient insulation in the building envelope (walls, roofs, floors and glazing) to achieve average U-values considerably better than the limiting standards demanded by Part L1a of 2013 Building Regulations. Table 2 below illustrates the proposed U-values and the limiting area-weighted values set by Part L1a of 2013 Building Regulations.

Table 2: Insulation Enhancement Proposals for Main Thermal Elements

Thermal Element	Maximum Area-Weighted U-value (W/m^2K) Allowable Under 2013 Building Regulations	Applicant's Proposed U-value (W/m^2K) Required To Meet 2013 Building Regulations Baseline	% Improvement On 2013 Allowable U-Value Standard
Main external walls	0.30	0.28	6.67
Roof (joists)	0.20	0.15	25.00
Roof (rafters)	0.20	0.19	5.00
Ground floor	0.25	0.16-0.18	28.00-36.00
Windows	2.00	1.40	30.00

2.4 The Applicant intends to meet the U-value performance standards detailed in Table 2 through the following construction specification for the main thermal elements:

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Table 3: Fabric Enhancement Construction Specification

Thermal Element	Proposed U-value (W/m^2K) required to Meet 2013 Building Regulations Baseline	Construction Measures
Main external walls (houses)	0.28	Space 4 timber frame construction including mineral wool insulation, plus either a reflective breather membrane or reflective vapour barrier.
Main external walls (apartments)	0.26	Masonry construction, including outer leaf or 100mm brick or external cladding on medium density blocks, 100mm cavity fully filled with Knauf Supafil 34 insulation ('k' value of 0.034), 100mm aircrete blocks ('k' value of 0.19).
Roof (joists)	0.15	One layer of 100mm mineral wool insulation ('k' value of 0.044) quilt laid between ceiling joists and one layer of 200mm mineral wool ('k' value of 0.044) laid over to provide a total thickness of 300mm.
Roof (rafters)	0.19	Space 4 cassette roof system.
Ground floor	0.16-0.18	Beam and block construction to include 75mm Kingspan Thermawall TF70 insulation ('k' value of 0.022).
Windows	1.40	BFRC, PVC-U double glazed, soft-coated with 'g' value of 0.45.

Heating and Controls

2.5 The Applicant proposes the installation of Ideal Logic Combi ESP1 35 gas boilers, which possess a SEDBUK (2009) efficiency of 89%. All dwellings will benefit from efficient heating controls, including Time and Temperature Zone Controls and optimum start thermostats. Due to the former, it will be possible for the future homeowners to co-ordinate the heating performance of at least two distinct zones within their property. Thermostatic radiator valves will be provided to all radiators as a form of localised heating controls.

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Ventilation and Air Tightness

2.6 Ventilation to all dwellings will be provided via highly efficient intermittent extract fans. Air tightness standards will be improved by the Applicant adopting a mixture of 'Space4' (houses), Aircrete Product Association (apartments) and Accredited Construction details for non-repeating thermal bridges, which are typically far superior to the default psi value standards assumed by SAP (2012). Each dwelling's design air permeability will be reduced from 10 m^3/hm^2 to 5 m^3/hm^2 to further lower space heating requirements.

Internal Lighting

2.7 All of the Applicant's internal lighting throughout the development will be of the dedicated low energy type. Although not assessed within the Building Regulations calculation, external lighting will also be low energy and some will be controlled through PIR sensors or daylight cut-off devices to minimise use and promote the security of the development.

Energy Demand After Energy Efficiency Proposals

2.8 The energy efficiency measures detailed in Paragraphs 2.4 to 2.8 will reduce the predicted carbon dioxide emissions at the Littlehampton, Phase 2 development from **59,332 $kgCO_2$/year** to **58,383 $kgCO_2$/year**. This is a reduction of **949 $kgCO_2$/year**, or **1.60%**. A further reduction in emissions of at least **4,984 $kgCO_2$/year** must be secured via the installation of renewable energy technologies in order to deliver a 10% reduction compared to the baseline case.

Feasibility of Renewable Energy Technologies

2.9 This section of the Statement conducts a thorough review of the renewable energy and low carbon technologies that could theoretically be applied to Parcels A2/B6 of the Littlehampton development. Renewable energy is defined as *"those energy flows that occur naturally and repeatedly in the environment – from the wind, the fall of water, the movement of oceans, from the sun and also from biomass"* (London Plan, 2008). This definition has been widened by the UK Government through the use of the term 'Low or Zero Carbon Technologies' (LZC), which include heat pumps and gas-fired CHP – technologies not always considered as being renewable. The technologies to be evaluated in this Statement are as follows:

- Combined Heat and Power
- Biomass

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- Heat pumps (ground source and air source)
- Hydroelectric power
- Wind energy
- Solar thermal panels
- Solar photovoltaic panels

Combined Heat and Power

2.10 CHP is a form of decentralised energy generation that generally uses gas to generate electricity for local consumption, reducing the need for grid electricity and its associated high carbon dioxide emissions. As the CHP system is close to the point of energy demand, it is possible to use the heat that is generated during the electricity generation process. As both the electricity and heat from the generator is used, the efficiency of the system is increased above that of a conventional power plant where the heat is not utilised. CHP is suitable for dense, mixed-use developments where there is a high, constant and varied heat demand. This is not the case for Parcels A2/B6 of the Littlehampton development, which is residential and only incorporates a total of forty-five dwellings. In addition, as there are no other CHP networks in the vicinity of the development with which to forge a connection, this is not a suitable technology for the development.

Biomass

2.11 Biomass community heating is an alternative to conventional fossil fuel heating but, as per the reasons used against the installation of gas-fuelled CHP, should be discounted as an option for the proposed dwellings. Biomass boilers within individual dwellings are usually installed with a standard gas boiler as back-up in case the occupier runs out of fuel. Although they are reducing in size, they are still large enough to require a dedicated room with additional space for the fuel – there is insufficient space available for such infrastructure in the majority of proposed dwelling types. The management of fuel deliveries and ash dispersal is also complex, necessitating a dedicated operative as opposed to residents of the future dwellings. Furthermore, the emissions of Nitrous Oxide and particulate matter that are associated with biomass installations would have the capacity to worsen local air pollution.

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Ground and Air Source Heat Pumps (GSHPs)

2.12 Neither of these technologies has been considered for implementation at Littlehampton due to their higher carbon dioxide emissions compared to the proposed gas boiler specification. Although both technologies are renowned for delivering reductions in carbon dioxide emissions, they do so from a much higher baseline than when gas is the specified fuel for space heating and hot water generation. Electricity consumption is also associated with much higher Nitrous Oxide emissions than Class 5 gas boilers.

Hydroelectric power

2.13 Hydroelectric power plants generate electricity using the gravitational force of flowing or falling water. However, there are no rivers of sufficient scale in the vicinity of the Littlehampton development to facilitate a hydroelectric power installation.

Wind Turbines

2.14 Wind turbines are a modern, high-technology descendant of the windmills that have been around for centuries. In modern windmills the kinetic energy of the wind is used to turn a turbine to generate electricity as opposed to moving water or turning a grist mill wheel. A site with an average wind speed of 5m/s or more is generally considered to be suitable for installing a wind turbine. The average wind speed at the Littlehampton development is 4.5m/s at 10m AOD and is below the level required to generate significant carbon dioxide reductions or commercial take-up. The installation of a single, large wind turbine to serve the development would also be controversial due to the nature of the locality. Even if space could be found within the development to accommodate a very high (15-20m) turbine, their installation would then present a significant visual blight to neighbours.

Solar thermal and photovoltaic panels

2.15 Solar thermal heating panels contribute to the hot water demand of a dwelling. Water or glycol (heat transfer liquid) is circulated to roof level where it is heated using solar energy before being returned to a thermal store where heat is exchanged with water from the conventional system. The proposed dwellings generally contain suitable attributes (orientation, available roof-space and limited shadowing) for solar photovoltaic installations to be designed-in, although solar thermal installations are unsuitable. In part this is because the smaller dwelling types – for example, the Hanbury and Alnwick – have very little space to accommodate a hot water cylinder, however, even if this was not the case, the technology is unable to deliver a 10% reduction in carbon dioxide

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emissions from the theoretical baseline – only around an 8% reduction on average can be obtained due to the limits of hot water demand. The specification of gas combination boilers also reduces the energy demand for heating and storing hot water.

