



NEW BARN LANE, BERSTED, WEST SUSSEX

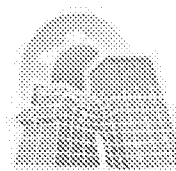


ENERGY STATEMENT

16th September 2019

SEC/ds/sus/ES- 3650

ARUN DISTRICT COUNCIL BE/103/19/RES



Southern Energy
Consultants
Energy & Sustainability Solutions

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.

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Report type:

Planning Condition: Supporting Document

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1.0 Introduction

- 1.1 This Energy Statement has been commissioned by Bellway Homes (the Applicant) and carried out by Southern Energy Consultants to respond to planning condition 10 related to the planning consent (Ref: APP/C3810/V/17/3166900, dated 12th February 2018) for their development at New Barn Lane, North Bersted. The overall development is located within the Arun District Council authority boundary and includes the construction of 50 residential dwellings of mixed type and tenure, together with provision of landscaping, amenity space, car and cycle parking, and various infrastructure works.
- 1.2 This Statement first details the contents of condition 10 and its underpinning policy, before, in subsequent Sections, proceeding to detail the Applicant's comprehensive response.

Planning Condition 10

- 1.3 Planning Condition 10 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 or equivalent fabric first standards that would secure a 10% reduction in energy use. Details and a timetable of how this is to be achieved, including details of physical works on site, shall be submitted to and approved in writing by the local planning authority [as part of the reserved matters submissions required by condition 1]. The approved details shall be implemented in accordance with the approved timetable and retained as operational thereafter."*
- 1.4 Condition 10 is justified through Policy ECC SP2 (Energy and Climate Change Mitigation) of Arun District Council's Local Plan (2014). This policy requires all major developments of 10 or more dwellings to incorporate decentralised, renewable and low carbon energy supply systems, which must be responsible for producing at least 10% of the total predicted energy requirements from renewable or low carbon energy generation on site.

Summary of Requirements

- 1.5 The aim of this Statement is to set out the Applicant's approach which will comply with Policy ME4 and better the lifetime emissions reductions requirements achieved by

delivering a 10% reduction in regulated emissions through the installation of renewable or low carbon technologies. In so doing, the Applicant will demonstrate how the “equivalent fabric first standards” permitted by Condition 10 will deliver greater reductions in emissions than an alternative approach

- 1.6 In order to arrive at the optimal strategy for the New Barn Lane development, Southern Energy Consultants have carried out Standard Assessment Procedure (SAP) calculations on the proposed dwellings, using Government approved Elmhurst software, and detailed examples of the analysis are appended to this Energy Statement. A feasibility study has then been carried out to consider the potential for incorporating renewable or low carbon technologies into development.
- 1.7 Section 2 of this Statement calculates the baseline emissions for the development. These are the carbon dioxide emissions equivalent to the regulatory standard set by Part L1a of 2013 Building Regulations, encompassing the sources of space heating, hot water and fixed electrical items. The potential suitability of various renewable and low carbon energy sources, including district heating, is then discussed. Section 3 then sets out the additional best practice energy efficiency measures that the Applicant proposes to incorporate in order to better the emissions reduction standard required by Condition 10.

2.0 Calculation of Baseline Carbon Dioxide Emissions and Feasibility Study of Renewable Energy and Low Carbon Technologies

Introduction

- 2.1 The aims of Section 2 are to (a) demonstrate the approach that the Applicant could take to delivering compliance with Part L1a of Building Regulations (2013) through the adoption of best practice energy efficiency measures, and (b) consider the suitability of various renewable energy and low carbon technologies for delivering per annum reductions of at least 10% in carbon dioxide emissions beyond the baseline standard.

Calculation of Theoretical Baseline

- 2.2 In order that an energy assessment can be conducted, the theoretical baseline for carbon dioxide emissions first has to be calculated for the range of twelve proposed dwelling types. The estimated regulated carbon dioxide emissions for the dwellings have been calculated using SAP (2012) methodology and the most up-to-date Elmhurst software. SAP calculates the regulated carbon dioxide emissions associated with space heating, hot water and fixed electrical items. Table 1 below provides a breakdown of the theoretical carbon dioxide emissions for the development (assuming no renewable/low carbon technologies were installed), which total **74,168 kgCO₂/year**.

Table 1: Baseline Carbon Dioxide Emissions for the New Barn Lane Park Development

DWELLING TYPE	REGULATED CARBON DIOXIDE EMISSIONS (kgCO ₂ /yr)	NUMBER OF DWELLINGS	TOTAL EMISSIONS PER TYPE (kgCO ₂ /yr)
Private dwellings			
Cooper	1,244	4	4,976
Chandler	1,496	10	14,960
Carver	1,522	3	4,566
Mason	1,576	4	6,304

Scrivener	1,712	5	8,560
Milliner	1,766	6	10,596
Bowyer	1,878	3	5,634
Private sub-total		35	55,596
Affordable dwellings			
1B Flat	990	5	4,950
2B Flat	1,186	1	1,186
Baker	1,312	5	6,560
Ploughwright	1,455	3	4,365
Cartographer	1,511	1	1,511
Affordable sub-total		15	18,572
TOTAL		50	74,168

Applicant's Measures to Meet the Baseline Scenario

- 2.3 In addition to the passive solar gains secured by orientating the majority of dwelling living areas in a southerly, south-westerly or south-easterly direction and maximising opportunities to increase the area of glazing on these elevations, the Applicant would comply with the baseline scenario by meeting the fabric performance for thermal elements (walls, roofs, floors and glazing) listed in Table 2 below. The fabric performance standards are in all cases superior to the limiting standards set by Part L1a of Building Regulations (2013).

Table 2: Fabric Performance Standards to Comply with Baseline Scenario

Thermal Element	Maximum Area-Weighted U-value (W/m ² K) Allowable Under 2013 Building Regulations	Applicant's Proposed U-value (W/m ² K) required to Meet 2013 Building Regulations Baseline	% Improvement on 2013 Allowable U-Value Standard
Main external walls	0.30	0.24	20.00

Roof (joists)	0.20	0.10	50.00
Roof (rafters)	0.20	0.13	40.00
Ground floor	0.25	0.17	32.00
Windows	2.00	1.40	15.00

- 2.4 The space heating requirement of the development will be reduced as a consequence of the fabric measures detailed above. In addition, the Applicant will specify boilers with a SEDBUK 2009 efficiency of at least 88.5%. The proposed dwellings will also benefit from enhanced heating controls to maximise efficiency in use. As well as having independent temperature controls such as thermostatic radiator valves, all dwellings will be supplied with programmers, timers and room thermostats.
- 2.5 Air tightness standards will be improved by the Applicant adopting predominantly Aircrete Product Association psi values for non-repeating thermal bridges, which better the thermal heat loss results delivered via traditional Accredited Construction Details. The Applicant's details incorporate thermal heat loss improvements by reducing air leakage loss and convective bypass of insulation. This approach will assist all dwellings in delivering a reduction in air permeability from $10\text{m}^3/\text{hm}^2$ to not more than $7\text{m}^3/\text{hm}^2$.
- 2.6 Ventilation will be provided via high-efficiency, low energy extract fans. It is not proposed to provide any mechanical cooling to the proposed dwellings. Instead it is the intention of the Applicant to reduce the need for active cooling as far as possible. This will be achieved through the specification of mainly non-mechanical measures such as good thermal insulation and an air tight build. Openable windows will be installed as a necessary fixture in all dwellings to facilitate natural ventilation. These will help facilitate cross-ventilation, convective-ventilation and night purging.
- 2.7 All internal lighting throughout the New Barn Lane Park development will be of the dedicated low energy type. External lighting will also be low energy and some will be controlled through PIR sensors or daylight cut-off devices.

Feasibility of Renewable Energy and Low Carbon Technologies

2.8 This section of the Statement conducts a thorough review of the renewable energy and low carbon technologies that could theoretically be applied to the New Barn Lane Park development. Renewable energy is defined as the flows of energy 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. 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 (as per the requirements of Condition 14 / Policy ME4)
- Biomass
- Heat pumps (ground source and air source)
- Hydroelectric power
- Wind energy
- Solar thermal panels
- Solar photovoltaic panels

District Heating and Combined Heat and Power (CHP)

2.9 CHP is a form of district heating 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 very high, constant and varied heat demand.

