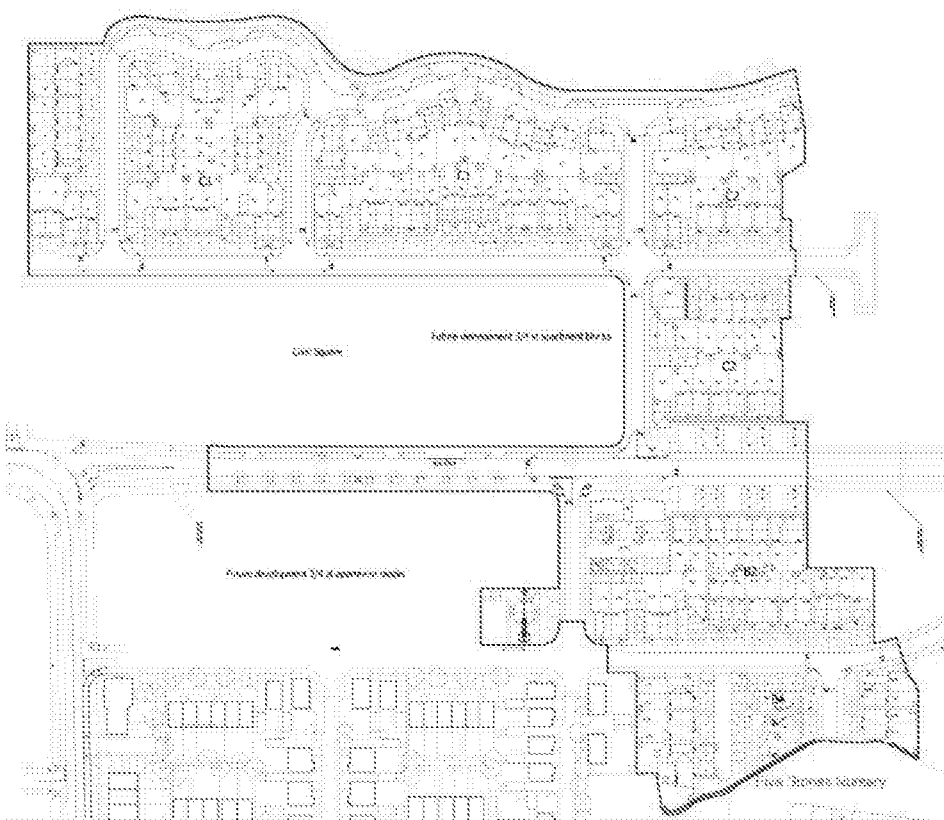


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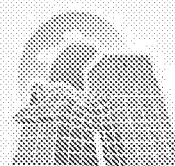
LITTLEHAMPTON PHASE 2 - PARCELS C1 & PART PARCELS B2, B4, C2



ENERGY STATEMENT

28th November 2017

SE066/DC/ES/3596/
ARUN DISTRICT COUNCIL LU/398/17/DOC



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.

Report prepared by:
QA:

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28th November 2017

Report type:

Planning Application Supporting Document

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1.0 Introduction

1.1 This Energy Statement has been commissioned by Persimmon Homes (the Client) 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 Phase 2 of their development at Littlehampton. The site falls under the West Sussex District Council jurisdiction and the Client has secured planning consent for the development of 126 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 Client 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 Client's proposed approach for minimising greenhouse gas emissions from the new dwellings at Phase 2 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 (2012) (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.

1.4 In 2012, the 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 Paragraph 95 of 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 126 dwellings proposed for Phase 2 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 Client’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 Phase 2 of the Littlehampton development.

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 126 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.
- 2.2 The Building Regulation (2013) baseline for the development identifies predicted carbon dioxide emissions, relative to each dwelling type's Target Emission Rate, of **190,555 kgCO₂/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 (kgCO₂/year) for Phase 2, Littlehampton

	Number of Dwellings	Emissions (kgCO ₂ /year)	Total Emissions (kgCO ₂ /year)
Private			
Alnwick	11	1,166	12,826
Hanbury	20	1,294	25,880
Souter	18	1,507	27,126
Hatfield	4	1,578	6,312
Clayton	8	1,733	13,864
Whitehall	2	1,645	3,290
Greyfriars	6	1,689	10,134
Leicester	6	1,743	10,458
Lumley	7	1,942	13,594
Wolvesey	8	2,110	16,880
Sub-total			140,364
Affordable			
WP2420A	19	1,312	24,928

WP3520A/C	5	1,467	7,335
WP3625A	6	1,876	11,256
Apartments	6	1,112	6,672
Sub-total			50,191
TOTAL			190,555

- 2.3 In accordance with the Client'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 **19,056 kgCO₂/year**.

Best Practice Energy Efficiency Measures

- 2.4 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 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	0.28	6.67
Roof (joists)	0.20	0.14	30.00
Roof (rafters)	0.20	0.13	35.00
Ground floor	0.25	0.18	28.00
Windows	2.00	1.40	30.00

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

Table 3: Fabric Enhancement Construction Specification

Thermal Element	Proposed U-value (W/m ² K) 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)	0.14	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)	0.13	Sloping ceilings to typically include 130mm Celotex XR4000 insulation between rafters and 50mm Celotex GA4000 underneath.
Ground floor	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

- 2.6 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.

Ventilation and Air Tightness

- 2.7 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 m³/hm² to 5 m³/hm² to further lower space heating requirements.

Internal Lighting

- 2.8 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

- 2.9 The energy efficiency measures detailed in Paragraphs 2.4 to 2.9 will reduce the predicted carbon dioxide emissions at the Littlehampton, Phase 2 development from **190,555 kgCO₂/year** to **187,697 kgCO₂/year**. This is a reduction of **2,858 kgCO₂/year**, or **1.50%**. A further reduction in emissions of at least **16,198 kgCO₂/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

- 2.10 This section of the Statement conducts a thorough review of the renewable energy and low carbon technologies that could theoretically be applied to Phase 2 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
- Heat pumps (ground source and air source)
- Hydroelectric power
- Wind energy
- Solar thermal panels
- Solar photovoltaic panels

Combined Heat and Power

- 2.11 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 Phase 2 of the Littlehampton development, which is residential and only incorporates a total of one hundred and twenty-six 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

- 2.12 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.

Ground and Air Source Heat Pumps (GSHPs)

- 2.13 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

- 2.14 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

- 2.15 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

- 2.16 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 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.

- 2.17 However, 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. Further SAP calculations have been carried out, which show the reductions in emissions that could be secured given the installation of 37 kWp of solar PV output, with priority given to installing arrays on optimally orientated (south-facing) dwellings. These include plots 28-32, 34, 35, 56-59, 61-64, and 75-77. However, the exact allocations on a per dwelling basis will be determined at the detailed design stage.

Modelling of Solar PV Installations and Emissions Reductions

- 2.18 Further SAP calculations have been carried out to model the effects on site-wide emissions of introducing 37 kWp of solar PV panels to Phase 2 of the Littlehampton development. Examples of 2 kWp installations on plots 58 (Type Hanbury) and 62 (Type Alnwick) are provided in the Appendix to this Statement. Overall, the introduction of 37 kWp of solar PV output to optimally orientated dwellings will reduce emissions across the site by **16,280 kgCO₂/year**. In addition, to the reductions secured via best practice energy efficiency measures, which were **2,858 kgCO₂/year**, this amasses to a total reduction of **19,138 kgCO₂/year**. Compared to baseline emissions of **190,555 kgCO₂/year**, this is equivalent to an overall reduction in emissions of **10.04%**. This is summarised in Table 4 overleaf

Table 4: Emissions Reduction from Energy Efficiency Measures and Solar PV Installations – Phase 2, Littlehampton

	Emissions (kgCO ₂ /year)
Baseline	190,555
Reduction from energy efficiency measures	(2,858)
Reduction from 37 kWp solar PV output	(16,280)
Total reduction	19,138
Emissions after reductions	171,417
Overall percentage reduction from baseline	10.04%

3.0 Conclusion

- 3.1 This Energy Statement has set out the Client's detailed energy strategy pertaining to Phase 2 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 37 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 Client's proposed approach will deliver a **10.04%** 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.

Appendix

PV Location Plan

Example SAP calculations:

Plot 58 (Hanbury)
Plot 63 (Alnwick)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



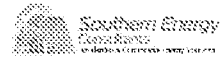
Property Reference	SECLIT058				Issued on Date	29/09/2017
Survey Reference	001	Prop Type Ref	Hanbury			
Property	Plot 58, Littlehampton, Phase 2, Littlehampton, West Sussex, BN17					
SAP Rating	92 A	DER	8.23	TER	19.17	
Environmental	94 A	% DER<TER	57.06			
CO ₂ Emissions (t/year)	0.25	DFEE	51.44	TREE	53.32	
General Requirements Compliance	Pass	% DFEE<TFEE	3.52			
Surveyor	Stephen Smith, Tel: 01635 261582				Surveyor ID	D168-0001
Client	Persimmon Homes South East					

SAP2012 - 9.92 input data (DesignData) -

SAP2012 Input Data (House)	29/09/2017
FullRefNo:	001
Regs Region:	England
SAP Region:	South East England
Postcode:	BN17
DwellingOrientation:	South
Property Type:	House, Semi-Detached
Storeys:	2
Date Built:	2015
Sheltered Sides:	2
Sunlight Shade:	Average or unknown
Measurements	Perimeter, Floor Area, Storey Height
1st Storey:	17.63, 36.41, 2.33
2nd Storey:	16.73, 34.31, 2.57
Living Area:	14.94 m2, fraction: 21.1%
Thermal Mass:	Simple calculation
Thermal Mass Simple:	Low
Thermal MassValue:	100
External Walls	Nett Area, Gross Area, Kappa, Element, Construction, Type, ShelterFactor, UValueFinal
External Wall 1	68.68, 84.07, 0, Other, Cavity, 0, 0.28, Calculate
Party Walls	Area, Kappa, Element, Construction, Type, ShelterFactor, UValueFinal
Party Wall 1	37.26, 0, Other, FilledWithEdge, 0, 0
External Roofs	Nett Area, Gross Area, Kappa, Construction, Element, UValueFinal
External Roof 1	36.41, 36.41, 9, Plasterboard, insulated at ceiling level, 0.14
Heat Loss Floors	Area, Kappa, Construction, Element, Type, ShelterFactor, UValueFinal
Heat Loss Floor 1	36.41, 0, Other, Ground Floor - Solid, 0, 0.18
Description	Data Source, Type, Glazing, Glazing Gap, Argon Filled, Solar Trans, Frame Type, Frame Factor, U Value
Opening Type 1	Manufacturer, Solid Door, , , , , , ,
Opening Type 2	BPRC data, Window, Double Low-E Hard 0.15, , , 0.45, , ,
Openings	Opening Type, Location, Orientation, Pitch, Curtain Type, Overhang Ratio, Wide Overhang, Width, Height, Count, Area, Curtain Closed
Opening 1	Solid Door, External Wall 1, South, , , , 0, 0, 0, 1.95,
Opening 2	Window, External Wall 1, South, , None, 0, , 0, 0, 0, 1.03,
Opening 3	Window, External Wall 1, South, , None, 0, , 0, 0, 0, 1.44,
Opening 4	Window, External Wall 1, South, , None, 0, , 0, 0, 0, 2.39,
Opening 5	Window, External Wall 1, North, , None, 0, , 0, 0, 0, 2.88,
Opening 6	Window, External Wall 1, North, , None, 0, , 0, 0, 0, 1.26,
Opening 7	Window, External Wall 1, North, , None, 0, , 0, 0, 0, 3.78,
Opening 8	Window, External Wall 1, East, , None, 0, , 0, 0, 0, 0.66,
Conservatory:	None
Draught Proofing:	100
Draught Lobby:	No
Thermal Bridges	
Bridging:	Calculate Bridges
Y	0.068
List of Bridges	Junction with, Bridge Type, Source Type, Imported, Length, Psi, Adjusted, Result, Reference
0.	External wall, E1 Steel lintel with perforated steel base plate, , No, 0, 0, 0, 0.00,
1.	External wall, E2 Other lintels (including other steel lintels), Independently assessed, Yes, 10.91, 0.179, 0.179, 1.95, Space4
2.	External wall, E3 Sill, Table K1 - Approved, Yes, 9.98, 0.04, 0.04, 0.40, ACD
3.	External wall, E4 Jamb, Table K1 - Approved, Yes, 26.7, 0.05, 0.05, 1.34, ACD
4.	External wall, E5 Ground floor (normal), Independently assessed, Yes, 17.63, 0.081, 0.081, 1.43, Space4
5.	External wall, E19 Ground floor (inverted), , No, 0, 0, 0, 0.00,
6.	External wall, E20 Exposed floor (normal), , No, 0, 0, 0, 0.00,
7.	External wall, E21 Exposed floor (inverted), , No, 0, 0, 0, 0.00,
8.	External wall, E22 Basement floor, , No, 0, 0, 0, 0.00,
9.	External wall, E6 Intermediate floor within a dwelling, Table K1 - Approved, Yes, 16.73, 0.07, 0.07, 1.17, ACD
10.	External wall, E7 Party floor between dwellings (in blocks of flats), , No, 0, 0, 0, 0.00,
11.	External wall, E8 Balcony within a dwelling, wall insulation continuous, , No, 0, 0, 0, 0.00,
12.	External wall, E9 Balcony between dwellings, wall insulation continuous, , No, 0, 0, 0, 0.00,
13.	External wall, E23 Balcony within or between dwellings, balcony support penetrates wall insulation, , No, 0, 0, 0, 0.00,
14.	External wall, E10 Eaves (insulation at ceiling level), Independently assessed, No, 9.47, 0.026, 0.026, 0.25, Space4
15.	External wall, E24 Eaves (insulation at ceiling level - inverted), , No, 0, 0, 0, 0.00,
16.	External wall, E11 Eaves (insulation at rafter level), , No, 0, 0, 0, 0.00,
17.	External wall, E12 Gable (insulation at ceiling level), Independently assessed, No, 7.26, 0.07, 0.07, 0.51, Space4
18.	External wall, E13 Gable (insulation at rafter level), , No, 0, 0, 0, 0.00,
19.	External wall, E14 Flat roof, , No, 0, 0, 0, 0.00,
20.	External wall, E15 Flat roof with parapet, , No, 0, 0, 0, 0.00,
21.	External wall, E16 Corner (normal), Independently assessed, Yes, 9.8, 0.055, 0.055, 0.54, Space4
22.	External wall, E17 Corner (inverted - internal area greater than external area), , No, 0, 0, 0, 0.00,
23.	External wall, E18 Party wall between dwellings, Independently assessed, Yes, 9.8, 0.037, 0.037, 0.36, Space4
24.	External wall, E25 Staggered party wall between dwellings, , No, 0, 0, 0, 0.00,
25.	Party wall, P1 Party wall - Ground floor, Independently assessed, No, 8.16, 0.113, 0.113, 0.92, Space4
26.	Party wall, P6 Party wall - Ground floor (inverted), , No, 0, 0, 0, 0.00,
27.	Party wall, P2 Party wall - Intermediate floor within a dwelling, Independently assessed, No, 7.26, 0.001, 0.001, 0.01, Space4
28.	Party wall, P3 Party wall - Intermediate floor between dwellings (in blocks of flats), , No, 0, 0, 0, 0.00,
29.	Party wall, P7 Party Wall - Exposed floor (normal), , No, 0, 0, 0, 0.00,
30.	Party wall, P8 Party Wall - Exposed floor (inverted), , No, 0, 0, 0, 0.00,
31.	Party wall, P4 Party wall - Roof (insulation at ceiling level), Table K1 - Default, No, 7.26, 0.24, 0.24, 1.74, Default
32.	Party wall, P5 Party wall - Roof (insulation at rafter level), , No, 0, 0, 0, 0.00,