2.16 However, there are few constraints on the capacity for solar photovoltaic panels to deliver reductions in emissions, apart from the presence of dormer windows to the Souter Type. For all dwellings on the site, roof-space is available at no worse than a west-east orientation, sufficient for solar photovoltaic installations to be effective at delivering emissions reductions. Further SAP calculations have been carried out, which show the reductions in emissions that could be secured given the installation of 11.92 kWp of solar PV output, with priority given to installing arrays on optimally orientated (south-facing) dwellings. These are plots 1, 3, 7 and 9.

Modelling of Solar PV Installations and Emissions Reductions

2.17 Further SAP calculations have been carried out to model the effects on site-wide emissions of introducing 11.92 kWp of solar PV panels to Parcels A2/B6 of the Littlehampton development. An examples of a 2.98 kWp installation on plot 1 (Type Clayton) is provided in the Appendix to this Statement. Overall, the introduction of 11.92 kWp of solar PV output to optimally orientated dwellings will reduce emissions across the site by **5,662 kgCO_2/year**. In addition, to the reductions secured via best practice energy efficiency measures, which were **949 kgCO_2/year**, this amasses to a total reduction of **6,611 kgCO_2/year**.

2.18 Compared to baseline emissions of **59,332 kgCO2/year**, this is equivalent to an overall reduction in emissions of **11.14%.** This is summarised in Table 4 overleaf. At the detailed design stage, the number of installations may reduce due to optimisation of plot design and the rated output of the specified panels, however, the reduction in carbon dioxide emissions will remain the same.

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Table 4: Emissions Reduction from Energy Efficiency Measures and Solar PV Installations – Parcels A2/B6, Littlehampton

	Emissions ($kgCO_2$/year)
Baseline	59,332
Reduction from energy efficiency measures	(942)
Reduction from 11.92 kWp solar PV output	(5,662)
Total reduction	**6,611**
Emissions after reductions	**52,721**
Overall percentage reduction from baseline	**11.14%**

3.0 Conclusion

3.1 This Energy Statement has set out the Applicant's detailed energy strategy pertaining to Parcels A2 and B6 of their development at Littlehampton. The strategy has been developed to comply in full with the requirements of Planning Condition 31 and the NPPF by delivering a 10% reduction in carbon dioxide emissions compared to the target standard set by Part L1a of Building Regulations (2013). The focus of the strategy has been to first reduce energy consumption at the point of demand by introducing a robust fabric specification and efficient heating and ventilation systems. Secondly, renewable energy installations, in the form of **11.92** kWp of solar PV output, will be installed to further reduce carbon dioxide emissions on a site-wide basis.

3.2 SAP calculations, carried out by an accredited energy assessor, have verified that the Applicant's proposed approach will deliver a **11.14%** reduction in carbon dioxide emissions compared to the baseline scenario. Once the dwellings are built, as built compliance reports will be compiled to verify that the development has been built out in accordance with the energy efficiency measures and renewable energy installations proposed in this Statement.

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Appendix

Example SAP calculations:
Plot 1 (Clayton) with 2.98 kWp

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

Property Reference	SECLITA2B6	Issued on Date	14/09/2019
Assessment Reference	001	Prop. Type Ref.	Clayton
Property	Plot 1, Battle Road, Hailsham, East Sussex, BN27		

SAP Rating	98 A	DER	3.36	TER	18.42
Environmental	98 A	% DER<TER	81.76		
CO_2 Emissions (t/year)	-0.11	DFEE	54.47	TFEE	56.67
General Requirements Compliance	Pass	% DFEE-TFEE	3.87		

Assessor	Stephen Smith, Tel: 01635261582	Assessor ID	D168-0001
Client	Persimmon Homes South East		

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	46.3900 (1b)	x	2.3100 (2b)	=	107.1609	(1b) - (3b)
First floor	46.3900 (1c)	x	2.5700 (2c)	=	119.2223	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	92.7800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	226.3832	(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) =		0.1325	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.3825	(18)
Number of sides sheltered			2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.3251	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	3.5000	3.3000	3.2000	2.9000	3.0000	2.6000	2.7000	2.6000	2.6000	2.7000	2.8000	3.1000	(22)
Wind factor	0.8750	0.8250	0.8000	0.7250	0.7500	0.6500	0.6750	0.6500	0.6500	0.6750	0.7000	0.7750	(22a)
Adj infilt rate	0.2845	0.2682	0.2601	0.2357	0.2439	0.2113	0.2195	0.2113	0.2113	0.2195	0.2276	0.2520	(22b)
Effective ac	0.5405	0.5360	0.5338	0.5278	0.5297	0.5223	0.5241	0.5223	0.5223	0.5241	0.5259	0.5317	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Opening Type 1			3.9000	1.3000	5.0700			(26)
Opening Type 2 (Uw = 1.40)			21.5600	1.3258	28.5833			(27)
Heat Loss Floor 1			46.3900	0.1600	7.4224			(28a)
External Wall 1	135.1300	25.4600	109.6700	0.2800	30.7076			(29a)
External Roof 1	46.3900		46.3900	0.1100	5.1029			(30)
Total net area of external elements Aum(A, m2)			227.9100					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	76.8862			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							100.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							12.1698	(36)
Total fabric heat loss						(33) + (36) =	89.0560	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	40.3766	40.0409	39.8805	39.4288	39.5745	39.0216	39.1524	39.0216	39.0216	39.1524	39.2882	39.7250	(38)
Heat transfer coeff	129.4326	129.0970	128.9365	128.4849	128.6305	128.0777	128.2085	128.0777	128.0777	128.2085	128.3442	128.7810	(39)
Average = Sum(39)m / 12 =												128.5297	(39)

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

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CALCULATION OF HEAT DEMAND 09 Jan 2014

HLP	1.3950	1.3914	1.3897	1.3848	1.3864	1.3804	1.3819	1.3804	1.3804	1.3819	1.3833	1.3880	(40)
HLP (average)												1.3853	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

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4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.6619	(42)
Average daily hot water use (litres/day)												97.4199	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	107.1619	103.2651	99.3683	95.4715	91.5747	87.6779	87.6779	91.5747	95.4715	99.3683	103.2651	107.1619	(44)
Energy conte	158.9180	138.9907	143.4260	125.0423	119.9810	103.5345	95.9399	110.0925	111.4073	129.8345	141.7245	153.9036	(45)
Energy content (annual)										Total = Sum(45)m =		1532.7949	(45)
Distribution loss (46)m = 0.15 x (45)m	23.8377	20.8486	21.5139	18.7563	17.9972	15.5302	14.3910	16.5139	16.7111	19.4752	21.2587	23.0855	(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	14.1380	12.7589	14.0986	13.5993	14.0203	13.5307	13.9584	13.9985	13.5681	14.0662	13.6529	14.1259	(61)
Total heat required for water heating calculated for each month	173.0560	151.7496	157.5246	138.6416	134.0013	117.0652	109.8984	124.0910	124.9754	143.9007	155.3774	168.0296	(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	173.0560	151.7496	157.5246	138.6416	134.0013	117.0652	109.8984	124.0910	124.9754	143.9007	155.3774	168.0296	(64)
								Total per year (kWh/year) = Sum(64)m =				1698.3107	(64)
RHI water heating demand												1698	(64)
Heat gains from water heating, kWh/month	56.3747	49.4041	51.2138	44.9764	43.3988	37.8079	35.3896	40.1054	40.4350	46.6865	50.5366	54.7044	(65)

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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	159.7135	159.7135	159.7135	159.7135	159.7135	159.7135	159.7135	159.7135	159.7135	159.7135	159.7135	159.7135	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	54.4043	48.3214	39.2976	29.7508	22.2391	18.7752	20.2872	26.3701	35.3939	44.9407	52.4524	55.9164	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	364.3287	368.1093	358.5824	338.3006	312.6984	288.6361	272.5609	268.7803	278.3073	298.5891	324.1912	348.2536	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.6332	53.6332	53.6332	53.6332	53.6332	53.6332	53.6332	53.6332	53.6332	53.6332	53.6332	53.6332	(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)	-106.4757	-106.4757	-106.4757	-106.4757	-106.4757	-106.4757	-106.4757	-106.4757	-106.4757	-106.4757	-106.4757	-106.4757	(71)
Water heating gains (Table 5)	75.7725	73.5181	68.8357	62.4672	58.3317	52.5110	47.5667	53.9051	56.1597	62.7507	70.1898	73.5275	(72)
Total internal gains	604.3766	599.8199	576.5868	540.3897	503.1403	469.7933	450.2860	458.9266	479.7319	516.1516	556.7045	587.5685	(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	7.2500	13.0723	0.6300	0.7000	0.7700	28.9642	(74)
East	1.4400	24.4329	0.6300	0.7000	0.7700	10.7525	(76)
South	7.1100	54.9219	0.6300	0.7000	0.7700	119.3403	(78)
West	5.7600	24.4329	0.6300	0.7000	0.7700	43.0099	(80)