2.10 The suitability of district heating and CHP to this development has been investigated in terms of appropriateness and how well the technology aligns itself with the Applicant’s priorities for this energy strategy, which are to provide the greatest reductions in carbon

dioxide emissions over the lifetime of the development and minimise pollutants using an affordable approach. While CHP would enable reductions in carbon dioxide emissions beyond the baseline case, the following reasons make it unsuited to this development:

- **Diversity and extent of heat demand** – CHP is best suited to developments where there is a diversity of energy demand. A mixed-use scheme, or a large residential scheme (>1,000 homes) will have extended periods of the day in which there is a continuous demand for heat. In these circumstances, the district heating network and CHP engine can operate consistently to generate electricity, with heat as a by-product. On a small-sized residential scheme such as this, heat demand will be intermittent, even during peak periods.
- **Thermal storage** – To compensate for fluctuations in the demand for heat, thermal buffers will be required to store CHP thermal output. To store heat without the need for dumping will require a large store that can take > 4 hours of charging. On a scheme of this size, such a thermal store could double the usual size of any plant room. Furthermore, to improve stratification, buffers should be at least 1.5 times as tall as they are wide, with a potential impact on height requirements.
- **Distributional heat losses** – thermal stores are a source of standing heat losses, as are even the best insulated distribution networks. When communal systems satisfy only a small and intermittent demand, these standing losses will represent a large part (>30%) of total demand. Carbon dioxide emissions savings gained within the dwellings through association with CHP may be considerably reduced by the additional heat losses associated with the network.
- **Plant room size and location** – to incorporate a central plant room would require a considerable amount of space. The most suitable location in terms of space would be the designated amenity space, but the installation of such infrastructure would be in conflict with the Applicant's objective to deliver a vibrant development with land uses suitable for children and young families.

- **Minimising heat demands** – the Applicant’s proposed energy strategy is based on the adoption of best practice standards for energy efficiency, an approach resulting in reduced space heating demands.
- **Installed costs** – the installed cost of any CHP / district heating network benefit from economies of scale. On a small-sized scheme such as New Barn Lane Park, any economies of scale would be negligible or non-existent.
- **Running costs** – the fixed costs associated with the management and operation of a communal plant room would need to be shared by future occupants as part of an energy standing charge. The smaller the scheme, the greater the cost for the individual occupant, a particularly unfair situation in the light of the Applicant’s commitment to provide 30% affordable housing. In addition, CHP engines impose additional running costs as contracts for maintenance and replacement costs are typically handled by specialist companies.
- **Absence of other local infrastructure** – there are no other CHP / district heating networks in the vicinity of the development with which to forge a connection to serve the New Barn Lane Park 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 vast majority of proposed dwelling types. The management of fuel deliveries and ash dispersal is also complex, which would necessitate a dedicated operative as opposed to residents of the future dwellings at New Barn Lane Park. Furthermore, the emissions of Nitrous Oxide and particulate matter that are associated with biomass installations would have the capacity to worsen local air pollution.

Ground and Air Source Heat Pumps (GSHPs)

- 2.12 Neither of these technologies has been considered for implementation at New Barn Lane Park 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 New Barn Lane Park 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 New Barn Lane Park development is 4.7m/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 surrounding communities.

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 one and two bedroom flats/houses have very little space to accommodate a hot water cylinder. The specification of gas combination boilers also reduces the energy demand for heating and storing hot water.

- 2.16 There are few constraints on the capacity for solar photovoltaic panels to deliver reductions in emissions. 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. However, the current useful lifespan of solar photovoltaic panels is limited to a period of around twenty-five years on average. At this point the carbon dioxide emissions reductions will dissolve, and it is unlikely that the future owners of the dwellings will pay to replace their installation. Thus, the Applicant's preferred approach is to focus on delivering further energy efficient enhancements that result in emissions savings over the lifetime of the development, which can be assumed to be around 100 years.

3.0 Best Practice Energy Efficiency Measures

Introduction

- 3.1 The Applicant's proposed approach is to better the carbon dioxide emissions standards set by Part L1a of Building Regulations (2013) through the installation of best practice energy efficiency measures. The Applicant will thus deliver a level of performance resulting in lower emissions for each dwelling type than the baseline standards set out in Table 1.

Proposed Best Practice Energy Efficiency Measures

- 3.2 In comparison to the performance standards necessary to comply with the Part L1a baseline scenario for carbon dioxide emissions, the Applicant proposes the following best practice design measures that will further enhance the energy efficiency of the new dwellings:

- Specification of 150mm of ground floor insulation (PIR) with very low thermal conductivity, reducing the average U-value from 0.17 to 0.11 W/m²K.
- Specification of enhanced double glazing, with this U-value reduced from 1.40 to 1.30 W/m²K.
- Adoption of Time and Temperature Zone Controls to all dwellings. As such, it will be possible for future occupants to minimise the energy demand and carbon dioxide emissions associated with the heating operation of their home in two defined localities.
- Commitment to reduce the air permeability of all dwellings from 7m³/hm² to not more than 5m³/hm².

Carbon Dioxide Emissions Analysis – After Best Practice Energy Efficiency Measures

3.3 As a result of the best practice energy efficiency measures detailed above, the Applicant's carbon dioxide emissions are reduced from the regulatory baseline scenario of **74,168 kgCO₂/year** to **71,674 kgCO₂/year**. The breakdown on a per house type basis is provided in Table 3 below. Examples of detailed SAP calculations for the most common dwelling types are provided in the Appendix to this Statement. The calculations pertaining to other dwelling types are available upon request.

Table 3: Carbon Dioxide Emissions for the New Barn Lane Park Development Following Best Practice Energy Efficiency Measures

DWELLING TYPE	REGULATED CARBON DIOXIDE EMISSIONS (kgCO ₂ /yr)	NUMBER OF DWELLINGS	TOTAL EMISSIONS PER TYPE (kgCO ₂ /yr)
Private dwellings			
Cooper	1,200	4	4,800
Chandler	1,444	10	14,440
Carver	1,466	3	4,398
Mason	1,518	4	6,072

Scrivener	1,654	5	8,270
Milliner	1,706	6	10,236
Bowyer	1,814	3	5,442
Private sub-total		35	53,658
Affordable dwellings			
1B Flat	968	5	4,840
2B Flat	1,150	1	1,150
Baker	1,273	5	6,375
Ploughwright	1,399	3	4,197
Cartographer	1,454	1	1,454
Affordable sub-total		15	18,016
TOTAL		50	71,674

- 3.4 The introduction of enhanced energy efficiency measures has reduced carbon dioxide emissions from the baseline scenario by **2,494 kgCO₂/year**, or **3.36%**. At first glance, this approach may appear inferior to an alternative strategy focused on renewable energy installations. The installation of an average of 17 kWp (apportioned to optimally orientated plots) of solar PV output would reduce carbon dioxide emissions by 7,417 kgCO₂/year. This is equivalent to the 10% per annum reduction sought by Condition 10 and Policy ECC SP2 (Energy and Climate Change Mitigation) of Arun District Council's Local Plan (2014). However, adopting this approach ignores the likely lifetime emissions associated with the proposed development. It is reasonable to assume that the expected lifetime of the development will be approximately 100 years. As was stated in Section 2, the common lifespan of solar photovoltaic panels is around 25 years. After 25 years, there can be no guarantee that the panels will be replaced by the future homeowners. It is therefore important to compare the likely lifetime carbon dioxide emissions deriving from the Applicant's proposed strategy, focused on best practice energy efficiency measures, with the delivery of renewable energy proposals. Following the end of the working life of the solar photovoltaic panels, the carbon dioxide emissions in the alternative scenario will revert to those shown in Table 1, the baseline case.