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



SAP2012 - 9.92 input data (DesignData) -

33.	External roof, R1 Head of roof window, , No, 0, 0, 0, 0.00,
34.	External roof, R2 Sill of roof window, , No, 0, 0, 0, 0.00,
35.	External roof, R3 Jamb of roof window, , No, 0, 0, 0, 0.00,
36.	External roof, R4 Ridge (vaulted ceiling), , No, 0, 0, 0, 0.00,
37.	External roof, R5 Ridge (inverted), , No, 0, 0, 0, 0.00,
38.	External roof, R6 Flat ceiling, , No, 0, 0, 0, 0.00,
39.	External roof, R7 Flat ceiling (inverted), , No, 0, 0, 0, 0.00,
40.	External roof, R8 Roof to wall (rafter), , No, 0, 0, 0, 0.00,
41.	External roof, R9 Roof to wall (flat ceiling), , No, 0, 0, 0, 0.00,
Pressure Test:	True
Designed q50:	5
AsBuilt q50:	15
Property Tested:	False
Mechanical Ventilation	None
Chimneys MHS:	0
Chimneys SHS:	0
Chimneys Other:	0
Chimneys Total:	0
Open Flues MHS:	0
Open Flues SHS:	0
Open Flues Other:	0
Open Flues Total:	0
Intermittent Fans:	3
Passive Vents:	0
Flueless Gas Fires:	0
Cooling System	None
Light Fittings:	20
LEL Fittings:	20
Percentage of LEL Fittings:	100
External Lights Fitted:	Yes
External LELs Fitted:	Yes
Electricity Tariff:	Standard
Main Heating 1	
Description	
Percentage	100
Sedbuk ID	17929
Fuel Type	Mains gas
MHS	Mains gas BGW Post 98 Combi condens. with auto ign.
SAP Code	104
Boiler Efficiency Type	Split Efficiencies
Efficiency Winter	90.5
Efficiency Summer	87.3
Controls by PCDF	0
MHS Controls	CBI Time and temperature zone control
Boiler Interlock	Yes
Compensator	0
Delayed Start Stat	Yes
Ctrl SAP Code	2110
Flue Type	Balanced
Fan Assisted Flue	Yes
Pumped	Pump in heated space
Heat Pump Age	2013 or later
Heat Emitter	Radiators
Flow Temperature	Normal (> 45°C)
Combi boiler type	Standard Combi
Combi keep hot type	None
Main Heating 2	None
Heating Systems Interaction	Each system heats separate parts of dwelling
Smoke Control Area	Unknown
Community Heating	None
Secondary Heating	None
Water Heating	
Type	MainHeating1
WHS	HWP From main heating 1
Low Water Usage	Yes
SAP Code	901
Showers in Property	Non-electric only
Hot Water Cylinder	None
Flue Gas Heat Recovery System	None
Waste Water Heat Recovery	none
PV Unit	
Type	One Dwelling
PVUnit 1	Cells Peak = 2, Orientation = South, Elevation = 30°, Overshading = Modest, , Connected to Dwelling = Yes
Wind Turbine	None
Terrain Type:	Urban
Small Scale Hydro	None
Special Features	None

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

DWELLING AS DESIGNED

Semi-Detached House, total floor area 71 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) 19.17 kgCO₂/m²
Dwelling Carbon Dioxide Emission Rate (DER) 8.23 kgCO₂/m²OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)53.3 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)51.4 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest
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Regs Region: England

Elmhurst Energy Systems

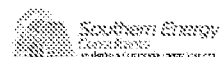
SAP2012 Calculator (Design

System) version 4.04r08



FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



SAP2012 - 9.92 input data (DesignData) -

External wall	0.28 (max. 0.30)	0.28 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)		OK
Floor	0.18 (max. 0.25)	0.18 (max. 0.70)	OK
Roof	0.14 (max. 0.20)	0.14 (max. 0.35)	OK
Openings	1.39 (max. 2.00)	1.40 (max. 3.30)	OK

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

3 Air permeability			
Air permeability at 50 pascals:	5.00 (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 ESPl 35			
Combi boiler			
Efficiency: 89.6% SEDBUK2009			
Minimum: 88.0%	OK		

Secondary heating system:	None		

5 Cylinder insulation			
Hot water storage	No cylinder		

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

Hot water controls:	No cylinder		

Boiler interlock	Yes		OK

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

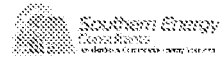
8 Mechanical ventilation			
Not applicable			

9 Summertime temperature			
Overheating risk (South East England):	Slight		OK
Based on:			
Overshading:	Average		
Windows facing North:	7.92 m ² , No overhang		
Windows facing East:	0.66 m ² , No overhang		
Windows facing South:	4.86 m ² , No overhang		
Air change rate:	3.00 ach		
Blinds/curtains:	None		

10 Key features			
Party wall U-value	0.00 W/m ² K		
Photovoltaic array			

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	36.4100 (1b)	x 2.3300 (2b)	= 84.8353 (1b) - (3b)
First floor	34.3100 (1c)	x 2.5700 (2c)	= 88.1767 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	70.7200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 173.0120 (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) = 0.1734 (8)
Pressure test					Yes
Measured/design q50					5.0000
Infiltration rate					0.4234 (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) =	0.3599 (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	0.4589	0.4499	0.4409	0.3959	0.3869	0.3419	0.3419	0.3329	0.3599	0.3869	0.4049	0.4229 (22b)
Effective ac	0.6053	0.6012	0.5972	0.5784	0.5748	0.5584	0.5584	0.5554	0.5648	0.5748	0.5820	0.5894 (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			1.9500	1.3000	2.5350		(26)					
Opening Type 2 (Uw = 1.40)			13.4400	1.3258	17.8182		(27)					
Heat Loss Floor 1			36.4100	0.1800	6.5538		(28a)					
External Wall 1	84.0700	15.3900	68.6800	0.2800	19.2304		(29a)					
External Roof 1	36.4100		36.4100	0.1400	5.0974		(30)					
Total net area of external elements Aum(A, m2)			156.8900				(31)					
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		51.2348		(33)					
Party Wall 1			37.2600	0.0000	0.0000		(32)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							100.0000 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.6140 (36)					
Total fabric heat loss						(33) + (36) =	61.8488 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 34.5576	Feb 34.3242	Mar 34.0954	Apr 33.0208	May 32.8198	Jun 31.8839	Jul 31.8839	Aug 31.7106	Sep 32.2444	Oct 32.8198	Nov 33.2265	Dec 33.6517 (38)
Heat transfer coeff	96.4063	96.1729	95.9442	94.8696	94.6685	93.7326	93.7326	93.5593	94.0931	94.6685	95.0753	95.5005 (39)
Average = Sum(39)m / 12 =												94.8686 (39)
HLP	Jan 1.3632	Feb 1.3599	Mar 1.3567	Apr 1.3415	May 1.3386	Jun 1.3254	Jul 1.3254	Aug 1.3230	Sep 1.3305	Oct 1.3386	Nov 1.3444	Dec 1.3504 (40)
HLP (average)												1.3415 (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												2.2635 (42)
Average daily hot water use (litres/day)												87.9576 (43)
Daily hot water use	Jan 96.7533	Feb 93.2350	Mar 89.7167	Apr 86.1984	May 82.6801	Jun 79.1618	Jul 79.1618	Aug 82.6801	Sep 86.1984	Oct 89.7167	Nov 93.2350	Dec 96.7533 (44)
Energy conte	143.4824	125.4906	129.4951	112.8970	108.3273	93.4782	86.6213	99.3992	100.5864	117.2237	127.9589	138.9551 (45)
Energy content (annual)												Total = Sum(45)m = 1383.9153 (45)
Distribution loss (46)m = 0.15 x (45)m	21.5224	18.8236	19.4243	16.9345	16.2491	14.0217	12.9932	14.9099	15.0880	17.5836	19.1938	20.8433 (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)

Regs Region: England

Elmhurst Energy Systems

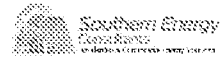
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System) version 4.04r08



FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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	14.0897	12.7061	14.0354	13.5464	13.9715	13.4904	13.9211	13.9538	13.5209	14.0090	13.5991	14.0792 (61)
Total heat required for water heating calculated for each month	157.5721	138.1967	143.5305	126.4433	122.2988	106.9686	100.5425	113.3530	114.1073	131.2327	141.5580	153.0343 (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	157.5721	138.1967	143.5305	126.4433	122.2988	106.9686	100.5425	113.3530	114.1073	131.2327	141.5580	153.0343 (64)
Heat gains from water heating, kWh/month	51.2303	44.9022	46.5660	40.9248	39.5117	34.4541	32.2819	36.5387	36.8252	42.4791	45.9461	49.7224 (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	113.1739	113.1739	113.1739	113.1739	113.1739	113.1739	113.1739	113.1739	113.1739	113.1739	113.1739	113.1739 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	17.9729	15.9634	12.9823	9.8284	7.3469	6.2025	6.7021	8.7116	11.6927	14.8465	17.3281	18.4724 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	198.9716	201.0363	195.8333	184.7568	170.7747	157.6334	148.8543	146.7896	151.9926	163.0691	177.0512	190.1925 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.3174	34.3174	34.3174	34.3174	34.3174	34.3174	34.3174	34.3174	34.3174	34.3174	34.3174	34.3174 (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)	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391 (71)
Water heating gains (Table 5)	68.8580	66.8187	62.5887	56.8400	53.1071	47.8529	43.3896	49.1112	51.1461	57.0956	63.8140	66.8311 (72)
Total internal gains	345.7547	343.7705	331.3565	311.3774	291.1808	271.6411	258.8981	264.5645	274.7835	294.9634	318.1455	335.4482 (73)

6. Solar gains

[Jan]						Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North						7.9200	10.6334	0.4500	0.0000	0.7700	29.1810 (74)	
East						0.6600	19.6403	0.4500	0.0000	0.7700	4.4915 (76)	
South						4.8600	46.7521	0.4500	0.0000	0.7700	78.7300 (78)	
Solar gains	112.4025	193.4923	273.4767	358.9472	424.3458	432.1392	412.0302	360.8813	302.3366	215.8817	134.9208	96.0503 (83)
Total gains	458.1572	537.2628	604.8331	670.3246	715.5266	703.7803	670.9284	625.4458	577.1201	510.8451	453.0664	431.4985 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Thl (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	20.3767	20.4262	20.4749	20.7068	20.7508	20.9580	20.9580	20.9968	20.8777	20.7508	20.6620	20.5700
alpha	2.3584	2.3617	2.3650	2.3805	2.3834	2.3972	2.3972	2.3998	2.3918	2.3834	2.3775	2.3713
util living area	0.9625	0.9448	0.9161	0.8620	0.7734	0.6475	0.5235	0.5665	0.7455	0.8870	0.9470	0.9671 (86)
MIT	18.2500	18.5490	19.0265	19.6494	20.2246	20.6566	20.8542	20.8187	20.4792	19.7398	18.8876	18.1958 (87)
Th 2	19.7917	19.7942	19.7967	19.8085	19.8107	19.8210	19.8210	19.8229	19.8170	19.8107	19.8062	19.8016 (88)
util rest of house	0.9565	0.9360	0.9020	0.8372	0.7289	0.5703	0.4109	0.4562	0.6800	0.8615	0.9370	0.9618 (89)
MIT 2	16.1556	16.5880	17.2756	18.1649	18.9552	19.5140	19.7295	19.7009	19.3104	18.3108	17.0901	16.0824 (90)
Living area fraction	16.5981	17.0022	17.6455	18.4785	19.2234	19.7554	19.9671	19.9371	19.5573	18.6127	17.4698	16.5289 (92)
Temperature adjustment	16.4481	16.8522	17.4955	18.3285	19.0734	19.6054	19.8171	19.7871	19.4073	18.4627	17.3198	16.3789 (93)

8. Space heating requirement

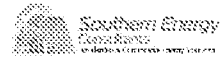
Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	426.3028	485.7961	523.0064	534.6104	497.7692	390.0478	275.4115	282.9461	376.6709	420.1248	410.4049	404.7019 (95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000 (96)
Heat loss rate W	1171.1509	1149.4821	1054.9519	894.4761	698.0277	469.1664	301.5484	316.8907	499.3816	744.3494	971.6506	1163.0914 (97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000 (97a)
Space heating kWh	554.1670	445.9970	395.7674	259.1033	148.9924	0.0000	0.0000	0.0000	0.0000	241.2231	404.0969	564.2418 (98)
Space heating												3013.5888 (98)
Space heating per m2												42.6130 (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													3329.9324 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	554.1670	445.9970	395.7674	259.1033	148.9924	0.0000	0.0000	0.0000	0.0000	241.2231	404.0969	564.2418	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	612.3393	492.8144	437.3120	286.3020	164.6324	0.0000	0.0000	0.0000	0.0000	266.5449	446.5159	623.4716	(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	157.5721	138.1967	143.5305	126.4433	122.2988	106.9686	100.5425	113.3530	114.1073	131.2327	141.5580	153.0343	(64)
Efficiency of water heater (217)m	89.7715	89.7220	89.6257	89.4250	89.0289	87.3000	87.3000	87.3000	87.3000	89.3461	89.6475	89.7977	(217)
Fuel for water heating, kWh/month	175.5258	154.0277	160.1444	141.3960	137.3699	122.5299	115.1689	129.8431	130.7071	146.8813	157.9051	170.4211	(219)
Water heating fuel used												1741.9203	(219)
Annual totals kWh/year													
Space heating fuel - main system												3329.9324	(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)												317.4070	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.00 * 1080 * 0.80) =										-1381.7915		-1381.7915	(233)
Total delivered energy for all uses												4082.4683	(238)

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

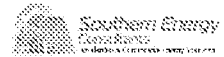
	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	3329.9324	0.2160	719.2654 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1741.9203	0.2160	376.2548 (264)
Space and water heating			1095.5202 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	317.4070	0.5190	164.7342 (268)
Energy saving/generation technologies			
PV Unit	-1381.7915	0.5190	-717.1498 (269)
Total CO2, kg/year			582.0296 (272)
Dwelling Carbon Dioxide Emission Rate (DER)			8.2300 (273)

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

DER			8.2300 ZC1
Total Floor Area		TFA	70.7200
Assumed number of occupants		N	2.2635
CO2 emission factor in Table 12 for electricity displaced from grid		EF	0.5190
CO2 emissions from appliances, equation (L14)			16.6723 ZC2
CO2 emissions from cooking, equation (L16)			2.4508 ZC3
Total CO2 emissions			27.3531 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			27.3531 ZC8

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF STANDARD ENE7 CO2 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF STANDARD ENE7 CO2 09 Jan 2014

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	36.4100 (1b)	x 2.3300 (2b)	= 84.8353 (1b) - (3b)
First floor	34.3100 (1c)	x 2.5700 (2c)	= 88.1767 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	70.7200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 173.0120 (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) = 0.1734 (8)
Pressure test					Yes
Measured/design q50					5.0000
Infiltration rate					0.4234 (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) =	0.3599 (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	0.4589	0.4499	0.4409	0.3959	0.3869	0.3419	0.3419	0.3329	0.3599	0.3869	0.4049	0.4229 (22b)
Effective ac	0.6053	0.6012	0.5972	0.5784	0.5748	0.5584	0.5584	0.5554	0.5648	0.5748	0.5820	0.5894 (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			1.9500	1.3000	2.5350		(26)					
Opening Type 2 (Uw = 1.40)			13.4400	1.3258	17.8182		(27)					
Heat Loss Floor 1			36.4100	0.1800	6.5538		(28a)					
External Wall 1	84.0700	15.3900	68.6800	0.2800	19.2304		(29a)					
External Roof 1	36.4100		36.4100	0.1400	5.0974		(30)					
Total net area of external elements Aum(A, m2)			156.8900				(31)					
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	51.2348		(33)					
Party Wall 1			37.2600	0.0000	0.0000		(32)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							100.0000 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.6140 (36)					
Total fabric heat loss						(33) + (36) =	61.8488 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 34.5576	Feb 34.3242	Mar 34.0954	Apr 33.0208	May 32.8198	Jun 31.8839	Jul 31.8839	Aug 31.7106	Sep 32.2444	Oct 32.8198	Nov 33.2265	Dec 33.6517 (38)
Heat transfer coeff	96.4063	96.1729	95.9442	94.8696	94.6685	93.7326	93.7326	93.5593	94.0931	94.6685	95.0753	95.5005 (39)
Average = Sum(39)m / 12 =												94.8686 (39)
HLP	Jan 1.3632	Feb 1.3599	Mar 1.3567	Apr 1.3415	May 1.3386	Jun 1.3254	Jul 1.3254	Aug 1.3230	Sep 1.3305	Oct 1.3386	Nov 1.3444	Dec 1.3504 (40)
HLP (average)												1.3415 (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												2.2635 (42)
Average daily hot water use (litres/day)												87.9576 (43)
Daily hot water use	Jan 96.7533	Feb 93.2350	Mar 89.7167	Apr 86.1984	May 82.6801	Jun 79.1618	Jul 79.1618	Aug 82.6801	Sep 86.1984	Oct 89.7167	Nov 93.2350	Dec 96.7533 (44)
Energy conte	143.4824	125.4906	129.4951	112.8970	108.3273	93.4782	86.6213	99.3992	100.5864	117.2237	127.9589	138.9551 (45)
Energy content (annual)										Total = Sum(45)m =		1383.9153 (45)
Distribution loss (46)m = 0.15 x (45)m	21.5224	18.8236	19.4243	16.9345	16.2491	14.0217	12.9932	14.9099	15.0880	17.5836	19.1938	20.8433 (46)
Water storage loss:												150.0000 (47)
Store volume												
b) If manufacturer declared loss factor is not known :												

Regs Region: England

Elmhurst Energy Systems

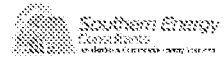
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FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF STANDARD ENE7 CO2 09 Jan 2014

Hot water storage loss factor from Table 2 (kWh/litre/day)													0.0191 (51)
Volume factor from Table 2a													0.9283 (52)
Temperature factor from Table 2b													0.5400 (53)
Enter (49) or (54) in (55)													1.4364 (55)
Total storage loss	44.5282	40.2190	44.5282	43.0918	44.5282	43.0918	44.5282	44.5282	43.0918	44.5282	43.0918	44.5282	(56)
If cylinder contains dedicated solar storage	44.5282	40.2190	44.5282	43.0918	44.5282	43.0918	44.5282	44.5282	43.0918	44.5282	43.0918	44.5282	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month	211.2730	186.7208	197.2857	178.5008	176.1179	159.0820	154.4119	167.1898	166.1902	185.0143	193.5627	206.7456	(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 =													(63)
Output from w/h	211.2730	186.7208	197.2857	178.5008	176.1179	159.0820	154.4119	167.1898	166.1902	185.0143	193.5627	206.7456	(64)
Heat gains from water heating, kWh/month	101.9404	90.7098	97.2896	90.0213	90.2513	83.5646	83.0341	87.2827	85.9280	93.2094	95.0294	100.4350	(65)
Total per year (kWh/year) = Sum(64)m =													(64)