Solar gains	202.0669	327.6842	461.0404	640.9932	719.9605	785.6026	733.1228	638.7461	533.5636	375.0403	239.1089	167.2755	(83)
Total gains	806.4435	927.5040	1037.6272	1181.3829	1223.1008	1255.3959	1183.4087	1097.6727	1013.2955	891.1919	795.8134	754.8440	(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	19.9117	19.9635	19.9883	20.0586	20.0359	20.1223	20.1018	20.1223	20.1223	20.1018	20.0806	20.0124	
alpha	2.3274	2.3309	2.3326	2.3372	2.3357	2.3415	2.3401	2.3415	2.3415	2.3401	2.3387	2.3342	
util living area	0.9281	0.9042	0.8596	0.7714	0.6557	0.4998	0.3797	0.3862	0.6056	0.7945	0.8961	0.9355	(86)
MIT	18.6757	18.9117	19.3994	20.0146	20.5044	20.8170	20.9325	20.9338	20.7011	20.1368	19.3437	18.6366	(87)
Th 2	19.7671	19.7699	19.7712	19.7750	19.7738	19.7784	19.7773	19.7784	19.7784	19.7773	19.7761	19.7725	(88)
util rest of house	0.9168	0.8897	0.8377	0.7350	0.5970	0.4141	0.2689	0.2674	0.5215	0.7512	0.8768	0.9251	(89)
MIT 2	16.7540	17.0894	17.7802	18.6298	19.2718	19.6381	19.7454	19.7494	19.5267	18.8216	17.7201	16.7023	(90)
Living area fraction									fLA = Living area / (4) =			0.1940	(91)
MIT	17.1268	17.4429	18.0944	18.8985	19.5110	19.8669	19.9757	19.9792	19.7545	19.0767	18.0351	17.0776	(92)
Temperature adjustment												-0.1500	
adjusted MIT	16.9768	17.2929	17.9444	18.7485	19.3610	19.7169	19.8257	19.8292	19.6045	18.9267	17.8851	16.9276	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8801	0.8497	0.7958	0.6986	0.5747	0.4095	0.2736	0.2727	0.5080	0.7141	0.8363	0.8900	(94)
Useful gains	709.7197	788.0647	825.7615	825.2948	702.8934	514.0314	323.7348	299.3025	514.7723	636.4075	665.5087	671.8148	(95)
Ext temp.	5.1000	5.4000	7.1000	9.6000	12.6000	15.3000	17.2000	17.4000	14.9000	11.7000	8.2000	5.2000	(96)
Heat loss rate W	1537.2450	1535.3378	1398.2341	1175.4422	869.6646	565.7000	336.6389	311.1220	602.5434	926.5267	1243.0304	1510.2887	(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	615.6789	502.1676	425.9196	252.1061	124.0777	0.0000	0.0000	0.0000	0.0000	215.8487	415.8156	623.8246	(98)
Space heating												3175.4387	(98)
RHI space heating demand												3175	(98)

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1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	46.3900 (1b)	x	2.3100 (2b)	=	107.1609	(1b) - (3b)
First floor	46.3900 (1c)	x	2.5700 (2c)	=	119.2223	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 92.7800						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	226.3832	(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) =	0.1325	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3825	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3251	(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	0.4146	0.4064	0.3983	0.3577	0.3495	0.3089	0.3089	0.3008	0.3251	0.3495	0.3658	0.3820	(22b)
Effective ac	0.5859	0.5826	0.5793	0.5640	0.5611	0.5477	0.5477	0.5452	0.5529	0.5611	0.5669	0.5730	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Opening Type 1			3.9000	1.3000	5.0700			(26)
Opening Type 2 (Uw = 1.40)			21.5600	1.3258	28.5833			(27)
Heat Loss Floor 1			46.3900	0.1600	7.4224			(28a)
External Wall 1	135.1300	25.4600	109.6700	0.2800	30.7076			(29a)
External Roof 1	46.3900		46.3900	0.1100	5.1029			(30)
Total net area of external elements Aum(A, m2)			227.9100					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		76.8862			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							100.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							12.1698	(36)
Total fabric heat loss					(33) + (36) =		89.0560	(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	43.7726	43.5233	43.2790	42.1313	41.9166	40.9171	40.9171	40.7320	41.3021	41.9166	42.3510	42.8051	(38)
Heat transfer coeff	132.8286	132.5793	132.3350	131.1874	130.9727	129.9731	129.9731	129.7880	130.3581	130.9727	131.4070	131.8612	(39)
Average = Sum(39)m / 12 =												131.1863	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.4317	1.4290	1.4263	1.4140	1.4116	1.4009	1.4009	1.3989	1.4050	1.4116	1.4163	1.4212	(40)
HLP (average)												1.4140	(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	2.6619	(42)
Average daily hot water use (litres/day)	97.4199	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	107.1619	103.2651	99.3683	95.4715	91.5747	87.6779	87.6779	91.5747	95.4715	99.3683	103.2651	107.1619	(44)
Energy conte	158.9180	138.9907	143.4260	125.0423	119.9810	103.5345	95.9399	110.0925	111.4073	129.8345	141.7245	153.9036	(45)
Energy content (annual)										Total = Sum(45)m =		1532.7949	(45)
Distribution loss (46)m = 0.15 x (45)m	23.8377	20.8486	21.5139	18.7563	17.9972	15.5302	14.3910	16.5139	16.7111	19.4752	21.2587	23.0855	(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													

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	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1380	12.7589	14.0986	13.5993	14.0203	13.5307	13.9584	13.9985	13.5681	14.0662	13.6529	14.1259	(61)
Total heat required for water heating calculated for each month													
	173.0560	151.7496	157.5246	138.6416	134.0013	117.0652	109.8984	124.0910	124.9754	143.9007	155.3774	168.0296	(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													
	173.0560	151.7496	157.5246	138.6416	134.0013	117.0652	109.8984	124.0910	124.9754	143.9007	155.3774	168.0296	(64)
								Total per year (kWh/year) = Sum(64)m =				1698.3107	(64)
Heat gains from water heating, kWh/month													
	56.3747	49.4041	51.2138	44.9764	43.3988	37.8079	35.3896	40.1054	40.4350	46.6865	50.5366	54.7044	(65)

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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	159.7135	159.7135	159.7135	159.7135	159.7135	159.7135	159.7135	159.7135	159.7135	159.7135	159.7135	159.7135	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	54.4043	48.3214	39.2976	29.7508	22.2391	18.7752	20.2872	26.3701	35.3939	44.9407	52.4524	55.9164	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	364.3287	368.1093	358.5824	338.3006	312.6984	288.6361	272.5609	268.7803	278.3073	298.5891	324.1912	348.2536	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.6332	53.6332	53.6332	53.6332	53.6332	53.6332	53.6332	53.6332	53.6332	53.6332	53.6332	53.6332	(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)													
	-106.4757	-106.4757	-106.4757	-106.4757	-106.4757	-106.4757	-106.4757	-106.4757	-106.4757	-106.4757	-106.4757	-106.4757	(71)
Water heating gains (Table 5)													
	75.7725	73.5181	68.8357	62.4672	58.3317	52.5110	47.5667	53.9051	56.1597	62.7507	70.1898	73.5275	(72)
Total internal gains													
	604.3766	599.8199	576.5868	540.3897	503.1403	469.7933	450.2860	458.9266	479.7319	516.1516	556.7045	587.5685	(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	7.2500	10.6334	0.6300	0.7000	0.7700	23.5603	(74)
East	1.4400	19.6403	0.6300	0.7000	0.7700	8.6433	(76)
South	7.1100	46.7521	0.6300	0.7000	0.7700	101.5880	(78)
West	5.7600	19.6403	0.6300	0.7000	0.7700	34.5734	(80)