3.5 Table 4 considers 3 possible scenarios and identifies the extrapolated lifetime carbon dioxide emissions at New Barn Lane Park over a period of 100 years:

- **Scenario A:** The Applicant complies with the regulatory baseline scenario without use of renewable energy installations;
- **Scenario B:** The proposed approach whereby the Applicant delivers a reduction in per annum carbon dioxide emissions of 10% (7,417 kgCO₂) compared to the baseline case, purely through solar PV installations – these emissions savings last for 25 years then emissions revert to the theoretical baseline case;
- **Scenario C:** The Applicant's proposed approach involving the delivery of a reduction in carbon dioxide emissions of **2,494 kgCO₂** per annum via best practice energy efficiency measures, lasting for the entirety of the 100 year lifespan of the dwellings.

Table 4: Lifetime Carbon Dioxide Emissions at Stoke Park Farm

Scenario	Annual Carbon Dioxide Emissions (KgCO ₂ /yr)	Predicted Lifetime Emissions (KgCO ₂)
(A) Part L1a 2013 Building Regulations Compliance Standard	74,168	7,416,800
(B) Renewable Energy Installations (17 kWp of solar PV)	71,674 (25 years) and 74,168 (75 years)	7,354,450
(C) Best Practice Energy Efficiency Measures	71,674	7,167,400

3.6 It is evident from Table 4 that the Scenario C approach will result in lifetime carbon dioxide emissions of **187,050 kgCO₂** less than the Scenario B strategy reliant on renewable energy installations. Thus, the Applicant's best practice energy efficiency proposals deliver lifetime carbon dioxide emissions some **2.54%** lower than a renewable energy strategy which delivers greater per annum reductions for a guaranteed period of only twenty-five years.

Furthermore, the Scenario C approach accords well with the requirements of current building regulations, which require all new dwellings to comply with a mandatory Fabric Energy Efficiency (FEE) standard. It is recognised by the Government, Building Research Establishment and Zero Carbon Hub that fabric energy efficiency benefits persist across the lifetime of any particular dwelling.

4.0 Conclusion

- 4.1 This Energy Statement has set out the Applicant's proposed energy strategy for the New Barn Lane Park, Ferndown development. In response to the stipulations of Planning Condition 10, the Applicant's has proposed an approach that seeks to minimise energy consumption and carbon dioxide emissions at the point of demand through the installation of highly efficient fabric, ventilation and heating systems, together with the benefits of passive solar gains, all features which will help to lower the fuel bills of future occupants.
- 4.2 Over the course of the lifetime of the sixty proposed dwellings, such a strategy results in lower lifetime emissions (**by 2.54%**) than if the Applicant sought to comply with Condition 10's requirement for a 10% reduction in per annum emissions through the specification of renewable energy or low carbon technologies. The Applicant's proposed approach involving the integration of best practice energy efficiency measures will reduce the future energy bills of occupants.

Appendix

SAP Calculation Examples (including best practice energy efficiency measures):

Type Chandler – Plot 8

Type Carver – Plot 11

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



Property Reference	SECNEWB008			Issued on Date	15/09/2019
Assessment Reference	001	Prop Type Ref	Chandler		
Property	Plot 8, New Barn Lane, Bersted, West Sussex, PO21				
SAP Rating	85 B	DER	15.35	TER	15.89
Environmental	88 B	% DER<TER	3.42		
CO ₂ Emissions (t/year)	1.05	DFEE	40.43	TFEE	40.60
General Requirements Compliance	Pass	% DFEE<TFEE	0.41		
Assessor	Stephen Smith, [REDACTED]			Assessor ID	D168-0001
Client	Bellway Homes (Wessex)				

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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

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

DWELLING AS DESIGNED

End-Terrace House, total floor area 88 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) 15.89 kgCO₂/m²
Dwelling Carbon Dioxide Emission Rate (DER) 15.35 kgCO₂/m²OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)40.6 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)40.4 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.24 (max. 0.30)	0.24 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.11 (max. 0.25)	0.11 (max. 0.70)	OK
Roof	0.10 (max. 0.20)	0.10 (max. 0.35)	OK
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

2a Thermal bridging

Thermal bridging calculated using user-specified y-value of 0.044

3 Air permeability

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

4 Heating efficiency

Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from 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: 0.1600 0.1600
Maximum 0.7 OK

9 Summertime temperature

Overheating risk (South East England): Slight OK

Based on:

Overshading: Average
Windows facing North East: 4.88 m², No overhang
Windows facing South West: 7.10 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

10 Key features

Party wall U-value 0.00 W/m²K
Roof U-value 0.10 W/m²K
Floor U-value 0.11 W/m²K

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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 (m ²)	Storey height (m)	Volume (m ³)
Ground floor	44.1700 (1b)	x 2.3500 (2b)	= 103.7995 (1b) - (3b)
First floor	44.1700 (1c)	x 2.5500 (2c)	= 112.6335 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	88.3400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 216.4330 (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)	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =											Air changes per hour		
Pressure test											0.0000 / (5) =		0.0000 (8)
Measured/design AP50											Yes		
Infiltration rate											5.0000		
Number of sides sheltered											0.2500 (18)		
											2 (19)		
Shelter factor											(20) = 1 - [0.075 x (19)] =		0.8500 (20)
Infiltration rate adjusted to include shelter factor											(21) = (18) x (20) =		0.2125 (21)
Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind factor	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)	
Adj infilt rate	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)	
	0.2709	0.2656	0.2603	0.2338	0.2284	0.2019	0.2019	0.1966	0.2125	0.2284	0.2391	0.2497 (22b)	
Mechanical extract ventilation - decentralised													
If mechanical ventilation:													0.5000 (23a)
Effective ac	0.5209	0.5156	0.5103	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						
Opening Type 1			2.1200	1.3000	2.7560			(26)					
Opening Type 2 (Uw = 1.30)			11.9800	1.2357	14.8042			(27)					
Heat Loss Floor 1			39.2500	0.1100	4.3175			(28a)					
External Wall 1	88.9400	14.1000	74.8400	0.2400	17.9616			(29a)					
External Roof 1	44.1700		44.1700	0.1000	4.4170			(30)					
Total net area of external elements Aum(A, m2)			172.3600					(31)					
Fabric heat loss, W/K = Sum (A x U)				(26)... (30) + (32) =	44.2563			(33)					
Party Wall 1			38.6500	0.0000	0.0000			(32)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K								250.0000 (35)					
Thermal bridges (User defined value 0.044 * total exposed area)								7.5838 (36)					
Total fabric heat loss						(33) + (36) =		51.8401 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)													
(38)m	Jan 37.2069	Feb 36.8274	Mar 36.4480	Apr 35.7114	May 35.7114	Jun 35.7114	Jul 35.7114	Aug 35.7114	Sep 35.7114	Oct 35.7114	Nov 35.7114	Dec 35.7114	(38)
Heat transfer coeff	89.0470	88.6676	88.2881	87.5516	87.5516	87.5516	87.5516	87.5516	87.5516	87.5516	87.5516	87.5516	(39)
Average = Sum(39)m / 12 =												87.8306	(39)
HLP	Jan 1.0080	Feb 1.0037	Mar 0.9994	Apr 0.9911	May 0.9911	Jun 0.9911	Jul 0.9911	Aug 0.9911	Sep 0.9911	Oct 0.9911	Nov 0.9911	Dec 0.9911	(40)
HLP (average)												0.9942	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

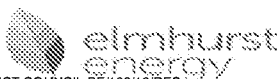
Assumed occupancy												2.6023 (42)
Average daily hot water use (litres/day)												96.0049 (43)
Daily hot water use	Jan 105.6054	Feb 101.7652	Mar 97.9250	Apr 94.0848	May 90.2446	Jun 86.4044	Jul 86.4044	Aug 90.2446	Sep 94.0848	Oct 97.9250	Nov 101.7652	Dec 105.6054 (44)
Energy conte	156.6097	136.9718	141.3427	123.2260	118.2382	102.0306	94.5464	108.4933	109.7891	127.9486	139.6659	151.6681 (45)
Energy content (annual)										Total = Sum(45)m =		1510.5304 (45)
Distribution loss (46)m = 0.15 x (45)m	23.4915	20.5458	21.2014	18.4839	17.7357	15.3046	14.1820	16.2740	16.4684	19.1923	20.9499	22.7502 (46)