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

Metabolic gains (Table 5), Watts													
(66)m	113.1739	113.1739	113.1739	113.1739	113.1739	113.1739	113.1739	113.1739	113.1739	113.1739	113.1739	113.1739	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	17.9729	15.9634	12.9823	9.8284	7.3469	6.2025	6.7021	8.7116	11.6927	14.8465	17.3281	18.4724	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	198.9716	201.0363	195.8333	184.7568	170.7747	157.6334	148.8543	146.7896	151.9926	163.0691	177.0512	190.1925	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.3174	34.3174	34.3174	34.3174	34.3174	34.3174	34.3174	34.3174	34.3174	34.3174	34.3174	34.3174	(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)	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	(71)
Water heating gains (Table 5)	137.0166	134.9848	130.7656	125.0296	121.3055	116.0619	111.6049	117.3155	119.3445	125.2814	131.9852	134.9933	(72)
Total internal gains	413.9133	411.9367	399.5334	379.5669	359.3792	339.8500	327.1134	332.7688	342.9818	363.1492	386.3167	403.6104	(73)

6. Solar gains

[Jan]														
	Area m2				Solar flux Table 6a W/m2		g Specific data or Table 6b		FF Specific data or Table 6c		Access factor Table 6d		Gains W	
North	7.9200				10.6334		0.4500		0.0000		0.7700		29.1810 (74)	
East	0.6600				19.6403		0.4500		0.0000		0.7700		4.4915 (76)	
South	4.8600				46.7521		0.4500		0.0000		0.7700		78.7300 (78)	
Solar gains	112.4025	193.4923	273.4767	358.9472	424.3458	432.1392	412.0302	360.8813	302.3366	215.8817	134.9208	96.0503	(83)	
Total gains	526.3159	605.4289	673.0100	738.5142	783.7250	771.9892	739.1437	693.6501	645.3184	579.0309	521.2376	499.6607	(84)	

7. Mean internal temperature (heating season)

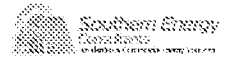
Temperature during heating periods in the living area from Table 9, Thl (C)													21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
tau	20.3767	20.4262	20.4749	20.7068	20.7508	20.9580	20.9580	20.9968	20.8777	20.7508	20.6620	20.5700	
alpha	2.3584	2.3617	2.3650	2.3805	2.3834	2.3972	2.3972	2.3998	2.3918	2.3834	2.3775	2.3713	
util living area	0.9507	0.9308	0.8985	0.8389	0.7442	0.6126	0.4873	0.5271	0.7073	0.8606	0.9307	0.9558	(86)
MIT	18.3896	18.6806	19.1459	19.7483	20.2953	20.6977	20.8757	20.8457	20.5416	19.8471	19.0203	18.3382	(87)
Th 2	19.7917	19.7942	19.7967	19.8085	19.8107	19.8210	19.8210	19.8229	19.8170	19.8107	19.8062	19.8016	(88)
util rest of house	0.9429	0.9200	0.8822	0.8115	0.6972	0.5351	0.3788	0.4198	0.6387	0.8311	0.9181	0.9489	(89)
MIT 2	17.4457	17.7327	18.1889	18.7765	19.2856	19.6393	19.7688	19.7536	19.5181	18.8842	18.0797	17.4019	(90)
Living area fraction	17.6451	17.9329	18.3911	18.9818	19.4989	19.8629	20.0026	19.9843	19.7343	19.0876	18.2784	17.5997	(91)
MIT	17.6451	17.9329	18.3911	18.9818	19.4989	19.8629	20.0026	19.9843	19.7343	19.0876	18.2784	17.5997	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.6451	17.9329	18.3911	18.9818	19.4989	19.8629	20.0026	19.9843	19.7343	19.0876	18.2784	17.5997	(93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	486.5603	543.9830	577.6493	582.4932	535.3942	415.4319	293.2825	302.2734	408.6579	468.4409	467.5782	465.4792	(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	1286.5562	1253.4149	1140.8775	956.4554	738.3143	493.3057	318.9352	335.3453	530.1476	803.5071	1062.7875	1279.6796	(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	595.1970	476.7382	419.0417	269.2528	150.9726	0.0000	0.0000	0.0000	0.0000	249.2892	428.5507	605.7651	(98)
Space heating													(98)
Space heating per m2													(98) / (4) =

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF STANDARD ENE7 CO2 09 Jan 2014

8c. Space cooling requirement

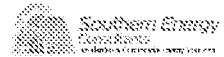
Not applicable

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

DER	11.7300	ZC1
Total Floor Area	70.7200	
Assumed number of occupants	N	2.2635
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190
CO2 emissions from appliances, equation (L14)		16.6723 ZC2
CO2 emissions from cooking, equation (L16)		2.4508 ZC3
Total CO2 emissions		30.8531 ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000 ZC5
Additional allowable electricity generation, kWh/m ² /year		0.0000 ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000 ZC7
Net CO2 emissions		30.8531 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	36.4100 (1b)	x 2.3300 (2b)	= 84.8353 (1b) - (3b)
First floor	34.3100 (1c)	x 2.5700 (2c)	= 88.1767 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	70.7200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 173.0120 (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) =	0.1734 (8)
Pressure test											Yes	
Measured/design q50												5.0000
Infiltration rate												0.4234 (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) =	0.3599 (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	0.4589	0.4499	0.4409	0.3959	0.3869	0.3419	0.3419	0.3329	0.3599	0.3869	0.4049	0.4229 (22b)
Effective ac	0.6053	0.6012	0.5972	0.5784	0.5748	0.5584	0.5584	0.5554	0.5648	0.5748	0.5820	0.5894 (25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K					
TER Opaque door			1.9500	1.0000	1.9500		(26)					
TER Opening Type (Uw = 1.40)			13.4400	1.3258	17.8182		(27)					
Heat Loss Floor 1			36.4100	0.1300	4.7333		(28a)					
External Wall 1	84.0700	15.3900	68.6800	0.1800	12.3624		(29a)					
External Roof 1	36.4100		36.4100	0.1300	4.7333		(30)					
Total net area of external elements Aum(A, m2)			156.8900				(31)					
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	41.5972		(33)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							9.1981 (36)					
Total fabric heat loss						(33) + (36) =	50.7953 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 34.5576	Feb 34.3242	Mar 34.0954	Apr 33.0208	May 32.8198	Jun 31.8839	Jul 31.8839	Aug 31.7106	Sep 32.2444	Oct 32.8198	Nov 33.2265	Dec 33.6517 (38)
Heat transfer coeff	85.3528	85.1194	84.8907	83.8161	83.6151	82.6792	82.6792	82.5058	83.0397	83.6151	84.0218	84.4470 (39)
Average = Sum(39)m / 12 =												83.8152 (39)
HLP	Jan 1.2069	Feb 1.2036	Mar 1.2004	Apr 1.1852	May 1.1823	Jun 1.1691	Jul 1.1691	Aug 1.1667	Sep 1.1742	Oct 1.1823	Nov 1.1881	Dec 1.1941 (40)
HLP (average)												1.1852 (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												2.2635 (42)
Average daily hot water use (litres/day)												87.9576 (43)
Daily hot water use	Jan 96.7533	Feb 93.2350	Mar 89.7167	Apr 86.1984	May 82.6801	Jun 79.1618	Jul 79.1618	Aug 82.6801	Sep 86.1984	Oct 89.7167	Nov 93.2350	Dec 96.7533 (44)
Energy conte	143.4824	125.4906	129.4951	112.8970	108.3273	93.4782	86.6213	99.3992	100.5864	117.2237	127.9589	138.9551 (45)
Energy content (annual)										Total = Sum(45)m =		1383.9153 (45)
Distribution loss (46)m = 0.15 x (45)m												
Water storage loss:	21.5224	18.8236	19.4243	16.9345	16.2491	14.0217	12.9932	14.9099	15.0880	17.5836	19.1938	20.8433 (46)
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

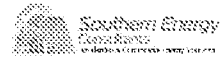
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FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	49.3044	42.9137	45.7187	42.5088	42.1329	39.0387	40.3400	42.1329	42.5088	45.7187	45.9789	49.3044 (61)
Total heat required for water heating calculated for each month												
	192.7869	168.4043	175.2138	155.4058	150.4602	132.5169	126.9613	141.5321	143.0952	162.9424	173.9378	188.2595 (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 =												
	192.7869	168.4043	175.2138	155.4058	150.4602	132.5169	126.9613	141.5321	143.0952	162.9424	173.9378	188.2595 (64)
Total per year (kWh/year) = Sum (64)m =												
	60.0340	52.4541	54.4868	48.1654	46.5521	40.8412	38.8866	43.5835	44.0722	50.4066	54.0411	58.5287 (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	113.1739	113.1739	113.1739	113.1739	113.1739	113.1739	113.1739	113.1739	113.1739	113.1739	113.1739	113.1739 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5												
	17.9729	15.9634	12.9823	9.8284	7.3469	6.2025	6.7021	8.7116	11.6927	14.8465	17.3281	18.4724 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5												
	198.9716	201.0363	195.8333	184.7568	170.7747	157.6334	148.8543	146.7896	151.9926	163.0691	177.0512	190.1925 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												
	34.3174	34.3174	34.3174	34.3174	34.3174	34.3174	34.3174	34.3174	34.3174	34.3174	34.3174	34.3174 (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)												
	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391 (71)
Water heating gains (Table 5)												
	80.6909	78.0566	73.2349	66.8964	62.5700	56.7239	52.2669	58.5799	61.2114	67.7508	75.0570	78.6676 (72)
Total internal gains												
	357.5876	355.0085	342.0027	321.4338	300.6437	280.5120	267.7754	274.0332	284.8487	305.6185	329.3885	347.2846 (73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W			
North				7.9200	10.6334	0.6300	0.7000	0.7700	25.7376 (74)			
East				0.6600	19.6403	0.6300	0.7000	0.7700	3.9615 (76)			
South				4.8600	46.7521	0.6300	0.7000	0.7700	69.4399 (78)			
Solar gains	99.1390	170.6602	241.2064	316.5914	374.2730	381.1468	363.4107	318.2973	266.6609	190.4077	119.0002	84.7164 (83)
Total gains	456.7266	525.6686	583.2091	638.0253	674.9166	661.6588	631.1861	592.3306	551.5096	496.0262	448.3887	432.0010 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Thl (C)												
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	57.5389	57.6967	57.8522	58.5939	58.7348	59.3996	59.3996	59.5244	59.1418	58.7348	58.4505	58.1561
alpha	4.8359	4.8464	4.8568	4.9063	4.9157	4.9600	4.9600	4.9683	4.9428	4.9157	4.8967	4.8771
util living area	0.9972	0.9940	0.9858	0.9592	0.8840	0.7279	0.5599	0.6136	0.8472	0.9718	0.9943	0.9979 (86)
MIT	19.7251	19.8849	20.1368	20.4693	20.7610	20.9371	20.9862	20.9787	20.8602	20.4883	20.0477	19.6989 (87)
Th 2	19.9145	19.9171	19.9197	19.9319	19.9342	19.9448	19.9448	19.9468	19.9407	19.9342	19.9295	19.9247 (88)
util rest of house	0.9963	0.9920	0.9807	0.9435	0.8391	0.6349	0.4340	0.4864	0.7742	0.9579	0.9920	0.9972 (89)
MIT 2	18.2248	18.4594	18.8264	19.3082	19.6979	19.9026	19.9397	19.9380	19.8283	19.3437	18.7065	18.1937 (90)
Living area fraction	18.5418	18.7605	19.1033	19.5535	19.9225	20.1211	20.1608	20.1579	20.0463	19.5855	18.9898	18.5117 (92)
MIT	18.5418	18.7605	19.1033	19.5535	19.9225	20.1211	20.1608	20.1579	20.0463	19.5855	18.9898	18.5117 (93)
Temperature adjustment												0.0000
adjusted MIT	18.5418	18.7605	19.1033	19.5535	19.9225	20.1211	20.1608	20.1579	20.0463	19.5855	18.9898	18.5117 (93)

8. Space heating requirement

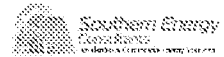
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9945	0.9889	0.9754	0.9364	0.8386	0.6518	0.4607	0.5132	0.7827	0.9517	0.9890	0.9957 (94)
Useful gains	454.2113	519.8226	568.8713	597.4429	565.9542	431.2669	290.7909	303.9922	431.6493	472.0787	443.4548	430.1585 (95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000 (96)
Heat loss rate W	1215.5749	1179.8008	1069.8984	892.9359	687.5269	456.4817	294.4047	310.0454	493.7795	751.3239	999.0048	1208.5766 (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	566.4545	443.5053	372.7642	212.7550	90.4501	0.0000	0.0000	0.0000	0.0000	207.7584	399.9960	579.1430 (98)
Space heating												2872.8266 (98)
Space heating per m2												(98) / (4) = 40.6225 (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

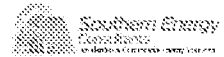
Fraction of space heat from secondary/supplementary system (Table 11)												0.0000 (201)
Fraction of space heat from main system(s)												1.0000 (202)
Efficiency of main space heating system 1 (in %)												93.4000 (206)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating requirement												3075.8315 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	566.4545	443.5053	372.7642	212.7550	90.4501	0.0000	0.0000	0.0000	0.0000	207.7584	399.9960	579.1430 (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)	606.4823	474.8451	399.1051	227.7890	96.8417	0.0000	0.0000	0.0000	0.0000	222.4394	428.2612	620.0675 (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	192.7869	168.4043	175.2138	155.4058	150.4602	132.5169	126.9613	141.5321	143.0952	162.9424	173.9378	188.2595 (64)
Efficiency of water heater	87.6022	87.3754	86.9049	85.8424	83.8159	80.3000	80.3000	80.3000	80.3000	85.6640	87.0806	80.3000 (216)
(217)m	87.6022	87.3754	86.9049	85.8424	83.8159	80.3000	80.3000	80.3000	80.3000	85.6640	87.0806	87.6941 (217)
Fuel for water heating, kWh/month	220.0708	192.7364	201.6154	181.0362	179.5128	165.0273	158.1088	176.2542	178.2007	190.2111	199.7434	214.6775 (219)
Water heating fuel used	220.0708	192.7364	201.6154	181.0362	179.5128	165.0273	158.1088	176.2542	178.2007	190.2111	199.7434	2257.1947 (219)
Annual totals kWh/year												2257.1947 (219)
Space heating fuel - main system												3075.8315 (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)												317.4070 (232)
Total delivered energy for all uses												5725.4332 (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	3075.8315	0.2160	664.3796 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2257.1947	0.2160	487.5541 (264)
Space and water heating			1151.9337 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	317.4070	0.5190	164.7342 (268)
Total CO2, kg/m2/year			1355.5929 (272)
Emissions per m2 for space and water heating			16.2887 (272a)
Fuel factor (mains gas)			1.0000
Emissions per m2 for lighting			2.3294 (272b)
Emissions per m2 for pumps and fans			0.5504 (272c)
Target Carbon Dioxide Emission Rate (TER) = (16.2887 * 1.00) + 2.3294 + 0.5504, rounded to 2 d.p.			19.1700 (273)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	36.4100 (1b)	x 2.3300 (2b)	= 84.8353 (1b) - (3b)
First floor	34.3100 (1c)	x 2.5700 (2c)	= 88.1767 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	70.7200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 173.0120 (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) = 0.1734 (8)
Pressure test					Yes
Measured/design q50					5.0000
Infiltration rate					0.4234 (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) =	0.3599 (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	0.4589	0.4499	0.4409	0.3959	0.3869	0.3419	0.3419	0.3329	0.3599	0.3869	0.4049	0.4229 (22b)
Effective ac	0.6053	0.6012	0.5972	0.5784	0.5748	0.5584	0.5584	0.5554	0.5648	0.5748	0.5820	0.5894 (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
Opening Type 1			1.9500	1.3000	2.5350		(26)
Opening Type 2 (Uw = 1.40)			13.4400	1.3258	17.8182		(27)
Heat Loss Floor 1			36.4100	0.1800	6.5538		(28a)
External Wall 1	84.0700	15.3900	68.6800	0.2800	19.2304		(29a)
External Roof 1	36.4100		36.4100	0.1400	5.0974		(30)
Total net area of external elements Aum(A, m ²)			156.8900				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	51.2348		(33)
Party Wall 1			37.2600	0.0000	0.0000		(32)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							100.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.6140 (36)
Total fabric heat loss						(33) + (36) =	61.8488 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heat transfer coeff	34.5576	34.3242	34.0954	33.0208	32.8198	31.8839	31.8839	31.7106	32.2444	32.8198	33.2265	33.6517 (38)
Average = Sum(39)m / 12 =	96.4063	96.1729	95.9442	94.8696	94.6685	93.7326	93.7326	93.5593	94.0931	94.6685	95.0753	95.5005 (39)
	94.8686 (39)											
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.3632	1.3599	1.3567	1.3415	1.3386	1.3254	1.3254	1.3230	1.3305	1.3386	1.3444	1.3504 (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												2.2635 (42)
Average daily hot water use (litres/day)												87.9576 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	96.7533	93.2350	89.7167	86.1984	82.6801	79.1618	79.1618	82.6801	86.1984	89.7167	93.2350	96.7533 (44)
Energy content (annual)	143.4824	125.4906	129.4951	112.8970	108.3273	93.4782	86.6213	99.3992	100.5864	117.2237	127.9589	138.9551 (45)
Distribution loss (46)m = 0.15 x (45)m												1383.9153 (45)
Water 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 (46)
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)