Solar gains	168.3650	295.9410	427.6677	565.4759	664.0023	672.1764	642.6862	567.5240	475.3030	333.3624	203.3672	142.9617	(83)
Total gains	772.7416	895.7608	1004.2545	1105.8656	1167.1425	1141.9697	1092.9722	1026.4506	955.0349	849.5140	760.0717	730.5302	(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	19.4026	19.4391	19.4750	19.6454	19.6776	19.8289	19.8289	19.8572	19.7703	19.6776	19.6125	19.5450	
alpha	2.2935	2.2959	2.2983	2.3097	2.3118	2.3219	2.3219	2.3238	2.3180	2.3118	2.3075	2.3030	
util living area													
	0.9401	0.9162	0.8780	0.8113	0.7128	0.5828	0.4605	0.4989	0.6774	0.8402	0.9183	0.9466	(86)
MIT	18.3828	18.6930	19.1773	19.7824	20.3183	20.7054	20.8785	20.8495	20.5532	19.8553	19.0104	18.3179	(87)
Th 2	19.7392	19.7412	19.7432	19.7526	19.7544	19.7627	19.7627	19.7642	19.7595	19.7544	19.7508	19.7471	(88)
util rest of house													
	0.9308	0.9033	0.8587	0.7802	0.6621	0.5025	0.3509	0.3898	0.6046	0.8069	0.9036	0.9382	(89)
MIT 2	16.3183	16.7623	17.4524	18.3032	19.0247	19.5107	19.6912	19.6693	19.3439	18.4266	17.2318	16.2291	(90)
Living area fraction									fLA = Living area / (4) =			0.1940	(91)
MIT	16.7188	17.1369	17.7870	18.5902	19.2757	19.7425	19.9215	19.8982	19.5785	18.7038	17.5769	16.6344	(92)
Temperature adjustment												-0.1500	
adjusted MIT	16.5688	16.9869	17.6370	18.4402	19.1257	19.5925	19.7715	19.7482	19.4285	18.5538	17.4269	16.4844	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8961	0.8640	0.8162	0.7398	0.6323	0.4903	0.3517	0.3882	0.5820	0.7655	0.8646	0.9055	(94)
Useful gains	692.4767	773.9271	819.6826	818.0651	737.9710	559.8601	384.4448	398.4872	555.8055	650.3400	657.1764	661.4665	(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													
	1629.6494	1602.4707	1473.8172	1251.5522	972.5626	648.8865	412.2142	434.5616	694.6184	1041.7271	1357.0263	1619.8311	(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													
	697.2565	556.7813	486.6761	312.1107	174.5361	0.0000	0.0000	0.0000	0.0000	291.1920	503.8919	713.0232	(98)
Space heating												3735.4678	(98)
Space heating per m2											(98) / (4) =	40.2616	(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	4127.5888	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	697.2565	556.7813	486.6761	312.1107	174.5361	0.0000	0.0000	0.0000	0.0000	291.1920	503.8919	713.0232	(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)	770.4492	615.2280	537.7637	344.8737	192.8576	0.0000	0.0000	0.0000	0.0000	321.7591	556.7866	787.8710	(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	173.0560	151.7496	157.5246	138.6416	134.0013	117.0652	109.8984	124.0910	124.9754	143.9007	155.3774	168.0296	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8452	89.7951	89.6960	89.4910	89.0818	87.3000	87.3000	87.3000	87.3000	89.4160	89.7249	89.8717	(217)
Fuel for water heating, kWh/month	192.6159	168.9955	175.6205	154.9223	150.4249	134.0953	125.8859	142.1432	143.1562	160.9340	173.1710	186.9660	(219)

Water heating fuel used	1908.9305	(219)
Annual totals kWh/year		
Space heating fuel – main system	4127.5888	(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)	384.3187	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV Unit 0 (0.80 * 2.98 * 1080 * 1.00) = -2573.5867	-2573.5867	(233)
Total delivered energy for all uses	3922.2513	(238)

10a. Fuel costs – using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating – main system 1	4127.5888	3.4800	143.6401	(240)
Space heating – secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1908.9305	3.4800	66.4308	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	384.3187	13.1900	50.6916	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-2573.5867	13.1900	-339.4561	(252)
Total energy cost			51.1989	(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] =	0.1561	(257)
SAP value		97.8228	
SAP rating (Section 12)		98	(258)
SAP band		A	

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating – main system 1	4127.5888	0.2160	891.5592	(261)
Space heating – secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1908.9305	0.2160	412.3290	(264)
Space and water heating			1303.8882	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	384.3187	0.5190	199.4614	(268)
Energy saving/generation technologies				
PV Unit	-2573.5867	0.5190	-1335.6915	(269)
Total kg/year			206.5831	(272)
CO2 emissions per m2			2.2300	(273)
EI value			97.9908	
EI rating			98	(274)
EI band			A	

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 / 0.8884 = 3.917, stars = 4
Water heating environmental impact	0.216 / 0.8884 = 0.2431, 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	46.3900 (1b)	x	2.3100 (2b)	=	107.1609	(1b) - (3b)
First floor	46.3900 (1c)	x	2.5700 (2c)	=	119.2223	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 92.7800						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	226.3832	(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) =		0.1325	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.3825	(18)
Number of sides sheltered			2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3251	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	3.5000	3.3000	3.2000	2.9000	3.0000	2.6000	2.7000	2.6000	2.6000	2.7000	2.8000	3.1000	(22)
Wind factor	0.8750	0.8250	0.8000	0.7250	0.7500	0.6500	0.6750	0.6500	0.6500	0.6750	0.7000	0.7750	(22a)
Adj infilt rate	0.2845	0.2682	0.2601	0.2357	0.2439	0.2113	0.2195	0.2113	0.2113	0.2195	0.2276	0.2520	(22b)
Effective ac	0.5405	0.5360	0.5338	0.5278	0.5297	0.5223	0.5241	0.5223	0.5223	0.5241	0.5259	0.5317	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Opening Type 1			3.9000	1.3000	5.0700			(26)
Opening Type 2 (Uw = 1.40)			21.5600	1.3258	28.5833			(27)
Heat Loss Floor 1			46.3900	0.1600	7.4224			(28a)
External Wall 1	135.1300	25.4600	109.6700	0.2800	30.7076			(29a)
External Roof 1	46.3900		46.3900	0.1100	5.1029			(30)
Total net area of external elements Aum(A, m2)			227.9100					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		76.8862			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							100.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							12.1698	(36)
Total fabric heat loss					(33) + (36) =		89.0560	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	40.3766	40.0409	39.8805	39.4288	39.5745	39.0216	39.1524	39.0216	39.0216	39.1524	39.2882	39.7250	(38)
Heat transfer coeff	129.4326	129.0970	128.9365	128.4849	128.6305	128.0777	128.2085	128.0777	128.0777	128.2085	128.3442	128.7810	(39)
Average = Sum(39)m / 12 =												128.5297	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3950	1.3914	1.3897	1.3848	1.3864	1.3804	1.3819	1.3804	1.3804	1.3819	1.3833	1.3880	(40)
HLP (average)												1.3853	(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	2.6619	(42)
Average daily hot water use (litres/day)	97.4199	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	107.1619	103.2651	99.3683	95.4715	91.5747	87.6779	87.6779	91.5747	95.4715	99.3683	103.2651	107.1619	(44)
Energy conte	158.9180	138.9907	143.4260	125.0423	119.9810	103.5345	95.9399	110.0925	111.4073	129.8345	141.7245	153.9036	(45)
Energy content (annual)										Total = Sum(45)m =		1532.7949	(45)
Distribution loss (46)m = 0.15 x (45)m	23.8377	20.8486	21.5139	18.7563	17.9972	15.5302	14.3910	16.5139	16.7111	19.4752	21.2587	23.0855	(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 ERC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1380	12.7589	14.0986	13.5993	14.0203	13.5307	13.9584	13.9985	13.5681	14.0662	13.6529	14.1259	(61)
Total heat required for water heating calculated for each month													
	173.0560	151.7496	157.5246	138.6416	134.0013	117.0652	109.8984	124.0910	124.9754	143.9007	155.3774	168.0296	(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													
	173.0560	151.7496	157.5246	138.6416	134.0013	117.0652	109.8984	124.0910	124.9754	143.9007	155.3774	168.0296	(64)
								Total per year (kWh/year) = Sum(64)m =				1698.3107	(64)
Heat gains from water heating, kWh/month													
	56.3747	49.4041	51.2138	44.9764	43.3988	37.8079	35.3896	40.1054	40.4350	46.6865	50.5366	54.7044	(65)