Regs Region: England

Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.08r10



FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Water storage loss:												
Total storage loss												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.1324	12.7540	14.0887	13.5910	14.0126	13.5244	13.9526	13.9915	13.5607	14.0573	13.6480	14.1206 (61)
Total heat required for water heating calculated for each month												
	170.7421	149.7258	155.4314	136.8170	132.2509	115.5550	108.4990	122.4849	123.3498	142.0059	153.3139	165.7887 (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												
	170.7421	149.7258	155.4314	136.8170	132.2509	115.5550	108.4990	122.4849	123.3498	142.0059	153.3139	165.7887 (64)
Total per year (kWh/year) = Sum(64)m = 1675.9644 (64)												
Heat gains from water heating, kWh/month												
	55.6058	48.7316	50.5186	44.3704	42.8174	37.3063	34.9248	39.5719	39.8950	46.0572	49.8509	53.9598 (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	130.1155	130.1155	130.1155	130.1155	130.1155	130.1155	130.1155	130.1155	130.1155	130.1155	130.1155	130.1155	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	22.7284	20.1872	16.4173	12.4290	9.2908	7.8437	8.4754	11.0166	14.7865	18.7748	21.9130	23.3601	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	235.9904	238.4392	232.2682	219.1309	202.5474	186.9612	176.5487	174.0998	180.2708	193.4082	209.9917	225.5779	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.0116	36.0116	36.0116	36.0116	36.0116	36.0116	36.0116	36.0116	36.0116	36.0116	36.0116	36.0116	(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)	-104.0924	-104.0924	-104.0924	-104.0924	-104.0924	-104.0924	-104.0924	-104.0924	-104.0924	-104.0924	-104.0924	-104.0924	(71)
Water heating gains (Table 5)	74.7390	72.5173	67.9014	61.6255	57.5502	51.8143	46.9420	53.1881	55.4098	61.9049	69.2374	72.5266	(72)
Total internal gains	398.4925	396.1784	381.6216	358.2201	334.4231	311.6538	297.0007	303.3392	315.5018	339.1225	366.1767	386.4992	(73)

6. Solar gains

[Jan]													Area m2	Solar flux Table 6a W/m2		g Specific data or Table 6b		FF Specific data or Table 6c		Access factor Table 6d		Gains W	
Northeast												4.8800	11.2829		0.7200		0.7000		0.7700		19.2312 (75)		
Southwest												7.1000	36.7938		0.7200		0.7000		0.7700		91.2425 (79)		
Solar gains												110.4737	194.5653	283.1800	379.3134	450.8209	458.9791	437.7530	382.6595	316.1966	219.6110	133.4853	93.7897 (83)
Total gains												508.9662	590.7437	664.8016	737.5334	785.2440	770.6329	734.7537	685.9987	631.6984	558.7335	499.6620	480.2889 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)													21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	68.8931	69.1879	69.4853	70.0698	70.0698	70.0698	70.0698	70.0698	70.0698	70.0698	70.0698	70.0698	
alpha	5.5929	5.6125	5.6324	5.6713	5.6713	5.6713	5.6713	5.6713	5.6713	5.6713	5.6713	5.6713	
util living area	0.9984	0.9958	0.9878	0.9572	0.8651	0.6901	0.5178	0.5749	0.8305	0.9748	0.9962	0.9988	(86)
MIT	19.9316	20.0833	20.3185	20.6131	20.8523	20.9688	20.9948	20.9909	20.9130	20.5994	20.2126	19.9149	(87)
Th 2	20.0767	20.0802	20.0838	20.0908	20.0908	20.0908	20.0908	20.0908	20.0908	20.0908	20.0908	20.0908	(88)
util rest of house	0.9978	0.9945	0.9836	0.9419	0.8204	0.6069	0.4143	0.4675	0.7613	0.9629	0.9947	0.9984	(89)
MIT 2	18.6429	18.8668	19.2107	19.6336	19.9458	20.0699	20.0888	20.0869	20.0208	19.6210	19.0640	18.6288	(90)
Living area fraction	18.9516	19.1582	19.4760	19.8682	20.1629	20.2852	20.3058	20.3034	20.2345	19.8554	19.3391	18.9369	(92)
MIT	18.9516	19.1582	19.4760	19.8682	20.1629	20.2852	20.3058	20.3034	20.2345	19.8554	19.3391	18.9369	(92)
Temperature adjustment	18.8016	19.0082	19.3260	19.7182	20.0129	20.1352	20.1558	20.1534	20.0845	19.7054	19.1891	18.7869	(93)
adjusted MIT	18.8016	19.0082	19.3260	19.7182	20.0129	20.1352	20.1558	20.1534	20.0845	19.7054	19.1891	18.7869	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9967	0.9921	0.9788	0.9340	0.8160	0.6112	0.4218	0.4752	0.7607	0.9560	0.9925	0.9976	(94)
Useful gains	507.2736	586.0866	650.7194	688.8518	640.7656	471.0480	309.9351	325.9648	480.5434	534.1744	495.9001	479.1180	(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	1291.3197	1250.9404	1132.3850	947.1524	727.8079	484.6186	311.3162	328.6193	523.9550	797.1914	1058.4198	1277.1026	(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	583.3303	446.7817	358.3592	185.9765	64.7595	0.0000	0.0000	0.0000	0.0000	195.6847	405.0142	593.7005	(98)
Space heating												2833.6066	(98)
Space heating per m2												32.0761	(99)
										(98) / (4) =			

8c. Space cooling requirement

Not applicable

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)													0.0000 (201)
Fraction of space heat from main system(s)													1.0000 (202)
Efficiency of main space heating system 1 (in %)													90.5000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													3131.0570 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	583.3303	446.7817	358.3592	185.9765	64.7595	0.0000	0.0000	0.0000	0.0000	195.6847	405.0142	593.7005	(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)	644.5639	493.6815	395.9770	205.4988	71.5574	0.0000	0.0000	0.0000	0.0000	216.2262	447.5295	656.0227	(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 requirement	170.7421	149.7258	155.4314	136.8170	132.2509	115.5550	108.4990	122.4849	123.3498	142.0059	153.3139	165.7887	(64)
Efficiency of water heater (217)m	89.7551	89.6749	89.5075	89.1155	88.3266	87.3000	87.3000	87.3000	87.3000	89.1262	89.5982	89.7816	(217)
Fuel for water heating, kWh/month	190.2312	166.9651	173.6519	153.5278	149.7294	132.3654	124.2829	140.3034	141.2942	159.3312	171.1128	184.6577	(219)
Water heating fuel used													1887.4530 (219)
Annual totals kWh/year													
Space heating fuel - main system													3131.0570 (211)
Space heating fuel - secondary													0.0000 (215)
Electricity for pumps and fans:													
(MEV)Decentralised, Database: total watage = 5.3360, total flow = 29.0000, SFP = 0.1840)													
mechanical ventilation fans (SFP = 0.1840)													48.5849 (230a)
central heating pump													30.0000 (230c)
main heating flue fan													45.0000 (230e)
Total electricity for the above, kWh/year													123.5849 (231)
Electricity for lighting (calculated in Appendix L)													401.3909 (232)
Total delivered energy for all uses													5543.4857 (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	3131.0570	0.2160	676.3083 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1887.4530	0.2160	407.6898 (264)
Space and water heating			1083.9981 (265)
Pumps and fans	123.5849	0.5190	64.1406 (267)
Energy for lighting	401.3909	0.5190	208.3219 (268)
Total CO2, kg/year			1356.4606 (272)
Dwelling Carbon Dioxide Emission Rate (DER)			15.3500 (273)

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

DER			15.3500 ZC1
Total Floor Area		TFA	88.3400
Assumed number of occupants		N	2.6023
CO2 emission factor in Table 12 for electricity displaced from grid		EF	0.5190
CO2 emissions from appliances, equation (L14)			15.8301 ZC2
CO2 emissions from cooking, equation (L16)			2.0541 ZC3
Total CO2 emissions			33.2341 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			33.2341 ZC8