Regs Region: England

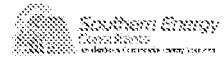
Elmhurst Energy Systems

SAP2012 Calculator (Design
System) version 4.04r08



FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (59)
Heat gains from water heating, kWh/month	30.4900	26.6668	27.5177	23.9906	23.0196	19.8641	18.4070	21.1223	21.3746	24.9100	27.1913	29.5279 (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	113.1739	113.1739	113.1739	113.1739	113.1739	113.1739	113.1739	113.1739	113.1739	113.1739	113.1739	113.1739	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	17.9729	15.9634	12.9823	9.8284	7.3469	6.2025	6.7021	8.7116	11.6927	14.8465	17.3281	18.4724	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	198.9716	201.0363	195.8333	184.7568	170.7747	157.6334	148.8543	146.7896	151.9926	163.0691	177.0512	190.1925	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.3174	34.3174	34.3174	34.3174	34.3174	34.3174	34.3174	34.3174	34.3174	34.3174	34.3174	34.3174	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	(71)
Water heating gains (Table 5)	40.9812	39.6827	36.9862	33.3203	30.9403	27.5891	24.7406	28.3902	29.6870	33.4812	37.7656	39.6881	(72)
Total internal gains	314.8779	313.6345	302.7540	284.8577	266.0140	248.3772	237.2491	240.8436	250.3243	268.3490	289.0971	305.3052	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
North	7.9200	10.6334	0.4500	0.0000	0.7700	29.1810 (74)
East	0.6600	19.6403	0.4500	0.0000	0.7700	4.4915 (76)
South	4.8600	46.7521	0.4500	0.0000	0.7700	78.7300 (78)

Solar gains	112.4025	193.4923	273.4767	358.9472	424.3458	432.1392	412.0302	360.8813	302.3366	215.8817	134.9208	96.0503 (83)
Total gains	427.2804	507.1268	576.2306	643.8049	690.3597	680.5164	649.2794	601.7249	552.6609	484.2307	424.0180	401.3555 (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	20.3767	20.4262	20.4749	20.7068	20.7508	20.9580	20.9580	20.9968	20.8777	20.7508	20.6620	20.5700	
alpha	2.3584	2.3617	2.3650	2.3805	2.3834	2.3972	2.3972	2.3998	2.3918	2.3834	2.3775	2.3713	
util living area	0.9675	0.9507	0.9232	0.8709	0.7844	0.6600	0.5359	0.5812	0.7596	0.8970	0.9535	0.9717	(86)
MIT	18.1850	18.4889	18.9744	19.6087	20.1964	20.6410	20.8464	20.8078	20.4544	19.6954	18.8290	18.1313	(87)
Th 2	19.7917	19.7942	19.7967	19.8085	19.8107	19.8210	19.8210	19.8229	19.8170	19.8107	19.8062	19.8016	(88)
util rest of house	0.9621	0.9426	0.9101	0.8472	0.7409	0.5831	0.4221	0.4701	0.6956	0.8732	0.9445	0.9670	(89)
MIT 2	17.2453	17.5467	18.0255	18.6489	19.2028	19.6006	19.7547	19.7339	19.4520	18.7457	17.8949	17.1988	(90)
Living area fraction									fLA = Living area / (4) =			0.2113	(91)
MIT	17.4438	17.7457	18.2260	18.8517	19.4127	19.8204	19.9853	19.9607	19.6638	18.9463	18.0922	17.3958	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.4438	17.7457	18.2260	18.8517	19.4127	19.8204	19.9853	19.9607	19.6638	18.9463	18.0922	17.3958	(93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	404.8899	468.6973	511.6727	530.3999	499.7578	396.7943	285.3498	291.5894	379.0395	412.1125	393.0369	382.8229	(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	1267.1502	1235.4101	1125.0402	944.1136	730.1521	489.3184	317.3164	333.1412	523.5164	790.1340	1045.0879	1260.2015	(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	641.5217	515.2310	456.3454	297.8738	171.4134	0.0000	0.0000	0.0000	0.0000	281.2480	469.4767	652.7697	(98)
Space heating												3485.8798	(98)
Space heating per m2												49.2913	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	881.0869	693.6216	711.0509	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7050	0.7702	0.7408	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	621.1978	534.2562	526.7742	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	879.5809	841.3740	787.1813	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	186.0358	228.4957	193.7429	0.0000	0.0000	0.0000	0.0000	(104)

Regs Region: England

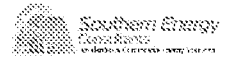
Elmhurst Energy Systems

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FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

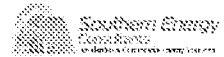


CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Space cooling											608.2744 (104)
Cooled fraction											1.0000 (105)
Intermittency factor (Table 10b)											
	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000 (106)
Space cooling kWh											
	0.0000	0.0000	0.0000	0.0000	46.5089	57.1239	48.4357	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling											152.0686 (107)
Space cooling per m2											2.1503 (108)
Energy for space heating											49.2913 (99)
Energy for space cooling											2.1503 (108)
Total											51.4416 (109)
Dwelling Fabric Energy Efficiency (DFEE)											51.4 (109)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	36.4100 (1b)	x 2.3300 (2b)	= 84.8353 (1b) - (3b)
First floor	34.3100 (1c)	x 2.5700 (2c)	= 88.1767 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	70.7200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 173.0120 (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) = 0.1734 (8)
Pressure test					Yes
Measured/design q50					5.0000
Infiltration rate					0.4234 (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) =	0.3599 (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	0.4589	0.4499	0.4409	0.3959	0.3869	0.3419	0.3419	0.3329	0.3599	0.3869	0.4049	0.4229 (22b)
Effective ac	0.6053	0.6012	0.5972	0.5784	0.5748	0.5584	0.5584	0.5554	0.5648	0.5748	0.5820	0.5894 (25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K					
TER Opaque door			1.9500	1.0000	1.9500		(26)					
TER Opening Type (Uw = 1.40)			13.4400	1.3258	17.8182		(27)					
Heat Loss Floor 1			36.4100	0.1300	4.7333		(28a)					
External Wall 1	84.0700	15.3900	68.6800	0.1800	12.3624		(29a)					
External Roof 1	36.4100		36.4100	0.1300	4.7333		(30)					
Total net area of external elements Aum(A, m2)			156.8900				(31)					
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	41.5972		(33)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							9.1981 (36)					
Total fabric heat loss						(33) + (36) =	50.7953 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 34.5576	Feb 34.3242	Mar 34.0954	Apr 33.0208	May 32.8198	Jun 31.8839	Jul 31.8839	Aug 31.7106	Sep 32.2444	Oct 32.8198	Nov 33.2265	Dec 33.6517 (38)
Heat transfer coeff	85.3528	85.1194	84.8907	83.8161	83.6151	82.6792	82.6792	82.5058	83.0397	83.6151	84.0218	84.4470 (39)
Average = Sum(39)m / 12 =												83.8152 (39)
HLP	Jan 1.2069	Feb 1.2036	Mar 1.2004	Apr 1.1852	May 1.1823	Jun 1.1691	Jul 1.1691	Aug 1.1667	Sep 1.1742	Oct 1.1823	Nov 1.1881	Dec 1.1941 (40)
HLP (average)												1.1852 (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												2.2635 (42)
Average daily hot water use (litres/day)												87.9576 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												
	96.7533	93.2350	89.7167	86.1984	82.6801	79.1618	79.1618	82.6801	86.1984	89.7167	93.2350	96.7533 (44)
Energy conte	143.4824	125.4906	129.4951	112.8970	108.3273	93.4782	86.6213	99.3992	100.5864	117.2237	127.9589	138.9551 (45)
Energy content (annual)												
Distribution loss (46)m = 0.15 x (45)m												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (46)
Water storage loss:												
Total storage loss												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage												

Regs Region: England

Elmhurst Energy Systems

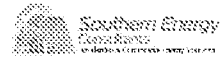
SAP2012 Calculator (Design

System) version 4.04r08



FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Heat gains from water heating, kWh/month	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (59)
	30.4900	26.6668	27.5177	23.9906	23.0196	19.8641	18.4070	21.1223	21.3746	24.9100	27.1913	29.5279 (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	113.1739	113.1739	113.1739	113.1739	113.1739	113.1739	113.1739	113.1739	113.1739	113.1739	113.1739	113.1739 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	17.9729	15.9634	12.9823	9.8284	7.3469	6.2025	6.7021	8.7116	11.6927	14.8465	17.3281	18.4724 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	198.9716	201.0363	195.8333	184.7568	170.7747	157.6334	148.8543	146.7896	151.9926	163.0691	177.0512	190.1925 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.3174	34.3174	34.3174	34.3174	34.3174	34.3174	34.3174	34.3174	34.3174	34.3174	34.3174	34.3174 (69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391 (71)
Water heating gains (Table 5)	40.9812	39.6827	36.9862	33.3203	30.9403	27.5891	24.7406	28.3902	29.6870	33.4812	37.7656	39.6881 (72)
Total internal gains	314.8779	313.6345	302.7540	284.8577	266.0140	248.3772	237.2491	240.8436	250.3243	268.3490	289.0971	305.3052 (73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
North	7.9200	10.6334	0.6300	0.7000	0.7700	25.7376 (74)
East	0.6600	19.6403	0.6300	0.7000	0.7700	3.9615 (76)
South	4.8600	46.7521	0.6300	0.7000	0.7700	69.4399 (78)

Solar gains	99.1390	170.6602	241.2064	316.5914	374.2730	381.1468	363.4107	318.2973	266.6609	190.4077	119.0002	84.7164 (83)
Total gains	414.0169	484.2947	543.9604	601.4491	640.2869	629.5240	600.6598	559.1409	516.9852	458.7567	408.0973	390.0215 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Thl (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	57.5389	57.6967	57.8522	58.5939	58.7348	59.3996	59.3996	59.5244	59.1418	58.7348	58.4505	58.1561
alpha	4.8359	4.8464	4.8568	4.9063	4.9157	4.9600	4.9600	4.9683	4.9428	4.9157	4.8967	4.8771
util living area	0.9982	0.9958	0.9893	0.9671	0.9006	0.7527	0.5847	0.6435	0.8714	0.9792	0.9962	0.9987 (86)
MIT	19.6697	19.8319	20.0884	20.4293	20.7346	20.9268	20.9834	20.9739	20.8381	20.4450	19.9959	19.6441 (87)
Th 2	19.9145	19.9171	19.9197	19.9319	19.9342	19.9448	19.9448	19.9468	19.9407	19.9342	19.9295	19.9247 (88)
util rest of house	0.9976	0.9944	0.9854	0.9540	0.8596	0.6608	0.4550	0.5131	0.8041	0.9684	0.9946	0.9982 (89)
MIT 2	18.7056	18.8693	19.1259	19.4689	19.7518	19.9105	19.9405	19.9392	19.8491	19.4903	19.0432	18.6882 (90)
Living area fraction									fLA = Living area / (4) =			0.2113 (91)
MIT	18.9093	19.0727	19.3293	19.6718	19.9595	20.1252	20.1608	20.1578	20.0580	19.6920	19.2445	18.8902 (92)
Temperature adjustment												0.0000
adjusted MIT	18.9093	19.0727	19.3293	19.6718	19.9595	20.1252	20.1608	20.1578	20.0580	19.6920	19.2445	18.8902 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	0.9968	0.9928	0.9825	0.9500	0.8608	0.6780	0.4828	0.5409	0.8129	0.9651	0.9932	0.9976 (94)
Ext temp.	412.6776	480.8008	534.4497	571.3524	551.1439	426.8432	289.9753	302.4374	420.2753	442.7596	405.3304	389.0735 (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	1246.9438	1206.3720	1089.0848	902.8491	690.6157	456.8198	294.4077	310.0394	494.7511	760.2244	1020.3998	1240.5391 (97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000 (97a)
Space heating kWh	620.6940	487.5839	412.6485	238.6776	103.7670	0.0000	0.0000	0.0000	0.0000	236.1938	442.8500	633.4904 (98)
Space heating												3175.9052 (98)
Space heating per m2										(98) / (4) =		44.9082 (99)

8c. Space cooling requirement

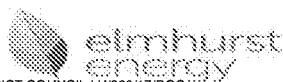
Calculated for June, July and August. See Table 10b	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	777.1842	611.8258	627.0445	0.0000	0.0000	0.0000	0.0000 (100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8537	0.9170	0.8921	0.0000	0.0000	0.0000	0.0000 (101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	663.4856	561.0513	559.4043	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	819.9793	784.5459	737.4078	0.0000	0.0000	0.0000	0.0000 (103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000 (103a)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	112.6754	166.2800	132.4346	0.0000	0.0000	0.0000	0.0000 (104)
Space cooling												411.3901 (104)

Regs Region: England

Elmhurst Energy Systems

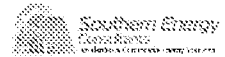
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System) version 4.04r08



FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

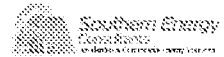


CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Cooled fraction											FC = cooled area / (4) =	1.0000 (105)
Intermittency factor (Table 10b)	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000 (106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	28.1689	41.5700	33.1087	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												102.8475 (107)
Space cooling per m2												1.4543 (108)
Energy for space heating												44.9082 (99)
Energy for space cooling												1.4543 (108)
Total												46.3625 (109)
Target Fabric Energy Efficiency (TFEE)												53.3 (109)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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 (m ²)	Storey height (m)	Volume (m ³)
Ground floor	36.4100 (1b)	x 2.3300 (2b)	= 84.8353 (1b) - (3b)
First floor	34.3100 (1c)	x 2.5700 (2c)	= 88.1767 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	70.7200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 173.0120 (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) = 0.1734 (8)
Pressure test					Yes
Measured/design q50					5.0000
Infiltration rate					0.4234 (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) =	0.3599 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.3000	4.8000	4.6000	4.3000	4.4000	4.1000	4.2000	4.0000	4.2000	4.6000	4.6000	4.9000 (22)
Wind factor	1.3250	1.2000	1.1500	1.0750	1.1000	1.0250	1.0500	1.0000	1.0500	1.1500	1.1500	1.2250 (22a)
Adj infilt rate	0.4769	0.4319	0.4139	0.3869	0.3959	0.3689	0.3779	0.3599	0.3779	0.4139	0.4139	0.4409 (22b)
Effective ac	0.6137	0.5933	0.5856	0.5748	0.5784	0.5680	0.5714	0.5648	0.5714	0.5856	0.5856	0.5972 (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			1.9500	1.3000	2.5350		(26)					
Opening Type 2 (Uw = 1.40)			13.4400	1.3258	17.8182		(27)					
Heat Loss Floor 1			36.4100	0.1800	6.5538		(28a)					
External Wall 1	84.0700	15.3900	68.6800	0.2800	19.2304		(29a)					
External Roof 1	36.4100		36.4100	0.1400	5.0974		(30)					
Total net area of external elements Aum(A, m2)			156.8900				(31)					
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	51.2348		(33)					
Party Wall 1			37.2600	0.0000	0.0000		(32)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							100.0000 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.6140 (36)					
Total fabric heat loss						(33) + (36) =	61.8488 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 35.0382	Feb 33.8712	Mar 33.4368	Apr 32.8198	May 33.0208	Jun 32.4316	Jul 32.6234	Aug 32.2444	Sep 32.6234	Oct 33.4368	Nov 33.4368	Dec 34.0954 (38)
Heat transfer coeff	96.8870	95.7200	95.2856	94.6685	94.8696	94.2803	94.4721	94.0931	94.4721	95.2856	95.2856	95.9442 (39)
Average = Sum(39)m / 12 =												95.1053 (39)
HLP	Jan 1.3700	Feb 1.3535	Mar 1.3474	Apr 1.3386	May 1.3415	Jun 1.3331	Jul 1.3359	Aug 1.3305	Sep 1.3359	Oct 1.3474	Nov 1.3474	Dec 1.3567 (40)
HLP (average)												1.3448 (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												2.2635 (42)
Average daily hot water use (litres/day)												87.9576 (43)
Daily hot water use	Jan 96.7533	Feb 93.2350	Mar 89.7167	Apr 86.1984	May 82.6801	Jun 79.1618	Jul 79.1618	Aug 82.6801	Sep 86.1984	Oct 89.7167	Nov 93.2350	Dec 96.7533 (44)
Energy conte	143.4824	125.4906	129.4951	112.8970	108.3273	93.4782	86.6213	99.3992	100.5864	117.2237	127.9589	138.9551 (45)
Energy content (annual)												Total = Sum(45)m = 1383.9153 (45)
Distribution loss (46)m = 0.15 x (45)m	21.5224	18.8236	19.4243	16.9345	16.2491	14.0217	12.9932	14.9099	15.0880	17.5836	19.1938	20.8433 (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)