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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	159.7135	159.7135	159.7135	159.7135	159.7135	159.7135	159.7135	159.7135	159.7135	159.7135	159.7135	159.7135	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	54.4043	48.3214	39.2976	29.7508	22.2391	18.7752	20.2872	26.3701	35.3939	44.9407	52.4524	55.9164	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	364.3287	368.1093	358.5824	338.3006	312.6984	288.6361	272.5609	268.7803	278.3073	298.5891	324.1912	348.2536	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.6332	53.6332	53.6332	53.6332	53.6332	53.6332	53.6332	53.6332	53.6332	53.6332	53.6332	53.6332	(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)													
	-106.4757	-106.4757	-106.4757	-106.4757	-106.4757	-106.4757	-106.4757	-106.4757	-106.4757	-106.4757	-106.4757	-106.4757	(71)
Water heating gains (Table 5)													
	75.7725	73.5181	68.8357	62.4672	58.3317	52.5110	47.5667	53.9051	56.1597	62.7507	70.1898	73.5275	(72)
Total internal gains													
	604.3766	599.8199	576.5868	540.3897	503.1403	469.7933	450.2860	458.9266	479.7319	516.1516	556.7045	587.5685	(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	7.2500	13.0723	0.6300	0.7000	0.7700	28.9642	(74)
East	1.4400	24.4329	0.6300	0.7000	0.7700	10.7525	(76)
South	7.1100	54.9219	0.6300	0.7000	0.7700	119.3403	(78)
West	5.7600	24.4329	0.6300	0.7000	0.7700	43.0099	(80)

Solar gains	202.0669	327.6842	461.0404	640.9932	719.9605	785.6026	733.1228	638.7461	533.5636	375.0403	239.1089	167.2755	(83)
Total gains	806.4435	927.5040	1037.6272	1181.3829	1223.1008	1255.3959	1183.4087	1097.6727	1013.2955	891.1919	795.8134	754.8440	(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	19.9117	19.9635	19.9883	20.0586	20.0359	20.1223	20.1018	20.1223	20.1223	20.1018	20.0806	20.0124	
alpha	2.3274	2.3309	2.3326	2.3372	2.3357	2.3415	2.3401	2.3415	2.3415	2.3401	2.3387	2.3342	
util living area													
	0.9281	0.9042	0.8596	0.7714	0.6557	0.4998	0.3797	0.3862	0.6056	0.7945	0.8961	0.9355	(86)
MIT	18.6757	18.9117	19.3994	20.0146	20.5044	20.8170	20.9325	20.9338	20.7011	20.1368	19.3437	18.6366	(87)
Th 2	19.7671	19.7699	19.7712	19.7750	19.7738	19.7784	19.7773	19.7784	19.7784	19.7773	19.7761	19.7725	(88)
util rest of house													
	0.9168	0.8897	0.8377	0.7350	0.5970	0.4141	0.2689	0.2674	0.5215	0.7512	0.8768	0.9251	(89)
MIT 2	16.7540	17.0894	17.7802	18.6298	19.2718	19.6381	19.7454	19.7494	19.5267	18.8216	17.7201	16.7023	(90)
Living area fraction									fLA = Living area / (4) =			0.1940	(91)
MIT	17.1268	17.4429	18.0944	18.8985	19.5110	19.8669	19.9757	19.9792	19.7545	19.0767	18.0351	17.0776	(92)
Temperature adjustment												-0.1500	
adjusted MIT	16.9768	17.2929	17.9444	18.7485	19.3610	19.7169	19.8257	19.8292	19.6045	18.9267	17.8851	16.9276	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8801	0.8497	0.7958	0.6986	0.5747	0.4095	0.2736	0.2727	0.5080	0.7141	0.8363	0.8900	(94)
Useful gains	709.7197	788.0647	825.7615	825.2948	702.8934	514.0314	323.7348	299.3025	514.7723	636.4075	665.5087	671.8148	(95)
Ext temp.	5.1000	5.4000	7.1000	9.6000	12.6000	15.3000	17.2000	17.4000	14.9000	11.7000	8.2000	5.2000	(96)
Heat loss rate W													
	1537.2450	1535.3378	1398.2341	1175.4422	869.6646	565.7000	336.6389	311.1220	602.5434	926.5267	1243.0304	1510.2887	(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													
	615.6789	502.1676	425.9196	252.1061	124.0777	0.0000	0.0000	0.0000	0.0000	215.8487	415.8156	623.8246	(98)
Space heating												3175.4387	(98)
Space heating per m2											(98) / (4) =	34.2255	(99)

8c. Space cooling requirement

Not applicable

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

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3508.7720	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	615.6789	502.1676	425.9196	252.1061	124.0777	0.0000	0.0000	0.0000	0.0000	215.8487	415.8156	623.8246	(98)
Space heating efficiency (main heating system 1)	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)	680.3081	554.8813	470.6294	278.5703	137.1025	0.0000	0.0000	0.0000	0.0000	238.5068	459.4647	689.3089	(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	173.0560	151.7496	157.5246	138.6416	134.0013	117.0652	109.8984	124.0910	124.9754	143.9007	155.3774	168.0296	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7780	89.7367	89.6131	89.3381	88.8097	87.3000	87.3000	87.3000	87.3000	89.1922	89.6065	89.8015	(217)
Fuel for water heating, kWh/month	192.7600	169.1054	175.7829	155.1875	150.8858	134.0953	125.8859	142.1432	143.1562	161.3377	173.3997	187.1122	(219)
Water heating fuel used												1910.8518	(219)

Annual totals kWh/year		
Space heating fuel - main system	3508.7720	(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)	384.3187	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV Unit 0 (0.80 * 2.98 * 1227 * 1.00) = -2924.8580	-2924.8580	(233)
Total delivered energy for all uses	2954.0845	(238)

10a. Fuel costs - using BEDF prices (438)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3508.7720	3.9200	137.5439	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1910.8518	3.9200	74.9054	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Energy for lighting	384.3187	16.9600	65.1805	(250)
Additional standing charges			88.0000	(251)
Energy saving/generation technologies				
PV Unit	-2924.8580	16.9600	-496.0559	(252)
Total energy cost			-117.7062	(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	3508.7720	0.2160	757.8948	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1910.8518	0.2160	412.7440	(264)
Space and water heating			1170.6387	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	384.3187	0.5190	199.4614	(268)
Energy saving/generation technologies				
PV Unit	-2924.8580	0.5190	-1518.0013	(269)
Total kg/year			-108.9762	(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	3508.7720	1.2200	4280.7019	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1910.8518	1.2200	2331.2392	(264)
Space and water heating			6611.9410	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	384.3187	3.0700	1179.8584	(268)
Energy saving/generation technologies				
PV Unit	-2924.8580	3.0700	-8979.3141	(269)
Primary energy kWh/year			-957.2647	(272)
Primary energy kWh/m2/year			-10.3176	(273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating:	A 98
Current environmental impact rating:	A 98

(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	-£ 31	-191 kg (174.8%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£31	2.05 kg/m²	A 99	A 100
Total Savings	£31	2.05 kg/m²		

Potential energy efficiency rating:	A 99	
Potential environmental impact rating:		A 100

Fuel prices for cost data on this page from database revision number 438 TEST (30 Jan 2019)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, South East England):

	Current	Potential	Saving
Electricity	£78	£86	-£8
Mains gas	£300	£261	£39
Space heating	£238	£238	£0
Water heating	£75	£44	£31
Lighting	£65	£65	£0
Generated (PV)	-£496	-£496	£0
Total cost of fuels	-£118	-£149	£31
Total cost of uses	-£118	-£149	£31
Delivered energy	32 kWh/m²	22 kWh/m²	10 kWh/m²
Carbon dioxide emissions	-0.1 tonnes	-0.3 tonnes	0.2 tonnes
CO2 emissions per m²	-1 kg/m²	-3 kg/m²	2 kg/m²
Primary energy	-10 kWh/m²	-22 kWh/m²	12 kWh/m²