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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 (m ²)	Storey height (m)	Volume (m ³)
Ground floor	44.1700 (1b)	x 2.3500 (2b)	= 103.7995 (1b) - (3b)
First floor	44.1700 (1c)	x 2.5500 (2c)	= 112.6335 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	88.3400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 216.4330 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	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)
Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(7a)+(7b)+(7c) =				30.0000 / (5) = 0.1386 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3886 (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) =				0.3303 (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	0.4212	0.4129	0.4046	0.3634	0.3551	0.3138	0.3138	0.3055	0.3303	0.3551	0.3716	0.3881 (22b)
Effective ac	0.5887	0.5852	0.5819	0.5660	0.5630	0.5492	0.5492	0.5467	0.5546	0.5630	0.5690	0.5753 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
TER Opaque door			2.1200	1.0000	2.1200		(26)
TER Opening Type (Uw = 1.40)			11.9800	1.3258	15.8826		(27)
Heat Loss Floor 1			39.2500	0.1300	5.1025		(28a)
External Wall 1	88.9400	14.1000	74.8400	0.1800	13.4712		(29a)
External Roof 1	44.1700		44.1700	0.1300	5.7421		(30)
Total net area of external elements Aum(A, m ²)			172.3600				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	42.3184		(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							0.0000 (36)
Total fabric heat loss						(33) + (36) =	42.3184 (37)
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)							
(38)m	42.0457	41.7997	41.5586	40.4262	40.2143	39.2280	39.2280
Heat transfer coeff	84.3641	84.1181	83.8770	82.7446	82.5327	81.5464	81.5464
Average = Sum(39)m / 12 =							
HLP	0.9550	0.9522	0.9495	0.9367	0.9343	0.9231	0.9231
HLP (average)							
Days in month	31	28	31	30	31	30	31

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.6023 (42)
Average daily hot water use (litres/day)												96.0049 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												
	105.6054	101.7652	97.9250	94.0848	90.2446	86.4044	86.4044	90.2446	94.0848	97.9250	101.7652	105.6054 (44)
Energy conte	156.6097	136.9718	141.3427	123.2260	118.2382	102.0306	94.5464	108.4933	109.7891	127.9486	139.6659	151.6681 (45)
Energy content (annual)											Total = Sum(45)m =	1510.5304 (45)
Distribution loss	(46)m = 0.15 x (45)m											
	23.4915	20.5458	21.2014	18.4839	17.7357	15.3046	14.1820	16.2740	16.4684	19.1923	20.9499	22.7502 (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												

Regs Region: England

Elmhurst Energy Systems

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System) version 4.08r10



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Calculation Type: New Build (As Designed)



CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Combi 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 (57)
Total heat required for water heating calculated for each month	50.9589	46.0274	49.9015	46.3980	45.9876	42.6104	44.0307	45.9876	46.3980	49.9015	49.3151	50.9589 (61)
Solar input	207.5686	182.9992	191.2442	169.6239	164.2259	144.6410	138.5771	154.4810	156.1871	177.8501	188.9810	202.6270 (62)
Output from w/h	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)
Heat gains from water heating, kWh/month	207.5686	182.9992	191.2442	169.6239	164.2259	144.6410	138.5771	154.4810	156.1871	177.8501	188.9810	202.6270 (64)
	64.8124	57.0500	59.4718	52.5721	50.8111	44.5778	42.4443	47.5709	48.1044	55.0183	58.7677	63.1694 (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)
(66)m	130.1155	130.1155	130.1155	130.1155	130.1155	130.1155	130.1155	130.1155	130.1155	130.1155	130.1155	130.1155	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	22.7284	20.1872	16.4173	12.4290	9.2908	7.8437	8.4754	11.0166	14.7865	18.7748	21.9130	23.3601	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	235.9904	238.4392	232.2682	219.1309	202.5474	186.9612	176.5487	174.0998	180.2708	193.4082	209.9917	225.5779	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.0116	36.0116	36.0116	36.0116	36.0116	36.0116	36.0116	36.0116	36.0116	36.0116	36.0116	36.0116	(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)	-104.0924	-104.0924	-104.0924	-104.0924	-104.0924	-104.0924	-104.0924	-104.0924	-104.0924	-104.0924	-104.0924	-104.0924	(71)
Water heating gains (Table 5)	87.1135	84.8958	79.9352	73.0168	68.2945	61.9136	57.0489	63.9394	66.8116	73.9493	81.6218	84.9051	(72)
Total internal gains	410.8670	408.5569	393.6554	369.6114	345.1674	321.7531	307.1076	314.0905	326.9036	351.1670	378.5611	398.8777	(73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2	g	Specific data or Table 6b	Specific data or Table 6c	FF	Access factor Table 6d	Gains W	
Northeast				4.8800	11.2829		0.6300		0.7000	0.7700	16.8273 (75)	
Southwest				7.1000	36.7938		0.6300		0.7000	0.7700	79.8372 (79)	
Solar gains	96.6645	170.2447	247.7825	331.8992	394.4683	401.6067	383.0339	334.8271	276.6720	192.1596	116.7996	82.0660 (83)
Total gains	507.5314	578.8016	641.4379	701.5106	739.6357	723.3598	690.1415	648.9177	603.5756	543.3265	495.3607	480.9437 (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	72.7172	72.9299	73.1395	74.1405	74.3308	75.2298	75.2298	75.3987	74.8810	74.3308	73.9468	73.5495	
alpha	5.8478	5.8620	5.8760	5.9427	5.9554	6.0153	6.0153	6.0266	5.9921	5.9554	5.9298	5.9033	
util living area	0.9984	0.9961	0.9889	0.9605	0.8716	0.6901	0.5150	0.5677	0.8274	0.9749	0.9962	0.9988	(86)
MIT	20.0056	20.1422	20.3579	20.6379	20.8640	20.9748	20.9962	20.9935	20.9270	20.6363	20.2707	19.9828	(87)
Th 2	20.1210	20.1233	20.1256	20.1365	20.1385	20.1479	20.1479	20.1497	20.1443	20.1385	20.1344	20.1301	(88)
util rest of house	0.9978	0.9948	0.9850	0.9464	0.8292	0.6110	0.4179	0.4675	0.7604	0.9632	0.9947	0.9984	(89)
MIT 2	18.7838	18.9849	19.2997	19.7058	20.0038	20.1309	20.1464	20.1469	20.0855	19.7107	19.1812	18.7574	(90)
Living area fraction	19.0764	19.2621	19.5532	19.9290	20.2098	20.3331	20.3500	20.3497	20.2870	19.9324	19.4422	19.0509	(91)
Temperature adjustment	19.0764	19.2621	19.5532	19.9290	20.2098	20.3331	20.3500	20.3497	20.2870	19.9324	19.4422	19.0509	(92)
adjusted MIT	19.0764	19.2621	19.5532	19.9290	20.2098	20.3331	20.3500	20.3497	20.2870	19.9324	19.4422	19.0509	(93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	0.9969	0.9930	0.9816	0.9423	0.8332	0.6289	0.4412	0.4916	0.7728	0.9596	0.9930	0.9977	(94)
Ext temp.	505.9569	574.7398	629.6616	661.0024	616.2352	454.9519	304.5215	318.9936	466.4202	521.3568	491.8881	479.8376	(95)
Heat loss rate W	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)
Month fracti	1246.5997	1208.1148	1094.8602	912.5917	702.3385	467.5109	305.7986	321.3590	506.8812	770.2295	1023.9237	1238.7068	(97)
Space heating kWh	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	551.0382	425.6280	346.1078	181.1443	64.0608	0.0000	0.0000	0.0000	0.0000	185.1612	383.0656	564.5986	(98)
Space heating per m2												2700.8047	(98)
												30.5728	(99)