Regs Region: England

Elmhurst Energy Systems

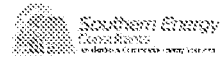
SAP2012 Calculator (Design

System) version 4.04r08



FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF HEAT DEMAND 09 Jan 2014

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	14.0897	12.7061	14.0354	13.5464	13.9715	13.4904	13.9211	13.9538	13.5209	14.0090	13.5991	14.0792 (61)
Total heat required for water heating calculated for each month	157.5721	138.1967	143.5305	126.4433	122.2988	106.9686	100.5425	113.3530	114.1073	131.2327	141.5580	153.0343 (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	157.5721	138.1967	143.5305	126.4433	122.2988	106.9686	100.5425	113.3530	114.1073	131.2327	141.5580	153.0343 (64)
RHI water heating demand	51.2303	44.9022	46.5660	40.9248	39.5117	34.4541	32.2819	36.5387	36.8252	42.4791	45.9461	49.7224 (65)
Heat gains from water heating, kWh/month												1549 (64)
												1549 (64)

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	135.8086	135.8086	135.8086	135.8086	135.8086	135.8086	135.8086	135.8086	135.8086	135.8086	135.8086	135.8086	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	44.9322	39.9084	32.4557	24.5711	18.3672	15.5063	16.7551	21.7790	29.2317	37.1163	43.3202	46.1811	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	296.9726	300.0542	292.2886	275.7564	254.8876	235.2738	222.1706	219.0889	226.8546	243.3867	264.2556	283.8694	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	50.8443	50.8443	50.8443	50.8443	50.8443	50.8443	50.8443	50.8443	50.8443	50.8443	50.8443	50.8443	(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)	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	(71)
Water heating gains (Table 5)	68.8580	66.8187	62.5887	56.8400	53.1071	47.8529	43.3896	49.1112	51.1461	57.0956	63.8140	66.8311	(72)
Total internal gains	509.8767	505.8952	486.4468	456.2814	425.4757	397.7469	381.4292	389.0929	406.3462	436.7125	470.5037	495.9954	(73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2		g Specific data or Table 6b		FF Specific data or Table 6c		Access factor Table 6d		Gains W
North				7.9200	14.2444		0.4500		0.0000		0.7700		39.0906 (74)
East				0.6600	26.6336		0.4500		0.0000		0.7700		6.0908 (76)
South				4.8600	59.7356		0.4500		0.0000		0.7700		100.5942 (78)
Solar gains	145.7757	212.4498	301.4997	416.1686	478.8848	526.2176	497.4846	435.9733	358.5795	256.5363	168.6648	119.8741	(83)
Total gains	655.6524	718.3450	787.9465	872.4500	904.3605	923.9645	878.9138	825.0662	764.9257	693.2488	639.1685	615.8695	(84)

7. Mean internal temperature (heating season)

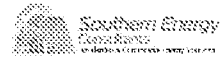
Temperature during heating periods in the living area from Table 9, Th1 (C)													21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	20.2756	20.5228	20.6164	20.7508	20.7068	20.8362	20.7939	20.8777	20.7939	20.6164	20.6164	20.4749	
alpha	2.3517	2.3682	2.3744	2.3834	2.3805	2.3891	2.3863	2.3918	2.3863	2.3744	2.3744	2.3650	
util living area	0.9124	0.8939	0.8521	0.7723	0.6541	0.4957	0.3785	0.3803	0.5874	0.7672	0.8762	0.9204	(86)
MIT	18.9246	19.1044	19.5234	20.0611	20.5359	20.8339	20.9375	20.9407	20.7435	20.2749	19.5530	18.8983	(87)
Th 2	19.7864	19.7992	19.8039	19.8107	19.8085	19.8150	19.8128	19.8170	19.8128	19.8039	19.8039	19.7967	(88)
util rest of house	0.8987	0.8778	0.8293	0.7363	0.5958	0.4110	0.2710	0.2664	0.5025	0.7190	0.8537	0.9076	(89)
MIT 2	17.1199	17.3801	17.9736	18.7175	19.3381	19.6880	19.7826	19.7904	19.6012	19.0209	18.0293	17.0900	(90)
Living area fraction	17.5012	17.7444	18.3010	19.0014	19.5911	19.9301	20.0266	20.0334	19.8425	19.2859	18.3512	17.4720	(91)
MIT	17.5012	17.7444	18.3010	19.0014	19.5911	19.9301	20.0266	20.0334	19.8425	19.2859	18.3512	17.4720	(92)
Temperature adjustment	adjusted MIT	17.3512	17.5944	18.1510	18.8514	19.4411	19.7801	19.8766	19.8834	19.6925	19.1359	18.2012	17.3220 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	564.2736	602.2773	621.9400	612.4260	520.5690	377.2784	243.5130	225.3590	377.0009	476.0245	520.2030	536.3867	(94)
Ext temp.	5.7000	5.9000	7.4000	9.7000	12.7000	15.4000	17.2000	17.4000	15.1000	12.2000	8.7000	5.8000	(96)
Heat loss rate W	1128.8493	1119.3856	1024.4134	866.3463	639.5286	412.9568	252.8645	233.6687	433.8633	660.8871	905.3263	1105.4674	(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	420.0443	347.4968	299.4402	182.8226	88.5059	0.0000	0.0000	0.0000	0.0000	137.5378	277.2888	423.3961	(98)
Space heating												2176.5324	(98)
RHI space heating demand												2177	(98)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	36.4100 (1b)	x 2.3300 (2b)	= 84.8353 (1b) - (3b)
First floor	34.3100 (1c)	x 2.5700 (2c)	= 88.1767 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	70.7200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 173.0120 (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) = 0.1734 (8)
Pressure test					Yes
Measured/design q50					5.0000
Infiltration rate					0.4234 (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) =	0.3599 (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	0.4589	0.4499	0.4409	0.3959	0.3869	0.3419	0.3419	0.3329	0.3599	0.3869	0.4049	0.4229 (22b)
Effective ac	0.6053	0.6012	0.5972	0.5784	0.5748	0.5584	0.5584	0.5554	0.5648	0.5748	0.5820	0.5894 (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
Opening Type 1			1.9500	1.3000	2.5350		(26)
Opening Type 2 (Uw = 1.40)			13.4400	1.3258	17.8182		(27)
Heat Loss Floor 1			36.4100	0.1800	6.5538		(28a)
External Wall 1	84.0700	15.3900	68.6800	0.2800	19.2304		(29a)
External Roof 1	36.4100		36.4100	0.1400	5.0974		(30)
Total net area of external elements Aum(A, m ²)			156.8900				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	51.2348	(33)
Party Wall 1			37.2600	0.0000	0.0000		(32)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							100.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.6140 (36)
Total fabric heat loss						(33) + (36) =	61.8488 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heat transfer coeff	34.5576	34.3242	34.0954	33.0208	32.8198	31.8839	31.8839	31.7106	32.2444	32.8198	33.2265	33.6517 (38)
Average = Sum(39)m / 12 =	96.4063	96.1729	95.9442	94.8696	94.6685	93.7326	93.7326	93.5593	94.0931	94.6685	95.0753	95.5005 (39)
												94.8686 (39)
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.3632	1.3599	1.3567	1.3415	1.3386	1.3254	1.3254	1.3230	1.3305	1.3386	1.3444	1.3504 (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												2.2635 (42)
Average daily hot water use (litres/day)												87.9576 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	96.7533	93.2350	89.7167	86.1984	82.6801	79.1618	79.1618	82.6801	86.1984	89.7167	93.2350	96.7533 (44)
Energy content (annual)	143.4824	125.4906	129.4951	112.8970	108.3273	93.4782	86.6213	99.3992	100.5864	117.2237	127.9589	138.9551 (45)
Distribution loss (46)m = 0.15 x (45)m												
	21.5224	18.8236	19.4243	16.9345	16.2491	14.0217	12.9932	14.9099	15.0880	17.5836	19.1938	20.8433 (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)

Regs Region: England

Elmhurst Energy Systems

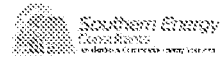
SAP2012 Calculator (Design

System) version 4.04r08



FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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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	14.0897	12.7061	14.0354	13.5464	13.9715	13.4904	13.9211	13.9538	13.5209	14.0090	13.5991	14.0792 (61)
Total heat required for water heating calculated for each month	157.5721	138.1967	143.5305	126.4433	122.2988	106.9686	100.5425	113.3530	114.1073	131.2327	141.5580	153.0343 (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	157.5721	138.1967	143.5305	126.4433	122.2988	106.9686	100.5425	113.3530	114.1073	131.2327	141.5580	153.0343 (64)
Heat gains from water heating, kWh/month	51.2303	44.9022	46.5660	40.9248	39.5117	34.4541	32.2819	36.5387	36.8252	42.4791	45.9461	49.7224 (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	135.8086	135.8086	135.8086	135.8086	135.8086	135.8086	135.8086	135.8086	135.8086	135.8086	135.8086	135.8086 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	44.9322	39.9084	32.4557	24.5711	18.3672	15.5063	16.7551	21.7790	29.2317	37.1163	43.3202	46.1811 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	296.9726	300.0542	292.2886	275.7564	254.8876	235.2738	222.1706	219.0889	226.8546	243.3867	264.2556	283.8694 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	50.8443	50.8443	50.8443	50.8443	50.8443	50.8443	50.8443	50.8443	50.8443	50.8443	50.8443	50.8443 (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)	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391 (71)
Water heating gains (Table 5)	68.8580	66.8187	62.5887	56.8400	53.1071	47.8529	43.3896	49.1112	51.1461	57.0956	63.8140	66.8311 (72)
Total internal gains	509.8767	505.8952	486.4468	456.2814	425.4757	397.7469	381.4292	389.0929	406.3462	436.7125	470.5037	495.9954 (73)

6. Solar gains

[Jan]			Area m2		Solar flux Table 6a W/m2		g Specific data or Table 6b		FF Specific data or Table 6c		Access factor Table 6d		Gains W
North			7.9200		10.6334		0.4500		0.0000		0.7700		29.1810 (74)
East			0.6600		19.6403		0.4500		0.0000		0.7700		4.4915 (76)
South			4.8600		46.7521		0.4500		0.0000		0.7700		78.7300 (78)
Solar gains	112.4025	193.4923	273.4767	358.9472	424.3458	432.1392	412.0302	360.8813	302.3366	215.8817	134.9208	96.0503	(83)
Total gains	622.2792	699.3875	759.9235	815.2286	849.8215	829.8862	793.4594	749.9742	708.6828	652.5942	605.4246	592.0457	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Thl (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	20.3767	20.4262	20.4749	20.7068	20.7508	20.9580	20.9580	20.9968	20.8777	20.7508	20.6620	20.5700
alpha	2.3584	2.3617	2.3650	2.3805	2.3834	2.3972	2.3972	2.3998	2.3918	2.3834	2.3775	2.3713
util living area	0.9320	0.9099	0.8751	0.8128	0.7168	0.5851	0.4615	0.4979	0.6737	0.8316	0.9088	0.9385 (86)
MIT	18.5769	18.8522	19.2881	19.8503	20.3567	20.7277	20.8898	20.8642	20.5915	19.9522	19.1743	18.5226 (87)
Th 2	19.7917	19.7942	19.7967	19.8085	19.8107	19.8210	19.8210	19.8229	19.8170	19.8107	19.8062	19.8016 (88)
util rest of house	0.9219	0.8966	0.8561	0.7827	0.6679	0.5079	0.3563	0.3934	0.6033	0.7982	0.8931	0.9293 (89)
MIT 2	16.6223	17.0163	17.6380	18.4317	19.1154	19.5841	19.7541	19.7349	19.4327	18.5914	17.4928	16.5501 (90)
Living area fraction	17.0353	17.4042	17.9866	18.7314	19.3776	19.8257	19.9940	19.9735	19.6775	18.6789	17.8480	16.9668 (92)
Temperature adjustment	16.8853	17.2542	17.8366	18.5814	19.2276	19.6757	19.8440	19.8235	19.5275	18.7289	17.6980	16.8168 (93)

8. Space heating requirement

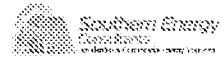
Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	0.8872	0.8585	0.8159	0.7449	0.6403	0.4974	0.3586	0.3935	0.5836	0.7600	0.8552	0.8962 (94)
Ext temp.	552.0580	600.4269	619.9893	607.2633	544.1493	412.7513	284.5031	295.0789	413.5597	495.9729	517.7519	530.6039 (95)
Heat loss rate W	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	1213.2988	1188.1366	1087.6811	918.4671	712.6300	475.7624	304.0730	320.2971	510.6947	769.5504	1007.6121	1204.9124 (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 per m2	491.9632	394.9410	347.9627	224.0667	125.3497	0.0000	0.0000	0.0000	0.0000	203.5417	352.6993	501.6855 (98)
												2642.2097 (98)
												(98) / (4) = 37.3616 (99)

8c. Space cooling requirement

Not applicable

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS 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													2919.5688 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	491.9632	394.9410	347.9627	224.0667	125.3497	0.0000	0.0000	0.0000	0.0000	203.5417	352.6993	501.6855	(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)	543.6057	436.3988	384.4892	247.5875	138.5079	0.0000	0.0000	0.0000	0.0000	224.9079	389.7230	554.3487	(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	157.5721	138.1967	143.5305	126.4433	122.2988	106.9686	100.5425	113.3530	114.1073	131.2327	141.5580	153.0343	(64)
Efficiency of water heater (217)m	89.7023	89.6482	89.5415	89.3189	88.8909	87.3000	87.3000	87.3000	87.3000	89.2180	89.5598	89.7312	(217)
Fuel for water heating, kWh/month	175.6611	154.1545	160.2949	141.5638	137.5831	122.5299	115.1689	129.8431	130.7071	147.0921	158.0598	170.5475	(219)
Water heating fuel used												1743.2058	(219)
Annual totals kWh/year													
Space heating fuel - main system												2919.5688	(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)												317.4070	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.00 * 1080 * 0.80) =										-1381.7915		-1381.7915	(233)
Total delivered energy for all uses												3673.3901	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	2919.5688	3.4800	101.6010 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	1743.2058	3.4800	60.6636 (247)
Pumps and fans for heating	75.0000	13.1900	9.8925 (249)
Energy for lighting	317.4070	13.1900	41.8660 (250)
Additional standing charges			120.0000 (251)
Energy saving/generation technologies			
PV Unit	-1381.7915	13.1900	-182.2583 (252)
Total energy cost			151.7647 (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] = 0.5508 (257)
SAP value	92.3160
SAP rating (Section 12)	92 (258)
SAP band	A

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

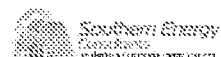
	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	2919.5688	0.2160	630.6269 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1743.2058	0.2160	376.5325 (264)
Space and water heating			1007.1593 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	317.4070	0.5190	164.7342 (268)
Energy saving/generation technologies			
PV Unit	-1381.7915	0.5190	-717.1498 (269)
Total kg/year			493.6688 (272)
CO2 emissions per m2			6.9800 (273)
EI value			94.2835
EI rating			94 (274)
EI band			A

Calculation of stars for heating and DHW

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

FULL SAP CALCULATION PRINTOUT

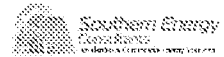
Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS 09 Jan 2014