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

Southern Energy Consultants
Accredited to Commercial Energy Solutions

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	46.3900 (1b)	x	2.3100 (2b)	=	107.1609	(1b) - (3b)
First floor	46.3900 (1c)	x	2.5700 (2c)	=	119.2223	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 92.7800						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	226.3832	(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) =	0.1325	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3825	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3251	(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	0.4146	0.4064	0.3983	0.3577	0.3495	0.3089	0.3089	0.3008	0.3251	0.3495	0.3658	0.3820	(22b)
Effective ac	0.5859	0.5826	0.5793	0.5640	0.5611	0.5477	0.5477	0.5452	0.5529	0.5611	0.5669	0.5730	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Opening Type 1			3.9000	1.3000	5.0700			(26)
Opening Type 2 (Uw = 1.40)			21.5600	1.3258	28.5833			(27)
Heat Loss Floor 1			46.3900	0.1600	7.4224			(28a)
External Wall 1	135.1300	25.4600	109.6700	0.2800	30.7076			(29a)
External Roof 1	46.3900		46.3900	0.1100	5.1029			(30)
Total net area of external elements Aum(A, m2)			227.9100					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		76.8862			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							100.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							12.1698	(36)
Total fabric heat loss					(33) + (36) =		89.0560	(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	43.7726	43.5233	43.2790	42.1313	41.9166	40.9171	40.9171	40.7320	41.3021	41.9166	42.3510	42.8051	(38)
Heat transfer coeff	132.8286	132.5793	132.3350	131.1874	130.9727	129.9731	129.9731	129.7880	130.3581	130.9727	131.4070	131.8612	(39)
Average = Sum(39)m / 12 =												131.1863	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.4317	1.4290	1.4263	1.4140	1.4116	1.4009	1.4009	1.3989	1.4050	1.4116	1.4163	1.4212	(40)
HLP (average)												1.4140	(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	2.6619	(42)
Average daily hot water use (litres/day)	97.4199	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	107.1619	103.2651	99.3683	95.4715	91.5747	87.6779	87.6779	91.5747	95.4715	99.3683	103.2651	107.1619	(44)
Energy conte	158.9180	138.9907	143.4260	125.0423	119.9810	103.5345	95.9399	110.0925	111.4073	129.8345	141.7245	153.9036	(45)
Energy content (annual)										Total = Sum(45)m =		1532.7949	(45)
Distribution loss (46)m = 0.15 x (45)m	23.8377	20.8486	21.5139	18.7563	17.9972	15.5302	14.3910	16.5139	16.7111	19.4752	21.2587	23.0855	(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 ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1380	12.7589	14.0986	13.5993	14.0203	13.5307	13.9584	13.9985	13.5681	14.0662	13.6529	14.1259	(61)
Total heat required for water heating calculated for each month													
	173.0560	151.7496	157.5246	138.6416	134.0013	117.0652	109.8984	124.0910	124.9754	143.9007	155.3774	168.0296	(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												1.1832	(H8)
Utilisation factor												0.5705	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												97.4199	(H14)
Volume ratio Veff/V												0.7699	(H15)
Solar storage volume factor												0.9477	(H16)
Solar input												-862.2020	(H17)
Solar input	-25.0021	-41.7214	-71.0563	-95.2294	-117.6479	-115.6667	-114.1381	-99.7230	-78.1031	-53.3352	-29.6561	-20.9225	(63)
								Solar input (sum of months) = Sum(63)m =				-862.2020	(63)
Output from w/h													
	148.0539	110.0282	86.4683	43.4121	16.3533	1.3985	0.0000	24.3680	46.8723	90.5655	125.7213	147.1070	(64)
								Total per year (kWh/year) = Sum(64)m =				840.3484	(64)
Heat gains from water heating, kWh/month													
	56.3747	49.4041	51.2138	44.9764	43.3988	37.8079	35.3896	40.1054	40.4350	46.6865	50.5366	54.7044	(65)

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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	159.7135	159.7135	159.7135	159.7135	159.7135	159.7135	159.7135	159.7135	159.7135	159.7135	159.7135	159.7135	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	54.4043	48.3214	39.2976	29.7508	22.2391	18.7752	20.2872	26.3701	35.3939	44.9407	52.4524	55.9164	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	364.3287	368.1093	358.5824	338.3006	312.6984	288.6361	272.5609	268.7803	278.3073	298.5891	324.1912	348.2536	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.6332	53.6332	53.6332	53.6332	53.6332	53.6332	53.6332	53.6332	53.6332	53.6332	53.6332	53.6332	(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)													
	-106.4757	-106.4757	-106.4757	-106.4757	-106.4757	-106.4757	-106.4757	-106.4757	-106.4757	-106.4757	-106.4757	-106.4757	(71)
Water heating gains (Table 5)													
	75.7725	73.5181	68.8357	62.4672	58.3317	52.5110	47.5667	53.9051	56.1597	62.7507	70.1898	73.5275	(72)
Total internal gains													
	604.3766	599.8199	576.5868	540.3897	503.1403	469.7933	450.2860	458.9266	479.7319	516.1516	556.7045	587.5685	(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	7.2500	10.6334	0.6300	0.7000	0.7700	23.5603	(74)
East	1.4400	19.6403	0.6300	0.7000	0.7700	8.6433	(76)
South	7.1100	46.7521	0.6300	0.7000	0.7700	101.5880	(78)
West	5.7600	19.6403	0.6300	0.7000	0.7700	34.5734	(80)

Solar gains	168.3650	295.9410	427.6677	565.4759	664.0023	672.1764	642.6862	567.5240	475.3030	333.3624	203.3672	142.9617	(83)
Total gains	772.7416	895.7608	1004.2545	1105.8656	1167.1425	1141.9697	1092.9722	1026.4506	955.0349	849.5140	760.0717	730.5302	(84)

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7. Mean internal temperature (heating season)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
tau	19.4026	19.4391	19.4750	19.6454	19.6776	19.8289	19.8289	19.8572	19.7703	19.6776	19.6125	19.5450	
alpha	2.2935	2.2959	2.2983	2.3097	2.3118	2.3219	2.3219	2.3238	2.3180	2.3118	2.3075	2.3030	
util living area													
	0.9401	0.9162	0.8780	0.8113	0.7128	0.5828	0.4605	0.4989	0.6774	0.8402	0.9183	0.9466	(86)
MIT	18.3828	18.6930	19.1773	19.7824	20.3183	20.7054	20.8785	20.8495	20.5532	19.8553	19.0104	18.3179	(87)
Th 2	19.7392	19.7412	19.7432	19.7526	19.7544	19.7627	19.7627	19.7642	19.7595	19.7544	19.7508	19.7471	(88)
util rest of house													
	0.9308	0.9033	0.8587	0.7802	0.6621	0.5025	0.3509	0.3898	0.6046	0.8069	0.9036	0.9382	(89)
MIT 2	16.3183	16.7623	17.4524	18.3032	19.0247	19.5107	19.6912	19.6693	19.3439	18.4266	17.2318	16.2291	(90)
Living area fraction									fLA = Living area / (4) =			0.1940	(91)
MIT	16.7188	17.1369	17.7870	18.5902	19.2757	19.7425	19.9215	19.8982	19.5785	18.7038	17.5769	16.6344	(92)
Temperature adjustment												-0.1500	
adjusted MIT	16.5688	16.9869	17.6370	18.4402	19.1257	19.5925	19.7715	19.7482	19.4285	18.5538	17.4269	16.4844	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8961	0.8640	0.8162	0.7398	0.6323	0.4903	0.3517	0.3882	0.5820	0.7655	0.8646	0.9055	(94)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Useful gains	692.4767	773.9271	819.6826	818.0651	737.9710	559.8601	384.4448	398.4872	555.8055	650.3400	657.1764	661.4665	(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	1629.6494	1602.4707	1473.8172	1251.5522	972.5626	648.8865	412.2142	434.5616	694.6184	1041.7271	1357.0263	1619.8311	(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	697.2565	556.7813	486.6761	312.1107	174.5361	0.0000	0.0000	0.0000	0.0000	291.1920	503.8919	713.0232	(98)

Space heating 3735.4678 (98)
Space heating per m2 (98) / (4) = 40.2616 (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	4127.5888	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	697.2565	556.7813	486.6761	312.1107	174.5361	0.0000	0.0000	0.0000	0.0000	291.1920	503.8919	713.0232	(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)	770.4492	615.2280	537.7637	344.8737	192.8576	0.0000	0.0000	0.0000	0.0000	321.7591	556.7866	787.8710	(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	148.0539	110.0282	86.4683	43.4121	16.3533	1.3985	0.0000	24.3680	46.8723	90.5655	125.7213	147.1070	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9227	89.9559	90.0023	90.0967	90.2167	87.3000	87.3000	87.3000	87.3000	89.7198	89.8424	89.9362	(217)
Fuel for water heating, kWh/month	164.6457	122.3135	96.0735	48.1839	18.1267	1.6019	0.0000	27.9129	53.6910	100.9425	139.9354	163.5683	(219)