8c. Space cooling requirement

Not applicable

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

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Fraction of space heat from secondary/supplementary system (Table 11)													0.0000 (201)
Fraction of space heat from main system(s)													1.0000 (202)
Efficiency of main space heating system 1 (in %)													93.4000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													2891.6539 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	551.0382	425.6280	346.1078	181.1443	64.0608	0.0000	0.0000	0.0000	0.0000	185.1612	383.0656	564.5986	(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)	589.9767	455.7045	370.5651	193.9447	68.5876	0.0000	0.0000	0.0000	0.0000	198.2454	410.1345	604.4953	(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 requirement	207.5686	182.9992	191.2442	169.6239	164.2259	144.6410	138.5771	154.4810	156.1871	177.8501	188.9810	202.6270	(64)
Efficiency of water heater	87.3924	87.1058	86.5267	85.2168	82.8990	80.3000	80.3000	80.3000	80.3000	85.1527	86.7935	87.4936	(217)
Fuel for water heating, kWh/month	237.5134	210.0885	221.0234	199.0499	198.1035	180.1258	172.5742	192.3798	194.5044	208.8602	217.7362	231.5907	(219)
Water heating fuel used												2463.5499	(219)
Annual totals kWh/year													
Space heating fuel - main system												2891.6539	(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)												401.3909	(232)
Total delivered energy for all uses												5831.5947	(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	2891.6539	0.2160	624.5972 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2463.5499	0.2160	532.1268 (264)
Space and water heating			1156.7240 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	401.3909	0.5190	208.3219 (268)
Total CO2, kg/m2/year			1403.9709 (272)
Emissions per m2 for space and water heating			13.0940 (272a)
Fuel factor (mains gas)			1.0000
Emissions per m2 for lighting			2.3582 (272b)
Emissions per m2 for pumps and fans			0.4406 (272c)
Target Carbon Dioxide Emission Rate (TER) = (13.0940 * 1.00) + 2.3582 + 0.4406, rounded to 2 d.p.			15.8900 (273)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



Property Reference	SECNEWB011			Issued on Date	15/09/2019
Assessment Reference	001	Prop Type Ref	Carver		
Property	Plot 11, Holmwood Park, Ferndown, Dorset, BH22				
SAP Rating	85 B	DER	16.30	TER	16.81
Environmental	87 B	% DER<TER	3.04		
CO ₂ Emissions (t/year)	1.20	DFEE	46.52	TFEE	47.93
General Requirements Compliance	Pass	% DFEE<TFEE	2.93		
Assessor	Stephen Smith, [REDACTED]			Assessor ID	D168-0001
Client	Bellway Homes (Wessex)				

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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

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

DWELLING AS DESIGNED

Detached House, total floor area 92 m²

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

1a TER and DER

Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 16.81 kgCO₂/m²
Dwelling Carbon Dioxide Emission Rate (DER) 16.30 kgCO₂/m²OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)47.9 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)46.5 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.24 (max. 0.30)	0.24 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.11 (max. 0.25)	0.11 (max. 0.70)	OK
Roof	0.10 (max. 0.20)	0.10 (max. 0.35)	OK
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

2a Thermal bridging

Thermal bridging calculated using user-specified y-value of 0.031

3 Air permeability

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

4 Heating efficiency

Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from 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: 0.1600 0.1600
Maximum 0.7 OK

9 Summertime temperature

Overheating risk (Southern England): Slight OK

Based on:

Overshading: Average
Windows facing North East: 10.23 m², No overhang
Windows facing South East: 1.92 m², No overhang
Windows facing South West: 5.38 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

10 Key features

Party wall U-value 0.00 W/m²K
Roof U-value 0.10 W/m²K
Floor U-value 0.11 W/m²K
Thermal bridging y-value 0.031 W/m²K

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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 (m ²)	Storey height (m)	Volume (m ³)
Ground floor	46.0300 (1b)	x 2.3500 (2b)	= 108.1705 (1b) - (3b)
First floor	46.0300 (1c)	x 2.5500 (2c)	= 117.3765 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	92.0600		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	225.5470 (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)	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =											Air changes per hour		
Pressure test											0.0000 / (5) =		0.0000 (8)
Measured/design AP50											Yes		
Infiltration rate											5.0000		
Number of sides sheltered											0.2500 (18)		
											2 (19)		
Shelter factor											(20) = 1 - [0.075 x (19)] =		0.8500 (20)
Infiltration rate adjusted to include shelter factor											(21) = (18) x (20) =		0.2125 (21)
Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind factor	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)	
Adj infilt rate	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)	
	0.2709	0.2656	0.2603	0.2338	0.2284	0.2019	0.2019	0.1966	0.2125	0.2284	0.2391	0.2497 (22b)	
Mechanical extract ventilation - decentralised													
If mechanical ventilation:													0.5000 (23a)
Effective ac	0.5209	0.5156	0.5103	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					
Opening Type 1			2.1200	1.3000	2.7560		(26)					
Opening Type 2 (Uw = 1.30)			17.5300	1.2357	21.6625		(27)					
Heat Loss Floor 1			46.0300	0.1100	5.0633		(28a)					
External Wall 1	128.7700	19.6500	109.1200	0.2400	26.1888		(29a)					
External Roof 1	46.0300		46.0300	0.1000	4.6030		(30)					
Total net area of external elements Aum(A, m2)			220.8300				(31)					
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		60.2736		(33)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000 (35)					
Thermal bridges (User defined value 0.031 * total exposed area)							6.8457 (36)					
Total fabric heat loss						(33) + (36) =	67.1194 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 38.7736	Feb 38.3782	Mar 37.9828	Apr 37.2153	May 37.2153	Jun 37.2153	Jul 37.2153	Aug 37.2153	Sep 37.2153	Oct 37.2153	Nov 37.2153	Dec 37.2153 (38)
Heat transfer coeff	105.8930	105.4976	105.1022	104.3346	104.3346	104.3346	104.3346	104.3346	104.3346	104.3346	104.3346	104.3346 (39)
Average = Sum(39)m / 12 =												104.6254 (39)
HLP	Jan 1.1503	Feb 1.1460	Mar 1.1417	Apr 1.1333	May 1.1333	Jun 1.1333	Jul 1.1333	Aug 1.1333	Sep 1.1333	Oct 1.1333	Nov 1.1333	Dec 1.1333 (40)
HLP (average)												1.1365 (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												2.6529 (42)
Average daily hot water use (litres/day)												97.2059 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	106.9265	103.0382	99.1500	95.2618	91.3735	87.4853	87.4853	91.3735	95.2618	99.1500	103.0382	106.9265 (44)
Energy conte	158.5689	138.6854	143.1109	124.7675	119.7174	103.3070	95.7291	109.8506	111.1626	129.5492	141.4131	153.5655 (45)
Energy content (annual)											Total = Sum(45)m =	1529.4272 (45)
Distribution loss (46)m = 0.15 x (45)m												
	23.7853	20.8028	21.4666	18.7151	17.9576	15.4961	14.3594	16.4776	16.6744	19.4324	21.2120	23.0348 (46)
Water storage loss:												

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.1371	12.7581	14.0971	13.5981	14.0191	13.5297	13.9576	13.9975	13.5669	14.0648	13.6522	14.1251 (61)
Total heat required for water heating calculated for each month	172.7060	151.4435	157.2080	138.3656	133.7365	116.8367	109.6867	123.8480	124.7295	143.6141	155.0653	167.6906 (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)
Output from w/h	172.7060	151.4435	157.2080	138.3656	133.7365	116.8367	109.6867	123.8480	124.7295	143.6141	155.0653	167.6906 (64)
Heat gains from water heating, kWh/month	56.2584	49.3024	51.1086	44.8847	43.3108	37.7320	35.3193	40.0247	40.3533	46.5913	50.4329	54.5918 (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	132.6440	132.6440	132.6440	132.6440	132.6440	132.6440	132.6440	132.6440	132.6440	132.6440	132.6440	132.6440	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	21.9276	19.4759	15.8389	11.9911	8.9635	7.5673	8.1768	10.6285	14.2655	18.1133	21.1410	22.5371	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	242.8169	245.3366	238.9871	225.4698	208.4065	192.3695	181.6557	179.1361	185.4856	199.0029	216.0662	232.1032	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.2644	36.2644	36.2644	36.2644	36.2644	36.2644	36.2644	36.2644	36.2644	36.2644	36.2644	36.2644	(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)	-106.1152	-106.1152	-106.1152	-106.1152	-106.1152	-106.1152	-106.1152	-106.1152	-106.1152	-106.1152	-106.1152	-106.1152	(71)
Water heating gains (Table 5)	75.6162	73.3667	68.6944	62.3399	58.2135	52.4056	47.4722	53.7966	56.0462	62.6228	70.0457	73.3761	(72)
Total internal gains	406.1540	403.9724	389.3136	365.5939	341.3766	318.1356	303.0979	309.3544	321.5905	345.5322	373.0460	393.8096	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	Specific data or Table 6c	FF	Access factor Table 6d	Gains W	
Northeast	10.2300	11.2829	0.7200		0.7000	0.7700	40.3145	(75)
Southeast	1.9200	36.7938	0.7200		0.7000	0.7700	24.6740	(77)
Southwest	5.3800	36.7938	0.7200		0.7000	0.7700	69.1387	(79)