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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 (m ²)	Storey height (m)	Volume (m ³)
Ground floor	36.4100 (1b)	x 2.3300 (2b)	= 84.8353 (1b) - (3b)
First floor	34.3100 (1c)	x 2.5700 (2c)	= 88.1767 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	70.7200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 173.0120 (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) = 0.1734 (8)
Pressure test					Yes
Measured/design q50					5.0000
Infiltration rate					0.4234 (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) =	0.3599 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.3000	4.8000	4.6000	4.3000	4.4000	4.1000	4.2000	4.0000	4.2000	4.6000	4.6000	4.9000 (22)
Wind factor	1.3250	1.2000	1.1500	1.0750	1.1000	1.0250	1.0500	1.0000	1.0500	1.1500	1.1500	1.2250 (22a)
Adj infilt rate	0.4769	0.4319	0.4139	0.3869	0.3959	0.3689	0.3779	0.3599	0.3779	0.4139	0.4139	0.4409 (22b)
Effective ac	0.6137	0.5933	0.5856	0.5748	0.5784	0.5680	0.5714	0.5648	0.5714	0.5856	0.5856	0.5972 (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			1.9500	1.3000	2.5350		(26)					
Opening Type 2 (Uw = 1.40)			13.4400	1.3258	17.8182		(27)					
Heat Loss Floor 1			36.4100	0.1800	6.5538		(28a)					
External Wall 1	84.0700	15.3900	68.6800	0.2800	19.2304		(29a)					
External Roof 1	36.4100		36.4100	0.1400	5.0974		(30)					
Total net area of external elements Aum(A, m2)			156.8900				(31)					
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	51.2348		(33)					
Party Wall 1			37.2600	0.0000	0.0000		(32)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							100.0000 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.6140 (36)					
Total fabric heat loss						(33) + (36) =	61.8488 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 35.0382	Feb 33.8712	Mar 33.4368	Apr 32.8198	May 33.0208	Jun 32.4316	Jul 32.6234	Aug 32.2444	Sep 32.6234	Oct 33.4368	Nov 33.4368	Dec 34.0954 (38)
Heat transfer coeff	96.8870	95.7200	95.2856	94.6685	94.8696	94.2803	94.4721	94.0931	94.4721	95.2856	95.2856	95.9442 (39)
Average = Sum(39)m / 12 =												95.1053 (39)
HLP	Jan 1.3700	Feb 1.3535	Mar 1.3474	Apr 1.3386	May 1.3415	Jun 1.3331	Jul 1.3359	Aug 1.3305	Sep 1.3359	Oct 1.3474	Nov 1.3474	Dec 1.3567 (40)
HLP (average)												1.3448 (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												2.2635 (42)
Average daily hot water use (litres/day)												87.9576 (43)
Daily hot water use	Jan 96.7533	Feb 93.2350	Mar 89.7167	Apr 86.1984	May 82.6801	Jun 79.1618	Jul 79.1618	Aug 82.6801	Sep 86.1984	Oct 89.7167	Nov 93.2350	Dec 96.7533 (44)
Energy conte	143.4824	125.4906	129.4951	112.8970	108.3273	93.4782	86.6213	99.3992	100.5864	117.2237	127.9589	138.9551 (45)
Energy content (annual)										Total = Sum(45)m =		1383.9153 (45)
Distribution loss (46)m = 0.15 x (45)m	21.5224	18.8236	19.4243	16.9345	16.2491	14.0217	12.9932	14.9099	15.0880	17.5836	19.1938	20.8433 (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)

Regs Region: England

Elmhurst Energy Systems

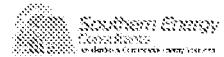
SAP2012 Calculator (Design

System) version 4.04r08



FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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

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	14.0897	12.7061	14.0354	13.5464	13.9715	13.4904	13.9211	13.9538	13.5209	14.0090	13.5991	14.0792 (61)
Total heat required for water heating calculated for each month	157.5721	138.1967	143.5305	126.4433	122.2988	106.9686	100.5425	113.3530	114.1073	131.2327	141.5580	153.0343 (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	157.5721	138.1967	143.5305	126.4433	122.2988	106.9686	100.5425	113.3530	114.1073	131.2327	141.5580	153.0343 (64)
Heat gains from water heating, kWh/month	51.2303	44.9022	46.5660	40.9248	39.5117	34.4541	32.2819	36.5387	36.8252	42.4791	45.9461	49.7224 (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	135.8086	135.8086	135.8086	135.8086	135.8086	135.8086	135.8086	135.8086	135.8086	135.8086	135.8086	135.8086 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	44.9322	39.9084	32.4557	24.5711	18.3672	15.5063	16.7551	21.7790	29.2317	37.1163	43.3202	46.1811 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	296.9726	300.0542	292.2886	275.7564	254.8876	235.2738	222.1706	219.0889	226.8546	243.3867	264.2556	283.8694 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	50.8443	50.8443	50.8443	50.8443	50.8443	50.8443	50.8443	50.8443	50.8443	50.8443	50.8443	50.8443 (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)	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391 (71)
Water heating gains (Table 5)	68.8580	66.8187	62.5887	56.8400	53.1071	47.8529	43.3896	49.1112	51.1461	57.0956	63.8140	66.8311 (72)
Total internal gains	509.8767	505.8952	486.4468	456.2814	425.4757	397.7469	381.4292	389.0929	406.3462	436.7125	470.5037	495.9954 (73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c				Access factor Table 6d			Gains W
North				7.9200	14.2444	0.4500	0.0000				0.7700			39.0906 (74)
East				0.6600	26.6336	0.4500	0.0000				0.7700			6.0908 (76)
South				4.8600	59.7356	0.4500	0.0000				0.7700			100.5942 (78)
Solar gains	145.7757	212.4498	301.4997	416.1686	478.8848	526.2176	497.4846	435.9733	358.5795	256.5363	168.6648	119.8741	(83)	
Total gains	655.6524	718.3450	787.9465	872.4500	904.3605	923.9645	878.9138	825.0662	764.9257	693.2488	639.1685	615.8695	(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	20.2756	20.5228	20.6164	20.7508	20.7068	20.8362	20.7939	20.8777	20.7939	20.6164	20.6164	20.4749
alpha	2.3517	2.3682	2.3744	2.3834	2.3805	2.3891	2.3863	2.3918	2.3863	2.3744	2.3744	2.3650
util living area	0.9124	0.8939	0.8521	0.7723	0.6541	0.4957	0.3785	0.3803	0.5874	0.7672	0.8762	0.9204 (86)
MIT	18.9246	19.1044	19.5234	20.0611	20.5359	20.8339	20.9375	20.9407	20.7435	20.2749	19.5530	18.8983 (87)
Th 2	19.7864	19.7992	19.8039	19.8107	19.8085	19.8150	19.8128	19.8170	19.8128	19.8039	19.8039	19.7967 (88)
util rest of house	0.8987	0.8778	0.8293	0.7363	0.5958	0.4110	0.2710	0.2664	0.5025	0.7190	0.8537	0.9076 (89)
MIT 2	17.1199	17.3801	17.9736	18.7175	19.3381	19.6880	19.7826	19.7904	19.6012	19.0209	18.0293	17.0900 (90)
Living area fraction	17.5012	17.7444	18.3010	19.0014	19.5911	19.9301	20.0266	20.0334	fLA = Living area / (4) =	19.8425	19.2859	0.2113 (91)
MIT	17.5012	17.7444	18.3010	19.0014	19.5911	19.9301	20.0266	20.0334	19.8425	19.2859	18.3512	17.4720 (92)
Temperature adjustment												-0.1500
adjusted MIT	17.3512	17.5944	18.1510	18.8514	19.4411	19.7801	19.8766	19.8834	19.6925	19.1359	18.2012	17.3220 (93)

8. Space heating requirement

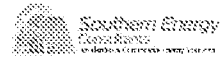
Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	564.2736	602.2773	621.9400	612.4260	520.5690	377.2784	243.5130	225.3590	377.0009	476.0245	520.2030	536.3867 (95)
Ext temp.	5.7000	5.9000	7.4000	9.7000	12.7000	15.4000	17.2000	17.4000	15.1000	12.2000	8.7000	5.8000 (96)
Heat loss rate W	1128.8493	1119.3856	1024.4134	866.3463	639.5286	412.9568	252.8645	233.6687	433.8633	660.8871	905.3263	1105.4674 (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	420.0443	347.4968	299.4402	182.8226	88.5059	0.0000	0.0000	0.0000	0.0000	137.5378	277.2888	423.3961 (98)
Space heating												2176.5324 (98)
Space heating per m2												30.7768 (99)

8c. Space cooling requirement

Not applicable

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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													2405.0081 (211)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Space heating requirement	420.0443	347.4968	299.4402	182.8226	88.5059	0.0000	0.0000	0.0000	0.0000	137.5378	277.2888	423.3961	(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)	464.1373	383.9744	330.8731	202.0139	97.7966	0.0000	0.0000	0.0000	0.0000	151.9755	306.3964	467.8410	(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	157.5721	138.1967	143.5305	126.4433	122.2988	106.9686	100.5425	113.3530	114.1073	131.2327	141.5580	153.0343	(64)
Efficiency of water heater (217)m	89.6040	89.5659	89.4378	89.1637	88.6155	87.3000	87.3000	87.3000	87.3000	88.9087	89.3926	89.6278	(217)
Fuel for water heating, kWh/month	175.8539	154.2962	160.4809	141.8102	138.0106	122.5299	115.1689	129.8431	130.7071	147.6038	158.3554	170.7442	(219)
Water heating fuel used												1745.4043	(219)
Annual totals kWh/year													
Space heating fuel - main system												2405.0081	(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)												317.4070	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.00 * 1284 * 0.80) =										-1643.2472		-1643.2472	(233)
Total delivered energy for all uses												2899.5723	(238)

10a. Fuel costs - using BEDF prices (417)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	2405.0081	4.1000	98.6053 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	1745.4043	4.1000	71.5616 (247)
Pumps and fans for heating	75.0000	15.7000	11.7750 (249)
Energy for lighting	317.4070	15.7000	49.8329 (250)
Additional standing charges			89.0000 (251)
Energy saving/generation technologies			
PV Unit	-1643.2472	15.7000	-257.9898 (252)
Total energy cost			62.7850 (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	2405.0081	0.2160	519.4818 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1745.4043	0.2160	377.0073 (264)
Space and water heating			896.4891 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	317.4070	0.5190	164.7342 (268)
Energy saving/generation technologies			
PV Unit	-1643.2472	0.5190	-852.8453 (269)
Total kg/year			247.3031 (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	2405.0081	1.2200	2934.1099 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1745.4043	1.2200	2129.3933 (264)
Space and water heating			5063.5032 (265)
Pumps and fans	75.0000	3.0700	230.2500 (267)
Energy for lighting	317.4070	3.0700	974.4396 (268)
Energy saving/generation technologies			
PV Unit	-1643.2472	3.0700	-5044.7688 (269)
Primary energy kWh/year			1223.4240 (272)
Primary energy kWh/m2/year			17.2995 (273)

SAP 2012 EPC IMPROVEMENTS

Regs Region: England

Elmhurst Energy Systems

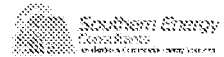
SAP2012 Calculator (Design

System) version 4.04r08



FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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

Current energy efficiency rating: A 92
Current environmental impact rating: A 94

(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	+ 1.3	-£ 31	-180 kg (72.9%)

Recommended measures	Typical annual savings	Energy efficiency	Environmental impact
Solar water heating	£31 2.55 kg/m²	A 94	A 96
Total Savings	£31 2.55 kg/m²		

Potential energy efficiency rating: A 94
Potential environmental impact rating: A 96

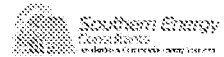
Fuel prices for cost data on this page from database revision number 417 TEST (24 Aug 2017)
Recommendation texts revision number 4.9c (22 Feb 2014)

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

	Current	Potential	Saving
Electricity	£62	£69	-£8
Mains gas	£259	£220	£39
Space heating	£199	£199	£0
Water heating	£72	£40	£31
Lighting	£50	£50	£0
Generated (PV)	-£258	-£258	£0
Total cost of fuels	£63	£31	£31
Total cost of uses	£63	£31	£31
Delivered energy	41 kWh/m²	28 kWh/m²	13 kWh/m²
Carbon dioxide emissions	0.2 tonnes	0.1 tonnes	0.2 tonnes
CO2 emissions per m²	3 kg/m²	1 kg/m²	3 kg/m²
Primary energy	17 kWh/m²	3 kWh/m²	14 kWh/m²

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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 (m ²)	Storey height (m)	Volume (m ³)
Ground floor	36.4100 (1b)	x 2.3300 (2b)	= 84.8353 (1b) - (3b)
First floor	34.3100 (1c)	x 2.5700 (2c)	= 88.1767 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	70.7200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 173.0120 (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) = 0.1734 (8)
Pressure test					Yes
Measured/design q50					5.0000
Infiltration rate					0.4234 (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) =	0.3599 (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	0.4589	0.4499	0.4409	0.3959	0.3869	0.3419	0.3419	0.3329	0.3599	0.3869	0.4049	0.4229 (22b)
Effective ac	0.6053	0.6012	0.5972	0.5784	0.5748	0.5584	0.5584	0.5554	0.5648	0.5748	0.5820	0.5894 (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			1.9500	1.3000	2.5350		(26)					
Opening Type 2 (Uw = 1.40)			13.4400	1.3258	17.8182		(27)					
Heat Loss Floor 1			36.4100	0.1800	6.5538		(28a)					
External Wall 1	84.0700	15.3900	68.6800	0.2800	19.2304		(29a)					
External Roof 1	36.4100		36.4100	0.1400	5.0974		(30)					
Total net area of external elements Aum(A, m2)			156.8900				(31)					
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	51.2348		(33)					
Party Wall 1			37.2600	0.0000	0.0000		(32)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							100.0000 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.6140 (36)					
Total fabric heat loss						(33) + (36) =	61.8488 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 34.5576	Feb 34.3242	Mar 34.0954	Apr 33.0208	May 32.8198	Jun 31.8839	Jul 31.8839	Aug 31.7106	Sep 32.2444	Oct 32.8198	Nov 33.2265	Dec 33.6517 (38)
Heat transfer coeff	96.4063	96.1729	95.9442	94.8696	94.6685	93.7326	93.7326	93.5593	94.0931	94.6685	95.0753	95.5005 (39)
Average = Sum(39)m / 12 =												94.8686 (39)
HLP	Jan 1.3632	Feb 1.3599	Mar 1.3567	Apr 1.3415	May 1.3386	Jun 1.3254	Jul 1.3254	Aug 1.3230	Sep 1.3305	Oct 1.3386	Nov 1.3444	Dec 1.3504 (40)
HLP (average)												1.3415 (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												2.2635 (42)
Average daily hot water use (litres/day)												87.9576 (43)
Daily hot water use	Jan 96.7533	Feb 93.2350	Mar 89.7167	Apr 86.1984	May 82.6801	Jun 79.1618	Jul 79.1618	Aug 82.6801	Sep 86.1984	Oct 89.7167	Nov 93.2350	Dec 96.7533 (44)
Energy conte	143.4824	125.4906	129.4951	112.8970	108.3273	93.4782	86.6213	99.3992	100.5864	117.2237	127.9589	138.9551 (45)
Energy content (annual)										Total = Sum(45)m =		1383.9153 (45)
Distribution loss (46)m = 0.15 x (45)m	21.5224	18.8236	19.4243	16.9345	16.2491	14.0217	12.9932	14.9099	15.0880	17.5836	19.1938	20.8433 (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)

Regs Region: England

Elmhurst Energy Systems

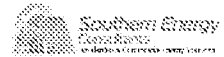
SAP2012 Calculator (Design

System) version 4.04r08



FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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	14.0897	12.7061	14.0354	13.5464	13.9715	13.4904	13.9211	13.9538	13.5209	14.0090	13.5991	14.0792 (61)
Total heat required for water heating calculated for each month	157.5721	138.1967	143.5305	126.4433	122.2988	106.9686	100.5425	113.3530	114.1073	131.2327	141.5580	153.0343 (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												1.3105 (H8)
Utilisation factor												0.5338 (H9)
Collector performance factor												0.8793 (H10)
Dedicated solar storage volume												75.0000 (H11)
Effective solar volume												75.0000 (H13)
Daily hot water demand												87.9576 (H14)
Volume ratio Veff/V												0.8527 (H15)
Solar storage volume factor												0.9681 (H16)
Solar input												-824.0657 (H17)
Solar input	-23.8963	-39.8760	-67.9134	-91.0173	-112.4442	-110.5506	-109.0896	-95.3121	-74.6485	-50.9762	-28.3444	-19.9971 (63)
												-824.0657 (63)
Solar input (sum of months) = Sum(63)m =												
Output from w/h	133.6759	98.3207	75.6171	35.4260	9.8546	0.0000	0.0000	18.0409	39.4587	80.2565	113.2136	133.0372 (64)
												736.9013 (64)
Total per year (kWh/year) = Sum(64)m =												
Heat gains from water heating, kWh/month	51.2303	44.9022	46.5660	40.9248	39.5117	34.4541	32.2819	36.5387	36.8252	42.4791	45.9461	49.7224 (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	135.8086	135.8086	135.8086	135.8086	135.8086	135.8086	135.8086	135.8086	135.8086	135.8086	135.8086	135.8086	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	44.9322	39.9084	32.4557	24.5711	18.3672	15.5063	16.7551	21.7790	29.2317	37.1163	43.3202	46.1811	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	296.9726	300.0542	292.2886	275.7564	254.8876	235.2738	222.1706	219.0889	226.8546	243.3867	264.2556	283.8694	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	50.8443	50.8443	50.8443	50.8443	50.8443	50.8443	50.8443	50.8443	50.8443	50.8443	50.8443	50.8443	(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)	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	(71)
Water heating gains (Table 5)	68.8580	66.8187	62.5887	56.8400	53.1071	47.8529	43.3896	49.1112	51.1461	57.0956	63.8140	66.8311	(72)
Total internal gains	509.8767	505.8952	486.4468	456.2814	425.4757	397.7469	381.4292	389.0929	406.3462	436.7125	470.5037	495.9954	(73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W			
North				7.9200	10.6334	0.4500	0.0000	0.7700	29.1810 (74)			
East				0.6600	19.6403	0.4500	0.0000	0.7700	4.4915 (76)			
South				4.8600	46.7521	0.4500	0.0000	0.7700	78.7300 (78)			
Solar gains	112.4025	193.4923	273.4767	358.9472	424.3458	432.1392	412.0302	360.8813	302.3366	215.8817	134.9208	96.0503 (83)
Total gains	622.2792	699.3875	759.9235	815.2286	849.8215	829.8862	793.4594	749.9742	708.6828	652.5942	605.4246	592.0457 (84)