Water heating fuel used	936.9953	(219)
Annual totals kWh/year		
Space heating fuel - main system	4127.5888	(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)
pump for solar water heating	50.0000	(230g)
Total electricity for the above, kWh/year	125.0000	(231)
Electricity for lighting (calculated in Appendix L)	384.3187	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV Unit 0 (0.80 * 2.98 * 1080 * 1.00) = -2573.5867	-2573.5867	(233)
Total delivered energy for all uses	3000.3161	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4127.5888	3.4800	143.6401	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	936.9953	3.4800	32.6074	(247)
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	384.3187	13.1900	50.6916	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-2573.5867	13.1900	-339.4561	(252)
Total energy cost			23.9706	(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] =	0.0731	(257)
SAP value		98.9807	
SAP rating (Section 12)		99	(258)
SAP band		A	

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4127.5888	0.2160	891.5592	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	936.9953	0.2160	202.3910	(264)
Space and water heating			1093.9502	(265)

Pumps and fans	125.0000	0.5190	64.8750 (267)
Energy for lighting	384.3187	0.5190	199.4614 (268)
Energy saving/generation technologies			
PV Unit	-2573.5867	0.5190	-1335.6915 (269)
Total kg/year			22.5951 (272)
CO2 emissions per m2			0.2400 (273)
EI value			99.7802
EI rating			100 (274)
EI band			A

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	46.3900 (1b)	x	2.3100 (2b)	=	107.1609	(1b) - (3b)
First floor	46.3900 (1c)	x	2.5700 (2c)	=	119.2223	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 92.7800						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	226.3832	(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) =	0.1325	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3825	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3251	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	3.5000	3.3000	3.2000	2.9000	3.0000	2.6000	2.7000	2.6000	2.6000	2.7000	2.8000	3.1000	(22)
Wind factor	0.8750	0.8250	0.8000	0.7250	0.7500	0.6500	0.6750	0.6500	0.6500	0.6750	0.7000	0.7750	(22a)
Adj infilt rate	0.2845	0.2682	0.2601	0.2357	0.2439	0.2113	0.2195	0.2113	0.2113	0.2195	0.2276	0.2520	(22b)
Effective ac	0.5405	0.5360	0.5338	0.5278	0.5297	0.5223	0.5241	0.5223	0.5223	0.5241	0.5259	0.5317	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Opening Type 1			3.9000	1.3000	5.0700			(26)
Opening Type 2 (Uw = 1.40)			21.5600	1.3258	28.5833			(27)
Heat Loss Floor 1			46.3900	0.1600	7.4224			(28a)
External Wall 1	135.1300	25.4600	109.6700	0.2800	30.7076			(29a)
External Roof 1	46.3900		46.3900	0.1100	5.1029			(30)
Total net area of external elements Aum(A, m2)			227.9100					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	76.8862			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	100.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	12.1698	(36)
Total fabric heat loss (33) + (36) =	89.0560	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	40.3766	40.0409	39.8805	39.4288	39.5745	39.0216	39.1524	39.0216	39.0216	39.1524	39.2882	39.7250	(38)
Heat transfer coeff	129.4326	129.0970	128.9365	128.4849	128.6305	128.0777	128.2085	128.0777	128.0777	128.2085	128.3442	128.7810	(39)
Average = Sum(39)m / 12 =												128.5297	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3950	1.3914	1.3897	1.3848	1.3864	1.3804	1.3819	1.3804	1.3804	1.3819	1.3833	1.3880	(40)
HLP (average)												1.3853	(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	2.6619	(42)
Average daily hot water use (litres/day)	97.4199	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	107.1619	103.2651	99.3683	95.4715	91.5747	87.6779	87.6779	91.5747	95.4715	99.3683	103.2651	107.1619	(44)
Energy conte	158.9180	138.9907	143.4260	125.0423	119.9810	103.5345	95.9399	110.0925	111.4073	129.8345	141.7245	153.9036	(45)
Energy content (annual)										Total = Sum(45)m =		1532.7949	(45)
Distribution loss (46)m = 0.15 x (45)m	23.8377	20.8486	21.5139	18.7563	17.9972	15.5302	14.3910	16.5139	16.7111	19.4752	21.2587	23.0855	(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	14.1380	12.7589	14.0986	13.5993	14.0203	13.5307	13.9584	13.9985	13.5681	14.0662	13.6529	14.1259	(61)
Total heat required for water heating calculated for each month													
	173.0560	151.7496	157.5246	138.6416	134.0013	117.0652	109.8984	124.0910	124.9754	143.9007	155.3774	168.0296	(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	1226.8700	(H5)
Overshading factor	0.8000	(H6)
Solar energy available	2061.1415	(H7)
Adjustment factor for showers	1.0000	(H7a)
Solar-to-load ratio	1.3447	(H8)
Utilisation factor	0.5246	(H9)
Collector performance factor	0.8793	(H10)
Dedicated solar storage volume	75.0000	(H11)
Effective solar volume	75.0000	(H13)
Daily hot water demand	97.4199	(H14)
Volume ratio Veff/V	0.7699	(H15)
Solar storage volume factor	0.9477	(H16)
Solar input	-901.0777	(H17)

Solar input	-28.0533	-43.1591	-71.3258	-99.9429	-117.5965	-124.4240	-119.9142	-103.7104	-81.4629	-56.0064	-32.5961	-22.8861	(63)
Solar input (sum of months) = Sum(63)m =												-901.0777	(63)
Output from w/h													
	145.0027	108.5905	86.1988	38.6986	16.4047	0.0000	0.0000	20.3806	43.5125	87.8943	122.7814	145.1434	(64)
Total per year (kWh/year) = Sum(64)m =												814.6077	(64)
Heat gains from water heating, kWh/month													
	56.3747	49.4041	51.2138	44.9764	43.3988	37.8079	35.3896	40.1054	40.4350	46.6865	50.5366	54.7044	(65)

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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	159.7135	159.7135	159.7135	159.7135	159.7135	159.7135	159.7135	159.7135	159.7135	159.7135	159.7135	159.7135	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	54.4043	48.3214	39.2976	29.7508	22.2391	18.7752	20.2872	26.3701	35.3939	44.9407	52.4524	55.9164	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	364.3287	368.1093	358.5824	338.3006	312.6984	288.6361	272.5609	268.7803	278.3073	298.5891	324.1912	348.2536	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.6332	53.6332	53.6332	53.6332	53.6332	53.6332	53.6332	53.6332	53.6332	53.6332	53.6332	53.6332	(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)													
	-106.4757	-106.4757	-106.4757	-106.4757	-106.4757	-106.4757	-106.4757	-106.4757	-106.4757	-106.4757	-106.4757	-106.4757	(71)
Water heating gains (Table 5)													
	75.7725	73.5181	68.8357	62.4672	58.3317	52.5110	47.5667	53.9051	56.1597	62.7507	70.1898	73.5275	(72)
Total internal gains													
	604.3766	599.8199	576.5868	540.3897	503.1403	469.7933	450.2860	458.9266	479.7319	516.1516	556.7045	587.5685	(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	7.2500	13.0723	0.6300	0.7000	0.7700	28.9642	(74)
East	1.4400	24.4329	0.6300	0.7000	0.7700	10.7525	(76)
South	7.1100	54.9219	0.6300	0.7000	0.7700	119.3403	(78)
West	5.7600	24.4329	0.6300	0.7000	0.7700	43.0099	(80)