Solar gains	134.1272	241.8592	366.4908	513.7182	629.8240	649.2055	615.9423	525.6628	416.8991	276.8961	163.0921	113.2070	(83)
Total gains	540.2812	645.8316	755.8044	879.3121	971.2006	967.3411	919.0402	835.0171	738.4896	622.4283	536.1382	507.0166	(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	60.3728	60.5991	60.8270	61.2745	61.2745	61.2745	61.2745	61.2745	61.2745	61.2745	61.2745	61.2745	
alpha	5.0249	5.0399	5.0551	5.0850	5.0850	5.0850	5.0850	5.0850	5.0850	5.0850	5.0850	5.0850	
util living area	0.9982	0.9952	0.9852	0.9457	0.8353	0.6540	0.4921	0.5596	0.8248	0.9739	0.9960	0.9987	(86)
MIT	19.7462	19.9222	20.2037	20.5591	20.8372	20.9641	20.9930	20.9871	20.8866	20.5099	20.0624	19.7245	(87)
Th 2	19.9600	19.9635	19.9669	19.9737	19.9737	19.9737	19.9737	19.9737	19.9737	19.9737	19.9737	19.9737	(88)
util rest of house	0.9976	0.9936	0.9800	0.9264	0.7828	0.5638	0.3812	0.4424	0.7492	0.9610	0.9943	0.9983	(89)
MIT 2	18.2876	18.5468	18.9573	19.4630	19.8194	19.9508	19.9712	19.9685	19.8845	19.4044	18.7596	18.2657	(90)
Living area fraction	18.5481	18.7924	19.1799	19.6587	20.0011	20.1318	20.1537	20.1504	20.0635	19.6018	18.9923	18.5263	(92)
MIT	18.5481	18.7924	19.1799	19.6587	20.0011	20.1318	20.1537	20.1504	20.0635	19.6018	18.9923	18.5263	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.3981	18.6424	19.0299	19.5087	19.8511	19.9818	20.0037	20.0004	19.9135	19.4518	18.8423	18.3763	(93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	0.9961	0.9905	0.9733	0.9153	0.7757	0.5646	0.3845	0.4456	0.7441	0.9518	0.9915	0.9972	(94)
Ext temp.	538.1898	639.7026	735.6589	804.8737	753.3158	546.1204	353.3864	372.0632	549.4869	592.4225	531.5973	505.5744	(95)
Heat loss rate W	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)
Month fracti	1492.8908	1449.7899	1316.9170	1106.8598	850.4459	561.5048	355.1231	375.6490	606.5448	923.5511	1225.1273	1479.0743	(97)
Space heating kWh	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	1.0000	(97a)
Space heating	710.2976	544.3787	432.4561	217.4300	72.2648	0.0000	0.0000	0.0000	0.0000	246.3597	499.3417	724.2839	(98)
Space heating per m2												3446.8124	(98)
										(98) / (4) =		37.4409	(99)

8c. Space cooling requirement

Not applicable

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)													0.0000 (201)
Fraction of space heat from main system(s)													1.0000 (202)
Efficiency of main space heating system 1 (in %)													90.5000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													3808.6325 (211)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Space heating requirement	710.2976	544.3787	432.4561	217.4300	72.2648	0.0000	0.0000	0.0000	0.0000	246.3597	499.3417	724.2839	(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)	784.8592	601.5234	477.8520	240.2542	79.8507	0.0000	0.0000	0.0000	0.0000	272.2206	551.7587	800.3137	(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 requirement	172.7060	151.4435	157.2080	138.3656	133.7365	116.8367	109.6867	123.8480	124.7295	143.6141	155.0653	167.6906	(64)
Efficiency of water heater (217)m	89.8558	89.7837	89.6241	89.2281	88.3965	87.3000	87.3000	87.3000	87.3000	89.2946	89.7207	89.8806	(216)
Fuel for water heating, kWh/month	192.2035	168.6759	175.4081	155.0696	151.2917	133.8336	125.6434	141.8649	142.8746	160.8317	172.8311	186.5704	(219)
Water heating fuel used												1907.0985	(219)
Annual totals kWh/year													
Space heating fuel - main system												3808.6325	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
(MEV)Decentralised, Database: total watage = 5.3360, total flow = 29.0000, SFP = 0.1840)													
mechanical ventilation fans (SFP = 0.1840)													50.6308 (230a)
central heating pump													30.0000 (230c)
main heating flue fan													45.0000 (230e)
Total electricity for the above, kWh/year													125.6308 (231)
Electricity for lighting (calculated in Appendix L)													387.2490 (232)
Total delivered energy for all uses													6228.6108 (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	3808.6325	0.2160	822.6646 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1907.0985	0.2160	411.9333 (264)
Space and water heating			1234.5979 (265)
Pumps and fans	125.6308	0.5190	65.2024 (267)
Energy for lighting	387.2490	0.5190	200.9822 (268)
Total CO2, kg/year			1500.7825 (272)
Dwelling Carbon Dioxide Emission Rate (DER)			16.3000 (273)

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

DER			16.3000 ZC1
Total Floor Area		TFA	92.0600
Assumed number of occupants		N	2.6529
CO2 emission factor in Table 12 for electricity displaced from grid		EF	0.5190
CO2 emissions from appliances, equation (L14)			15.6298 ZC2
CO2 emissions from cooking, equation (L16)			1.9842 ZC3
Total CO2 emissions			33.9141 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			33.9141 ZC8

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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 (m ²)	Storey height (m)	Volume (m ³)
Ground floor	46.0300 (1b)	x 2.3500 (2b)	= 108.1705 (1b) - (3b)
First floor	46.0300 (1c)	x 2.5500 (2c)	= 117.3765 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	92.0600		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 225.5470 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	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)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c)					30.0000 / (5) = 0.1330 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3830 (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) =	0.3256 (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	0.4151	0.4069	0.3988	0.3581	0.3500	0.3093	0.3093	0.3011	0.3256	0.3500	0.3663	0.3825 (22b)
Effective ac	0.5861	0.5828	0.5795	0.5641	0.5612	0.5478	0.5478	0.5453	0.5530	0.5612	0.5671	0.5732 (25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K						
TER Opaque door			2.1200	1.0000	2.1200			(26)					
TER Opening Type (Uw = 1.40)			17.5300	1.3258	23.2405			(27)					
Heat Loss Floor 1			46.0300	0.1300	5.9839			(28a)					
External Wall 1	128.7700	19.6500	109.1200	0.1800	19.6416			(29a)					
External Roof 1	46.0300		46.0300	0.1300	5.9839			(30)					
Total net area of external elements Aum(A, m2)			220.8300					(31)					
Fabric heat loss, W/K = Sum (A x U)			(26)... (30) + (32) =		56.9699			(33)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K								250.0000 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							0.0000	(36)					
Total fabric heat loss						(33) + (36) =	56.9699	(37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)													
(38)m	Jan 43.6273	Feb 43.3784	Mar 43.1343	Apr 41.9880	May 41.7735	Jun 40.7751	Jul 40.7751	Aug 40.5902	Sep 41.1596	Oct 41.7735	Nov 42.2074	Dec 42.6610	(38)
Heat transfer coeff	100.5973	100.3483	100.1042	98.9579	98.7434	97.7450	97.7450	97.5601	98.1296	98.7434	99.1773	99.6309	(39)
Average = Sum(39)m / 12 =												98.9569	(39)
HLP	Jan 1.0927	Feb 1.0900	Mar 1.0874	Apr 1.0749	May 1.0726	Jun 1.0618	Jul 1.0618	Aug 1.0597	Sep 1.0659	Oct 1.0726	Nov 1.0773	Dec 1.0822	(40)
HLP (average)												1.0749	(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												2.6529 (42)
Average daily hot water use (litres/day)												97.2059 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												
	106.9265	103.0382	99.1500	95.2618	91.3735	87.4853	87.4853	91.3735	95.2618	99.1500	103.0382	106.9265 (44)
Energy conte	158.5689	138.6854	143.1109	124.7675	119.7174	103.3070	95.7291	109.8506	111.1626	129.5492	141.4131	153.5655 (45)
Energy content (annual)											Total = Sum(45)m =	1529.4272 (45)
Distribution loss (46)m = 0.15 x (45)m												
	23.7853	20.8028	21.4666	18.7151	17.9576	15.4961	14.3594	16.4776	16.6744	19.4324	21.2120	23.0348 (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												