7. Mean internal temperature (heating season)

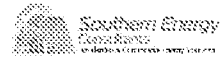
Temperature during heating periods in the living area from Table 9, Thl (C)													21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
tau	20.3767	20.4262	20.4749	20.7068	20.7508	20.9580	20.9580	20.9968	20.8777	20.7508	20.6620	20.5700	
alpha	2.3584	2.3617	2.3650	2.3805	2.3834	2.3972	2.3972	2.3998	2.3918	2.3834	2.3775	2.3713	
util living area	0.9320	0.9099	0.8751	0.8128	0.7168	0.5851	0.4615	0.4979	0.6737	0.8316	0.9088	0.9385	(86)
MIT	18.5769	18.8522	19.2881	19.8503	20.3567	20.7277	20.8898	20.8642	20.5915	19.9522	19.1743	18.5226	(87)
Th 2	19.7917	19.7942	19.7967	19.8085	19.8107	19.8210	19.8210	19.8229	19.8170	19.8107	19.8062	19.8016	(88)
util rest of house	0.9219	0.8966	0.8561	0.7827	0.6679	0.5079	0.3563	0.3934	0.6033	0.7982	0.8931	0.9293	(89)
MIT 2	16.6223	17.0163	17.6380	18.4317	19.1154	19.5841	19.7541	19.7349	19.4327	18.5914	17.4928	16.5501	(90)
Living area fraction										fLA = Living area / (4) =		0.2113	(91)
MIT	17.0353	17.4042	17.9866	18.7314	19.3776	19.8257	19.9940	19.9735	19.6775	18.8789	17.8480	16.9668	(92)
Temperature adjustment												-0.1500	
adjusted MIT	16.8853	17.2542	17.8366	18.5814	19.2276	19.6757	19.8440	19.8235	19.5275	18.7289	17.6980	16.8168	(93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	0.8872	0.8585	0.8159	0.7449	0.6403	0.4974	0.3586	0.3935	0.5836	0.7600	0.8552	0.8962	(94)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Useful gains	552.0580	600.4269	619.9893	607.2633	544.1493	412.7513	284.5031	295.0789	413.5597	495.9729	517.7519	530.6039 (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	1213.2988	1188.1366	1087.6811	918.4671	712.6300	475.7624	304.0730	320.2971	510.6947	769.5504	1007.6121	1204.9124 (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	491.9632	394.9410	347.9627	224.0667	125.3497	0.0000	0.0000	0.0000	0.0000	203.5417	352.6993	501.6855 (98)
Space heating												2642.2097 (98)
Space heating per m2											(98) / (4) =	37.3616 (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												2919.5688 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	491.9632	394.9410	347.9627	224.0667	125.3497	0.0000	0.0000	0.0000	0.0000	203.5417	352.6993	501.6855 (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)	543.6057	436.3988	384.4892	247.5875	138.5079	0.0000	0.0000	0.0000	0.0000	224.9079	389.7230	554.3487 (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	133.6759	98.3207	75.6171	35.4260	9.8546	0.0000	0.0000	18.0409	39.4587	80.2565	113.2136	133.0372 (64)
Efficiency of water heater	89.7967	89.8436	89.9116	90.0494	90.2589	87.3000	87.3000	87.3000	87.3000	89.5715	89.7010	87.3000 (216)
(217)m	89.7967	89.8436	89.9116	90.0494	90.2589	87.3000	87.3000	87.3000	87.3000	89.5715	89.7010	87.3000 (217)
Fuel for water heating, kWh/month	148.8650	109.4355	84.1016	39.3406	10.9182	0.0000	0.0000	20.6654	45.1990	89.6005	126.2121	148.1318 (219)
Water heating fuel used												822.4697 (219)
Annual totals kWh/year												
Space heating fuel - main system												2919.5688 (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)												317.4070 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV Unit 0 (0.80 * 2.00 * 1080 * 0.80) =									-1381.7915			-1381.7915 (233)
Total delivered energy for all uses												2802.6540 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	2919.5688	3.4800	101.6010 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	822.4697	3.4800	28.6219 (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	317.4070	13.1900	41.8660 (250)
Additional standing charges			120.0000 (251)
Energy saving/generation technologies			
PV Unit	-1381.7915	13.1900	-182.2583 (252)
Total energy cost			126.3181 (255)

11a. SAP rating - Individual heating systems

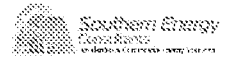
Energy cost deflator (Table 12):		0.4200 (256)
Energy cost factor (ECF)		0.4585 (257)
SAP value	[(255) x (256)] / [(4) + 45.0] =	93.6044
SAP rating (Section 12)		94 (258)
SAP band		A

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	2919.5688	0.2160	630.6269 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	822.4697	0.2160	177.6535 (264)
Space and water heating			808.2803 (265)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

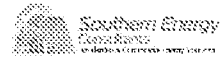


CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Pumps and fans	125.0000	0.5190	64.8750 (267)
Energy for lighting	317.4070	0.5190	164.7342 (268)
Energy saving/generation technologies			
PV Unit			
Total kg/year	-1381.7915	0.5190	-717.1498 (269)
CO2 emissions per m2			320.7398 (272)
EI value			4.5400 (273)
EI rating			96.2859
EI band			96 (274)
			A

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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 (m ²)	Storey height (m)	Volume (m ³)
Ground floor	36.4100 (1b)	x 2.3300 (2b)	= 84.8353 (1b) - (3b)
First floor	34.3100 (1c)	x 2.5700 (2c)	= 88.1767 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	70.7200		(4)
Dwelling volume		(3a) + (3b) + (3c) + (3d) + (3e) ... (3n) =	173.0120 (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) = 0.1734 (8)
Pressure test					Yes
Measured/design q50					5.0000
Infiltration rate					0.4234 (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) =	0.3599 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.3000	4.8000	4.6000	4.3000	4.4000	4.1000	4.2000	4.0000	4.2000	4.6000	4.6000	4.9000 (22)
Wind factor	1.3250	1.2000	1.1500	1.0750	1.1000	1.0250	1.0500	1.0000	1.0500	1.1500	1.1500	1.2250 (22a)
Adj infilt rate	0.4769	0.4319	0.4139	0.3869	0.3959	0.3689	0.3779	0.3599	0.3779	0.4139	0.4139	0.4409 (22b)
Effective ac	0.6137	0.5933	0.5856	0.5748	0.5784	0.5680	0.5714	0.5648	0.5714	0.5856	0.5856	0.5972 (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
Opening Type 1			1.9500	1.3000	2.5350		(26)
Opening Type 2 (Uw = 1.40)			13.4400	1.3258	17.8182		(27)
Heat Loss Floor 1			36.4100	0.1800	6.5538		(28a)
External Wall 1	84.0700	15.3900	68.6800	0.2800	19.2304		(29a)
External Roof 1	36.4100		36.4100	0.1400	5.0974		(30)
Total net area of external elements Aum(A, m ²)			156.8900				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	51.2348		(33)
Party Wall 1			37.2600	0.0000	0.0000		(32)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							100.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.6140 (36)
Total fabric heat loss						(33) + (36) =	61.8488 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heat transfer coeff	35.0382	33.8712	33.4368	32.8198	33.0208	32.4316	32.6234	32.2444	32.6234	33.4368	33.4368	34.0954 (38)
Average = Sum(39)m / 12 =	96.8870	95.7200	95.2856	94.6685	94.8696	94.2803	94.4721	94.0931	94.4721	95.2856	95.2856	95.9442 (39)
												95.1053 (39)
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.3700	1.3535	1.3474	1.3386	1.3415	1.3331	1.3359	1.3305	1.3359	1.3474	1.3474	1.3567 (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												2.2635 (42)
Average daily hot water use (litres/day)												87.9576 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	96.7533	93.2350	89.7167	86.1984	82.6801	79.1618	79.1618	82.6801	86.1984	89.7167	93.2350	96.7533 (44)
Energy content (annual)	143.4824	125.4906	129.4951	112.8970	108.3273	93.4782	86.6213	99.3992	100.5864	117.2237	127.9589	138.9551 (45)
Distribution loss (46)m = 0.15 x (45)m										Total = Sum(45)m =		1383.9153 (45)
Water storage loss:	21.5224	18.8236	19.4243	16.9345	16.2491	14.0217	12.9932	14.9099	15.0880	17.5836	19.1938	20.8433 (46)
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)

Regs Region: England

Elmhurst Energy Systems

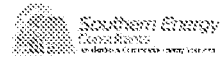
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System) version 4.04r08



FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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

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	14.0897	12.7061	14.0354	13.5464	13.9715	13.4904	13.9211	13.9538	13.5209	14.0090	13.5991	14.0792 (61)
Total heat required for water heating calculated for each month	157.5721	138.1967	143.5305	126.4433	122.2988	106.9686	100.5425	113.3530	114.1073	131.2327	141.5580	153.0343 (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												1283.7868 (H5)
Overshading factor												0.8000 (H6)
Solar energy available												2156.7619 (H7)
Adjustment factor for showers												1.0000 (H7a)
Solar-to-load ratio												1.5584 (H8)
Utilisation factor												0.4736 (H9)
Collector performance factor												0.8793 (H10)
Dedicated solar storage volume												75.0000 (H11)
Effective solar volume												75.0000 (H13)
Daily hot water demand												87.9576 (H14)
Volume ratio Veff/V												0.8527 (H15)
Solar storage volume factor												0.9681 (H16)
Solar input												-869.4913 (H17)
Solar input	-28.1792	-39.7450	-67.5252	-94.1943	-112.4716	-119.0413	-116.5805	-102.4352	-79.5276	-54.8869	-32.2110	-22.6936 (63)
												-869.4913 (63)
Solar input (sum of months) = Sum(63)m =												
Output from w/h	129.3929	98.4517	76.0053	32.2490	9.8272	0.0000	0.0000	10.9179	34.5797	76.3458	109.3470	130.3407 (64)
Total per year (kWh/year) = Sum(64)m =												707.4573 (64)
Heat gains from water heating, kWh/month	51.2303	44.9022	46.5660	40.9248	39.5117	34.4541	32.2819	36.5387	36.8252	42.4791	45.9461	49.7224 (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	135.8086	135.8086	135.8086	135.8086	135.8086	135.8086	135.8086	135.8086	135.8086	135.8086	135.8086	135.8086	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	44.9322	39.9084	32.4557	24.5711	18.3672	15.5063	16.7551	21.7790	29.2317	37.1163	43.3202	46.1811	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	296.9726	300.0542	292.2886	275.7564	254.8876	235.2738	222.1706	219.0889	226.8546	243.3867	264.2556	283.8694	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	50.8443	50.8443	50.8443	50.8443	50.8443	50.8443	50.8443	50.8443	50.8443	50.8443	50.8443	50.8443	(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)	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	(71)
Water heating gains (Table 5)	68.8580	66.8187	62.5887	56.8400	53.1071	47.8529	43.3896	49.1112	51.1461	57.0956	63.8140	66.8311	(72)
Total internal gains	509.8767	505.8952	486.4468	456.2814	425.4757	397.7469	381.4292	389.0929	406.3462	436.7125	470.5037	495.9954	(73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a	g Specific data or Table 6b		FF Specific data or Table 6c	Access factor Table 6d		Gains W	
North				7.9200	14.2444	0.4500		0.0000	0.7700		39.0906 (74)	
East				0.6600	26.6336	0.4500		0.0000	0.7700		6.0908 (76)	
South				4.8600	59.7356	0.4500		0.0000	0.7700		100.5942 (78)	

Solar gains	145.7757	212.4498	301.4997	416.1686	478.8848	526.2176	497.4846	435.9733	358.5795	256.5363	168.6648	119.8741 (83)
Total gains	655.6524	718.3450	787.9465	872.4500	904.3605	923.9645	878.9138	825.0662	764.9257	693.2488	639.1685	615.8695 (84)

7. Mean internal temperature (heating season)

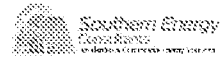
Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)	
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	20.2756	20.5228	20.6164	20.7508	20.7068	20.8362	20.7939	20.8777	20.7939	20.6164	20.6164	20.4749	
alpha	2.3517	2.3682	2.3744	2.3834	2.3805	2.3891	2.3863	2.3918	2.3863	2.3744	2.3744	2.3650	
util living area													
	0.9124	0.8939	0.8521	0.7723	0.6541	0.4957	0.3785	0.3803	0.5874	0.7672	0.8762	0.9204 (86)	
MIT	18.9246	19.1044	19.5234	20.0611	20.5359	20.8339	20.9375	20.9407	20.7435	20.2749	19.5530	18.8983 (87)	
Th 2	19.7864	19.7992	19.8039	19.8107	19.8085	19.8150	19.8128	19.8170	19.8128	19.8039	19.8039	19.7967 (88)	
util rest of house													
	0.8987	0.8778	0.8293	0.7363	0.5958	0.4110	0.2710	0.2664	0.5025	0.7190	0.8537	0.9076 (89)	
MIT 2	17.1199	17.3801	17.9736	18.7175	19.3381	19.6880	19.7826	19.7904	19.6012	19.0209	18.0293	17.0900 (90)	
Living area fraction									fLA = Living area / (4) =				0.2113 (91)
MIT	17.5012	17.7444	18.3010	19.0014	19.5911	19.9301	20.0266	20.0334	19.8425	19.2859	18.3512	17.4720 (92)	
Temperature adjustment												-0.1500	
adjusted MIT	17.3512	17.5944	18.1510	18.8514	19.4411	19.7801	19.8766	19.8834	19.6925	19.1359	18.2012	17.3220 (93)	

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.8606	0.8384	0.7893	0.7020	0.5756	0.4083	0.2771	0.2731	0.4929	0.6867	0.8139	0.8709 (94)

FULL SAP CALCULATION PRINTOUT

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Useful gains	564.2736	602.2773	621.9400	612.4260	520.5690	377.2784	243.5130	225.3590	377.0009	476.0245	520.2030	536.3867 (95)
Ext temp.	5.7000	5.9000	7.4000	9.7000	12.7000	15.4000	17.2000	17.4000	15.1000	12.2000	8.7000	5.8000 (96)
Heat loss rate W	1128.8493	1119.3856	1024.4134	866.3463	639.5286	412.9568	252.8645	233.6687	433.8633	660.8871	905.3263	1105.4674 (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	420.0443	347.4968	299.4402	182.8226	88.5059	0.0000	0.0000	0.0000	0.0000	137.5378	277.2888	423.3961 (98)
Space heating												2176.5324 (98)
Space heating per m2												(98) / (4) = 30.7768 (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												2405.0081 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	420.0443	347.4968	299.4402	182.8226	88.5059	0.0000	0.0000	0.0000	0.0000	137.5378	277.2888	423.3961 (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)	464.1373	383.9744	330.8731	202.0139	97.7966	0.0000	0.0000	0.0000	0.0000	151.9755	306.3964	467.8410 (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	129.3929	98.4517	76.0053	32.2490	9.8272	0.0000	0.0000	10.9179	34.5797	76.3458	109.3470	130.3407 (64)
Efficiency of water heater	89.7255	89.7735	89.8334	90.0053	90.1697	87.3000	87.3000	87.3000	87.3000	89.3312	89.5714	87.3000 (216)
(217)m	89.7255	89.7735	89.8334	90.0053	90.1697	87.3000	87.3000	87.3000	87.3000	89.3312	89.5714	89.7258 (217)
Fuel for water heating, kWh/month	144.2098	109.6667	84.6070	35.8301	10.8986	0.0000	0.0000	12.5062	39.6102	85.4638	122.0780	145.2655 (219)
Water heating fuel used												790.1359 (219)
Annual totals kWh/year												
Space heating fuel - main system												2405.0081 (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)												317.4070 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV Unit 0 (0.80 * 2.00 * 1284 * 0.80) =									-1643.2472			-1643.2472 (233)
Total delivered energy for all uses												1994.3039 (238)

10a. Fuel costs - using BEDF prices (417)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	2405.0081	4.1000	98.6053 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	790.1359	4.1000	32.3956 (247)
Pumps and fans for heating	75.0000	15.7000	11.7750 (249)
Pump for solar water heating	50.0000	15.7000	7.8500 (249)
Energy for lighting	317.4070	15.7000	49.8329 (250)
Additional standing charges			89.0000 (251)
Energy saving/generation technologies			
PV Unit	-1643.2472	15.7000	-257.9898 (252)
Total energy cost			31.4690 (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	2405.0081	0.2160	519.4818 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	790.1359	0.2160	170.6694 (264)
Space and water heating			690.1511 (265)
Pumps and fans	125.0000	0.5190	64.8750 (267)
Energy for lighting	317.4070	0.5190	164.7342 (268)
Energy saving/generation technologies			
PV Unit	-1643.2472	0.5190	-852.8453 (269)
Total kg/year			66.9151 (272)