Solar gains	202.0669	327.6842	461.0404	640.9932	719.9605	785.6026	733.1228	638.7461	533.5636	375.0403	239.1089	167.2755	(83)
Total gains	806.4435	927.5040	1037.6272	1181.3829	1223.1008	1255.3959	1183.4087	1097.6727	1013.2955	891.1919	795.8134	754.8440	(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	19.9117	19.9635	19.9883	20.0586	20.0359	20.1223	20.1018	20.1223	20.1223	20.1018	20.0806	20.0124	
alpha	2.3274	2.3309	2.3326	2.3372	2.3357	2.3415	2.3401	2.3415	2.3415	2.3401	2.3387	2.3342	
util living area													
	0.9281	0.9042	0.8596	0.7714	0.6557	0.4998	0.3797	0.3862	0.6056	0.7945	0.8961	0.9355	(86)
MIT	18.6757	18.9117	19.3994	20.0146	20.5044	20.8170	20.9325	20.9338	20.7011	20.1368	19.3437	18.6366	(87)
Th 2	19.7671	19.7699	19.7712	19.7750	19.7738	19.7784	19.7773	19.7784	19.7784	19.7773	19.7761	19.7725	(88)
util rest of house													
	0.9168	0.8897	0.8377	0.7350	0.5970	0.4141	0.2689	0.2674	0.5215	0.7512	0.8768	0.9251	(89)
MIT 2	16.7540	17.0894	17.7802	18.6298	19.2718	19.6381	19.7454	19.7494	19.5267	18.8216	17.7201	16.7023	(90)
Living area fraction									fLA = Living area / (4) =			0.1940	(91)
MIT	17.1268	17.4429	18.0944	18.8985	19.5110	19.8669	19.9757	19.9792	19.7545	19.0767	18.0351	17.0776	(92)
Temperature adjustment												-0.1500	
adjusted MIT	16.9768	17.2929	17.9444	18.7485	19.3610	19.7169	19.8257	19.8292	19.6045	18.9267	17.8851	16.9276	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8801	0.8497	0.7958	0.6986	0.5747	0.4095	0.2736	0.2727	0.5080	0.7141	0.8363	0.8900	(94)

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

Useful gains	709.7197	788.0647	825.7615	825.2948	702.8934	514.0314	323.7348	299.3025	514.7723	636.4075	665.5087	671.8148	(95)
Ext temp.	5.1000	5.4000	7.1000	9.6000	12.6000	15.3000	17.2000	17.4000	14.9000	11.7000	8.2000	5.2000	(96)
Heat loss rate W	1537.2450	1535.3378	1398.2341	1175.4422	869.6646	565.7000	336.6389	311.1220	602.5434	926.5267	1243.0304	1510.2887	(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	615.6789	502.1676	425.9196	252.1061	124.0777	0.0000	0.0000	0.0000	0.0000	215.8487	415.8156	623.8246	(98)
Space heating												3175.4387	(98)
Space heating per m2											(98) / (4) =	34.2255	(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	3508.7720	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	615.6789	502.1676	425.9196	252.1061	124.0777	0.0000	0.0000	0.0000	0.0000	215.8487	415.8156	623.8246	(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)	680.3081	554.8813	470.6294	278.5703	137.1025	0.0000	0.0000	0.0000	0.0000	238.5068	459.4647	689.3089	(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	145.0027	(64)
Efficiency of water heater	87.3000	(216)
(217)m 89.8720 89.9140 89.9451 90.0607 90.1143 87.3000 87.3000 87.3000 87.3000 89.5501 89.7500	89.8782	(217)
Fuel for water heating, kWh/month 161.3435 120.7715 95.8350 42.9695 18.2044 0.0000 0.0000 23.3455 49.8425 98.1509 136.8037	161.4891	(219)
Water heating fuel used	908.7557	(219)
Annual totals kWh/year		
Space heating fuel - main system	3508.7720	(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)
pump for solar water heating	50.0000	(230g)
Total electricity for the above, kWh/year	125.0000	(231)
Electricity for lighting (calculated in Appendix L)	384.3187	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV Unit 0 (0.80 * 2.98 * 1227 * 1.00) = -2924.8580	-2924.8580	(233)
Total delivered energy for all uses	2001.9884	(238)

10a. Fuel costs - using BEDF prices (438)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3508.7720	3.9200	137.5439	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	908.7557	3.9200	35.6232	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Pump for solar water heating	50.0000	16.9600	8.4800	(249)
Energy for lighting	384.3187	16.9600	65.1805	(250)
Additional standing charges			88.0000	(251)
Energy saving/generation technologies				
PV Unit	-2924.8580	16.9600	-496.0559	(252)
Total energy cost			-148.5084	(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	3508.7720	0.2160	757.8948	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	908.7557	0.2160	196.2912	(264)
Space and water heating			954.1860	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	384.3187	0.5190	199.4614	(268)
Energy saving/generation technologies				
PV Unit	-2924.8580	0.5190	-1518.0013	(269)
Total kg/year			-299.4789	(272)

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

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	3508.7720	1.2200	4280.7019	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	908.7557	1.2200	1108.6819	(264)
Space and water heating			5389.3838	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	384.3187	3.0700	1179.8584	(268)
Energy saving/generation technologies				
PV Unit	-2924.8580	3.0700	-8979.3141	(269)
Primary energy kWh/year			-2026.3219	(272)
Primary energy kWh/m2/year			-21.8401	(273)

Littlehampton Phase 3 Parcel A2, B6				
	Ft²	NO.	BEDROOMS	STOREY
Market:				
ALN	638	1	2 BED	2
HAN	761	6	3 BED	2
ASH	874	6	3 BED	2
HAT	969	6	3 BED	2
DER.CR	969	1	3 BED	2
CLA / CLA.CR	999	4	3 BED	2
3BCH (Coach House)	990	1	3 BED	2
F1, 2bed, 3 person	704	2	2 BED	
F2, 2bed, 3 person	661	1	2 BED	
F3, 2bed, 3 person	687	1	2 BED	
F4, 1bed, 2 person	538	3	1 BED	
F5, 2bed, 3 person	687	2	2 BED	
F6, 2bed, 3 person	670	1	2 BED	
Total Market		**35**		
HA				
3BH	761	4	3 BED	2
HA-F1, 2bed, 4 person	742	2	2 BED	
HA-F2, 2bed, 4 person	755	2	2 BED	
HA-F1-WH, 2 bed, 3 person	742	1	2 BED	
HA-F2-WH, 2 bed, 3 person	755	1	2 BED	
Total HA (20%)		**10**		
TOTAL ON SITE		**45**		

LEGEND

Open Space Area = 4383m²
Required: (2.4x45=108 residents) x 37m² = 3996m²

Chimney Location

LEGEND - PARKING ALLOCATION

80 — Allocated Parking 80 spaces total

10 — Visitors Parking 10 spaces total

6 — Unallocated Parking 6 spaces total

5 — Unallocated Visitor Motorcycle Parking 5 spaces total

Cycle Visitor Parking 11 spaces total (min required = 6)

D — Hatching / 'D' mark Mobility impaired parking spaces

Total of **96** car parking spaces proposed on site.
Total of 95 required on site as per the demand on Parking Calculator.

SCALE 1/500

0m 5m 10m 15m 20m 25m

Rev		Date
K	Further layout changes made - Plots 10-16 re-designed as per LPA comments.	07.02.20
J	Further layout re-design made due to LPA comments - Block A revised.	06.01.20
H	Further layout re-design made due to LPA comments - Block B revised. BinCycle store detached. Dwellings reduced to 45 units.	11.11.19
G	Redline amended to include access into Parcels A2 & B8.	25.10.19
F	Further layout re-design made due to LPA comments. Dwellings reduced to 46 units.	13.06.19
E	Further layout re-design made due to LPA comments. Additional unit added to Toddington Lane street frontage and pair of HAN semi's removed from main road replaced with CLA & HAT to enhance street scene. Access road to plots 1,5&7 repositioned to become parking courtyard to serve these plots. LEAP moved further away from Bypass.	06.06.19
D	Further layout re-design made due to LPA comments.	21.03.19
C	Further layout re-design made due to Engineer's comments.	13.02.19
B	Further changes made due to Engineer's comments. Plots 6 - 8 reconfigured due to parking conflict with site access.	02.11.18
A	Planning Layout re-designed at the request of the Planning Officer.	08.10.18

PERSIMMON
Together, we make a home

Persimmon Homes Thames Valley
Persimmon House, Knoll Road,
Camberley, Surrey GU15 3TQ
Tel: 01276 808080

Site:
PHASE 3
Littlehampton
Parcel A2.B6

Date: July 2018

Scale: 1:500 @ A1

Drg No: 544_PL_101

Drawing Title:
Site Layout - COLOUR - 46 units

Drawing Status: SUBMITTED

Drawn: AT

Checked: ME

Rev: K

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