Regs Region: England

Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.08r10

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Combi 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 (57)
Total heat required for water heating calculated for each month	50.9589	46.0274	50.5258	46.9784	46.5630	43.1434	44.5816	46.5630	46.9784	50.5258	49.3151	50.9589 (61)
Solar input	209.5278	184.7128	193.6366	171.7459	166.2804	146.4505	140.3107	156.4135	158.1410	180.0750	190.7282	204.5244 (62)
Output from w/h	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)
Heat gains from water heating, kWh/month	65.4639	57.6197	60.2158	53.2298	51.4468	45.1354	42.9753	48.1661	48.7062	55.7066	59.3486	63.8003 (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)
(66)m	132.6440	132.6440	132.6440	132.6440	132.6440	132.6440	132.6440	132.6440	132.6440	132.6440	132.6440	132.6440	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	21.9276	19.4759	15.8389	11.9911	8.9635	7.5673	8.1768	10.6285	14.2655	18.1133	21.1410	22.5371	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	242.8169	245.3366	238.9871	225.4698	208.4065	192.3695	181.6557	179.1361	185.4856	199.0029	216.0662	232.1032	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.2644	36.2644	36.2644	36.2644	36.2644	36.2644	36.2644	36.2644	36.2644	36.2644	36.2644	36.2644	(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)	-106.1152	-106.1152	-106.1152	-106.1152	-106.1152	-106.1152	-106.1152	-106.1152	-106.1152	-106.1152	-106.1152	-106.1152	(71)
Water heating gains (Table 5)	87.9891	85.7436	80.9352	73.9303	69.1489	62.6881	57.7625	64.7393	67.6474	74.8744	82.4287	85.7530	(72)
Total internal gains	418.5269	416.3494	401.5544	377.1843	352.3121	328.4181	313.3882	320.2971	333.1917	357.7839	385.4290	406.1865	(73)

6. Solar gains

[Jan]					Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c			Access factor Table 6d			Gains W		
Northeast					10.2300	11.2829	0.6300	0.7000			0.7700			35.2752 (75)		
Southeast					1.9200	36.7938	0.6300	0.7000			0.7700			21.5898 (77)		
Southwest					5.3800	36.7938	0.6300	0.7000			0.7700			60.4963 (79)		
Solar gains					117.3613	211.6268	320.6795	449.5034	551.0960	568.0549	538.9495	459.9549	364.7867	242.2841	142.7056	99.0561 (83)
Total gains					535.8882	627.9762	722.2339	826.6877	903.4080	896.4730	852.3378	780.2520	697.9784	600.0680	528.1346	505.2427 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	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	63.5510	63.7087	63.8640	64.6038	64.7441	65.4055	65.4055	65.5294	65.1491	64.7441	64.4609	64.1674	
alpha	5.2367	5.2472	5.2576	5.3069	5.3163	5.3604	5.3604	5.3686	5.3433	5.3163	5.2974	5.2778	
util living area	0.9983	0.9957	0.9870	0.9520	0.8485	0.6637	0.4981	0.5622	0.8293	0.9753	0.9962	0.9987	(86)
MIT	19.8196	19.9785	20.2378	20.5756	20.8429	20.9683	20.9943	20.9895	20.8982	20.5430	20.1187	19.7923	(87)
Th 2	20.0068	20.0090	20.0112	20.0214	20.0233	20.0322	20.0322	20.0338	20.0288	20.0233	20.0194	20.0154	(88)
util rest of house	0.9977	0.9942	0.9824	0.9348	0.7993	0.5772	0.3920	0.4508	0.7570	0.9632	0.9946	0.9983	(89)
MIT 2	18.4283	18.6618	19.0394	19.5248	19.8721	20.0116	20.0301	20.0296	19.9477	19.4891	18.8746	18.3946	(90)
Living area fraction	18.6768	18.8969	19.2534	19.7124	20.0455	20.1825	20.2023	20.2010	20.1174	19.6773	19.0968	18.6442	(91)
MIT	18.6768	18.8969	19.2534	19.7124	20.0455	20.1825	20.2023	20.2010	20.1174	19.6773	19.0968	18.6442	(92)
Temperature adjustment	18.6768	18.8969	19.2534	19.7124	20.0455	20.1825	20.2023	20.2010	20.1174	19.6773	19.0968	18.6442	(93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	534.0218	622.8592	706.0832	767.1806	723.2656	530.0781	350.2905	367.2069	533.5769	574.5495	524.1354	503.9333	(94)
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	1446.2619	1404.5654	1276.6660	1069.9759	824.0617	545.6573	352.1050	370.8252	590.4850	896.3200	1189.8082	1439.0928	(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	678.7066	525.3066	424.5137	218.0126	74.9923	0.0000	0.0000	0.0000	0.0000	239.3973	479.2844	695.7587	(98)
Space heating												3335.9722	(98)
Space heating per m2												36.2369	(99)

8c. Space cooling requirement

Not applicable

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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												3571.7047 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	678.7066	525.3066	424.5137	218.0126	74.9923	0.0000	0.0000	0.0000	0.0000	239.3973	479.2844	695.7587 (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)	726.6666	562.4267	454.5114	233.4182	80.2915	0.0000	0.0000	0.0000	0.0000	256.3140	513.1524	744.9236 (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	209.5278	184.7128	193.6366	171.7459	166.2804	146.4505	140.3107	156.4135	158.1410	180.0750	190.7282	204.5244 (64)
Efficiency of water heater	87.7951	87.5357	86.9732	85.6528	83.1889	80.3000	80.3000	80.3000	80.3000	85.7689	87.2752	80.3000 (216)
(217)m	87.7951	87.5357	86.9732	85.6528	83.1889	80.3000	80.3000	80.3000	80.3000	85.7689	87.2752	87.8887 (217)
Fuel for water heating, kWh/month	238.6554	211.0142	222.6393	200.5141	199.8830	182.3792	174.7331	194.7865	196.9377	209.9538	218.5366	232.7085 (219)
Water heating fuel used	238.6554	211.0142	222.6393	200.5141	199.8830	182.3792	174.7331	194.7865	196.9377	209.9538	218.5366	2482.7414 (219)
Annual totals kWh/year												
Space heating fuel - main system												3571.7047 (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)												387.2490 (232)
Total delivered energy for all uses												6516.6951 (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	3571.7047	0.2160	771.4882 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2482.7414	0.2160	536.2721 (264)
Space and water heating			1307.7604 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	387.2490	0.5190	200.9822 (268)
Total CO2, kg/m2/year			1547.6676 (272)
Emissions per m2 for space and water heating			14.2055 (272a)
Fuel factor (mains gas)			1.0000
Emissions per m2 for lighting			2.1832 (272b)
Emissions per m2 for pumps and fans			0.4228 (272c)
Target Carbon Dioxide Emission Rate (TER) = (14.2055 * 1.00) + 2.1832 + 0.4228, rounded to 2 d.p.			16.8100 (273)

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