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

Regs Region: England

Elmhurst Energy Systems

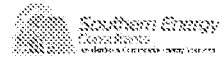
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FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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	2405.0081	1.2200	2934.1099 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	790.1359	1.2200	963.9658 (264)
Space and water heating			3898.0757 (265)
Pumps and fans	125.0000	3.0700	383.7500 (267)
Energy for lighting	317.4070	3.0700	974.4396 (268)
Energy saving/generation technologies			
PV Unit	-1643.2472	3.0700	-5044.7688 (269)
Primary energy kWh/year			211.4965 (272)
Primary energy kWh/m2/year			2.9906 (273)

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

Overheating Calculation Input Data

Dwelling type	SemiDetached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	South East England
Front of dwelling faces	South
Overshading	Average or unknown
Thermal mass parameter	100.0
Night ventilation	Yes
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	228.38 (P1)
Transmission heat loss coefficient	61.85 (37)
Summer heat loss coefficient	290.22 (P2)

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

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

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North	7.9200	86.6589	0.4500	0.0000	0.9000	277.9670
East	0.6600	124.7972	0.4500	0.0000	0.9000	33.3583
South	4.8600	118.3991	0.4500	0.0000	0.9000	233.0449

total: 544.3701

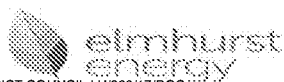
Solar gains	Jun 578	Jul 544	Aug 479	(P4)
Internal gains	395	378	386	
Total summer gains	973	923	865	(P5)
Summer gain/loss ratio	3.35	3.18	2.98	(P6)
Summer external temperature	15.40	17.40	17.50	
Thermal mass temperature increment (TMP = 100.0)	1.30	1.30	1.30	
Threshold temperature	20.05	21.88	21.78	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	
Assessment of likelihood of high internal temperature:	Slight			

Regs Region: England

Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.04r08



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Property Reference	SECLIT062				Issued on Date	29/09/2017
Survey Reference	001	Prop Type Ref	Ainwick			
Property	Plot 62, Littlehampton, Phase 2, Littlehampton, West Sussex, BN17					
SAP Rating	93 A	DER	7.06	TER	19.93	
Environmental	96 A	% DER<TER	64.57			
CO ₂ Emissions (t/year)	0.11	DFEE	51.80	TREE	53.12	
General Requirements Compliance	Pass	% DFEE<TFEE	2.47			
Surveyor	Stephen Smith, Tel: 01635 261582				Surveyor ID	D168-0001
Client	Persimmon Homes South East					

SAP2012 - 9.92 input data (DesignData) -

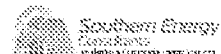
SAP2012 Input Data (House) 29/09/2017

FullRefNo: 001

Regs Region: England
 SAP Region: South East England
 Postcode: BN17
 DwellingOrientation: West
 Property Type: House, End-Terrace
 Storeys: 2
 Date Built: 2015
 Sheltered Sides: 2
 Sunlight Shade: Average or unknown
 Measurements: Perimeter, Floor Area, Storey Height
 1st Storey: 17.5, 30.69, 2.31
 2nd Storey: 17.5, 28.59, 2.54
 Living Area: 13.06 m2, fraction: 22.0%
 Thermal Mass: Simple calculation
 Thermal Mass Simple: Low
 Thermal MassValue: 100
 External Walls: Nett Area, Gross Area, Kappa, Element, Construction, Type, ShelterFactor, UValueFinal
 External Wall 1: 73.15, 84.88, 0, Other, Cavity, 0, 0.28, Calculate
 Party Walls: Area, Kappa, Element, Construction, Type, ShelterFactor, UValueFinal
 Party Wall 1: 36.38, 0, Other, FilledWithEdge, 0, 0
 External Roofs: Nett Area, Gross Area, Kappa, Construction, Element, UValueFinal
 External Roof 1: 30.69, 30.69, 9, Plasterboard, insulated at ceiling level, 0.14
 Heat Loss Floors: Area, Kappa, Construction, Element, Type, ShelterFactor, UValueFinal
 Heat Loss Floor 1: 30.69, 0, Other, Ground floor - Solid, 0, 0.18
 Description: Data Source, Type, Glazing, Glazing Gap, Argon Filled, Solar Trans, Frame Type, Frame Factor, U Value
 Opening Type 1: Manufacturer, Solid Door, , , , , , ,
 Opening Type 2: BPRC data, Window, Double Low-E Hard 0.15, , , 0.45, , ,
 Openings: Opening Type, Location, Orientation, Pitch, Curtain Type, Overhang Ratio, Wide Overhang, Width, Height, Count, Area, Curtain Closed
 Opening 1: Solid Door, External Wall 1, West, , , , 0, 0, 1.95,
 Opening 2: Window, External Wall 1, North, , None, 0, , 0, 0, 0.44,
 Opening 3: Window, External Wall 1, West, , None, 0, , 0, 0, 1.62,
 Opening 4: Window, External Wall 1, West, , None, 0, , 0, 0, 0.59,
 Opening 5: Window, External Wall 1, West, , None, 0, , 0, 0, 1.44,
 Opening 6: Window, External Wall 1, East, , None, 0, , 0, 0, 3.15,
 Opening 7: Window, External Wall 1, East, , None, 0, , 0, 0, 1.10,
 Opening 8: Window, External Wall 1, East, , None, 0, , 0, 0, 1.44,
 Conservatory: None
 Draught Proofing: 100
 Draught Lobby: No
 Thermal Bridges
 Bridging: User Input
 Y: 0.044
 Description: Est
 List of Bridges: Junction with, Bridge Type, Source Type, Imported, Length, Psi, Adjusted, Result, Reference
 0.: External wall, E1 Steel lintel with perforated steel base plate, , No, 0, 0, 0, 0.00,
 1.: External wall, E2 Other lintels (including other steel lintels), Independently assessed, Yes, 7.93, 0.179, 0.179, 1.42, Space4
 2.: External wall, E3 Sill, Table K1 - Approved, Yes, 7, 0.04, 0.04, 0.28, ACD
 3.: External wall, E4 Jamb, Table K1 - Approved, Yes, 22.5, 0.05, 0.05, 1.13, ACD
 4.: External wall, E5 Ground floor (normal), Independently assessed, Yes, 8.59, 0.081, 0.081, 0.70, Space4
 5.: External wall, E19 Ground floor (inverted), , No, 0, 0, 0, 0.00,
 6.: External wall, E20 Exposed floor (normal), , No, 0, 0, 0, 0.00,
 7.: External wall, E21 Exposed floor (inverted), , No, 0, 0, 0, 0.00,
 8.: External wall, E22 Basement floor, , No, 0, 0, 0, 0.00,
 9.: External wall, E6 Intermediate floor within a dwelling, Table K1 - Approved, Yes, 7.87, 0.07, 0.07, 0.55, ACD
 10.: External wall, E7 Party floor between dwellings (in blocks of flats), , No, 0, 0, 0, 0.00,
 11.: External wall, E8 Balcony within a dwelling, wall insulation continuous, , No, 0, 0, 0, 0.00,
 12.: External wall, E9 Balcony between dwellings, wall insulation continuous, , No, 0, 0, 0, 0.00,
 13.: External wall, E23 Balcony within or between dwellings, balcony support penetrates wall insulation, , No, 0, 0, 0, 0.00,
 14.: External wall, E10 Eaves (insulation at ceiling level), Independently assessed, No, 7.87, 0.026, 0.026, 0.20, Space4
 15.: External wall, E24 Eaves (insulation at ceiling level - inverted), , No, 0, 0, 0, 0.00,
 16.: External wall, E11 Eaves (insulation at rafter level), , No, 0, 0, 0, 0.00,
 17.: External wall, E12 Gable (insulation at ceiling level), Independently assessed, No, 0.8, 0.07, 0.07, 0.06, Space4
 18.: External wall, E13 Gable (insulation at rafter level), , No, 0, 0, 0, 0.00,
 19.: External wall, E14 Flat roof, , No, 0, 0, 0, 0.00,
 20.: External wall, E15 Flat roof with parapet, , No, 0, 0, 0, 0.00,
 21.: External wall, E16 Corner (normal), , No, 0, 0, 0, 0.00,
 22.: External wall, E17 Corner (inverted - internal area greater than external area), , No, 0, 0, 0, 0.00,
 23.: External wall, E18 Party wall between dwellings, Independently assessed, Yes, 19.4, 0.037, 0.037, 0.72, Space4
 24.: External wall, E25 Staggered party wall between dwellings, , No, 0, 0, 0, 0.00,
 25.: Party wall, P1 Party wall - Ground floor, Independently assessed, No, 8.27, 0.113, 0.113, 0.93, Space4
 26.: Party wall, P6 Party wall - Ground floor (inverted), , No, 0, 0, 0, 0.00,
 27.: Party wall, P2 Party wall - Intermediate floor within a dwelling, Independently assessed, No, 7.26, 0, 0, 0.00, Space4
 28.: Party wall, P3 Party wall - Intermediate floor between dwellings (in blocks of flats), , No, 0, 0, 0, 0.00,
 29.: Party wall, P7 Party Wall - Exposed floor (normal), , No, 0, 0, 0, 0.00,
 30.: Party wall, P8 Party Wall - Exposed floor (inverted), , No, 0, 0, 0, 0.00,
 31.: Party wall, P4 Party wall - Roof (insulation at ceiling level), Table K1 - Default, No, 7.26, 0.24, 0.24, 1.74, Default

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



SAP2012 - 9.92 input data (DesignData) -

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32.      Party wall, P5 Party wall - Roof (insulation at rafter level), , No, 0, 0, 0, 0.00,
33.      External roof, R1 Head of roof window, , No, 0, 0, 0, 0.00,
34.      External roof, R2 Sill of roof window, , No, 0, 0, 0, 0.00,
35.      External roof, R3 Jamb of roof window, , No, 0, 0, 0, 0.00,
36.      External roof, R4 Ridge (vaulted ceiling), , No, 0, 0, 0, 0.00,
37.      External roof, R5 Ridge (inverted), , No, 0, 0, 0, 0.00,
38.      External roof, R6 Flat ceiling, , No, 0, 0, 0, 0.00,
39.      External roof, R7 Flat ceiling (inverted), , No, 0, 0, 0, 0.00,
40.      External roof, R8 Roof to wall (rafter), , No, 0, 0, 0, 0.00,
41.      External roof, R9 Roof to wall (flat ceiling), , No, 0, 0, 0, 0.00,
Pressure Test:      True
Designed q50:      5
AsBuilt q50:      15
Property Tested:      False
Mechanical Ventilation      None
Chimneys MHS:      0
Chimneys SHS:      0
Chimneys Other:      0
Chimneys Total:      0
Open Flues MHS:      0
Open Flues SHS:      0
Open Flues Other:      0
Open Flues Total:      0
Intermittent Fans:      2
Passive Vents:      0
Flueless Gas Fires:      0
Cooling System      None
Light Fittings:      20
LEL Fittings:      20
Percentage of LEL Fittings:      100
External Lights Fitted:      Yes
External LELs Fitted:      Yes
Electricity Tariff:      Standard
Main Heating 1
  Description      None
  Percentage      100
  Sedbuk ID      17929
  Fuel Type      Mains gas
  MHS      Mains gas BGW Post 98 Combi condens. with auto ign.
  SAP Code      104
  Boiler Efficiency Type      Split Efficiencies
  Efficiency Winter      90.5
  Efficiency Summer      87.3
  Controls by PCDF      0
  MHS Controls      CBI Time and temperature zone control
  Boiler Interlock      Yes
  Compensator      0
  Delayed Start Stat      Yes
  Ctrl SAP Code      2110
  Flue Type      Balanced
  Fan Assisted Flue      Yes
  Pumped      Pump in heated space
  Heat Pump Age      2013 or later
  Heat Emitter      Radiators
  Flow Temperature      Normal (> 45°C)
  Combi boiler type      Standard Combi
  Combi keep hot type      None
Main Heating 2      None
Heating Systems Interaction      Each system heats separate parts of dwelling
Smoke Control Area      Unknown
Community Heating      None
Secondary Heating      None
Water Heating
  Type      MainHeating1
  WHS      HWP From main heating 1
  Low Water Usage      Yes
  SAP Code      901
  Showers in Property      Non-electric only
  Hot Water Cylinder      None
Flue Gas Heat Recovery System      None
Waste Water Heat Recovery      none
PV Unit
  Type      One Dwelling
  PVUnit 1      Cells Peak = 2, Orientation = South, Elevation = 30°, Overshading = Modest, , Connected to Dwelling = Yes
Wind Turbine      None
Terrain Type:      Urban
Small Scale Hydro      None
Special Features      None

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

DWELLING AS DESIGNED

End-Terrace House, total floor area 59 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) 19.93 kgCO₂/m²
Dwelling Carbon Dioxide Emission Rate (DER) 7.06 kgCO₂/m²OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)53.1 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)51.8 kWh/m²/yrOK

2 Fabric U-values

Regs Region: England

Elmhurst Energy Systems

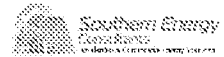
SAP2012 Calculator (Design

System) version 4.04r08



FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



SAP2012 - 9.92 input data (DesignData) -

Element	Average	Highest	
External wall	0.28 (max. 0.30)	0.28 (max: 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.18 (max. 0.25)	0.18 (max. 0.70)	OK
Roof	0.14 (max. 0.20)	0.14 (max. 0.35)	OK
Openings	1.38 (max. 2.00)	1.40 (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

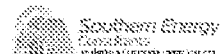
8 Mechanical ventilation			
Not applicable			

9 Summertime temperature			
Overheating risk (South East England):	Medium		OK
Based on:			
Overshading:	Average		
Windows facing North:	0.44 m², No overhang		
Windows facing East:	5.69 m², No overhang		
Windows facing West:	3.65 m², No overhang		
Air change rate:	3.00 ach		
Blinds/curtains:	None		

10 Key features			
Party wall U-value	0.00 W/m²K		
Photovoltaic array			

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	30.6900 (1b)	x 2.3100 (2b)	= 70.8939 (1b) - (3b)
First floor	28.5900 (1c)	x 2.5400 (2c)	= 72.6186 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	59.2800		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 143.5125 (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					2 * 10 = 20.0000 (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)					20.0000 / (5) = 0.1394 (8)
Pressure test					Yes
Measured/design q50					5.0000
Infiltration rate					0.3894 (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) =	0.3310 (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	0.4220	0.4137	0.4054	0.3641	0.3558	0.3144	0.3144	0.3061	0.3310	0.3558	0.3723	0.3889 (22b)
Effective ac	0.5890	0.5856	0.5822	0.5663	0.5633	0.5494	0.5494	0.5469	0.5548	0.5633	0.5693	0.5756 (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			1.9500	1.3000	2.5350		(26)					
Opening Type 2 (Uw = 1.40)			9.7800	1.3258	12.9659		(27)					
Heat Loss Floor 1			30.6900	0.1800	5.5242		(28a)					
External Wall 1	84.8800	11.7300	73.1500	0.2800	20.4820		(29a)					
External Roof 1	30.6900		30.6900	0.1400	4.2966		(30)					
Total net area of external elements Aum(A, m2)			146.2600				(31)					
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	45.8037		(33)					
Party Wall 1			36.3800	0.0000	0.0000		(32)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K								100.0000 (35)				
Thermal bridges (User defined value 0.044 * total exposed area)								6.4354 (36)				
Total fabric heat loss								(33) + (36) = 52.2391 (37)				
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 27.8959	Feb 27.7322	Mar 27.5717	Apr 26.8179	May 26.6769	Jun 26.0204	Jul 26.0204	Aug 25.8988	Sep 26.2732	Oct 26.6769	Nov 26.9622	Dec 27.2605 (38)
Heat transfer coeff	80.1351	79.9713	79.8108	79.0571	78.9160	78.2595	78.2595	78.1379	78.5124	78.9160	79.2013	79.4996 (39)
Average = Sum(39)m / 12 =												79.0564 (39)
HLP	Jan 1.3518	Feb 1.3490	Mar 1.3463	Apr 1.3336	May 1.3312	Jun 1.3202	Jul 1.3202	Aug 1.3181	Sep 1.3244	Oct 1.3312	Nov 1.3361	Dec 1.3411 (40)
HLP (average)												1.3336 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

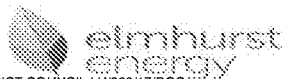
Assumed occupancy												1.9612 (42)
Average daily hot water use (litres/day)												80.7786 (43)
Daily hot water use	88.8565	85.6253	82.3942	79.1631	75.9319	72.7008	72.7008	75.9319	79.1631	82.3942	85.6253	88.8565 (44)
Energy conte	131.7716	115.2483	118.9259	103.6825	99.4858	85.8487	79.5514	91.2864	92.3767	107.6561	117.5151	127.6138 (45)
Energy content (annual)										Total = Sum(45)m =		1270.9623 (45)
Distribution loss (46)m = 0.15 x (45)m	19.7657	17.2872	17.8389	15.5524	14.9229	12.8773	11.9327	13.6930	13.8565	16.1484	17.6273	19.1421 (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)

Regs Region: England

Elmhurst Energy Systems

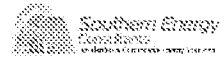
SAP2012 Calculator (Design

System) version 4.04r08



FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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	14.0376	12.6621	13.9917	13.5098	13.9379	13.4626	13.8954	13.9229	13.4883	13.9694	13.5543	14.0287 (61)
Total heat required for water heating calculated for each month	145.8092	127.9104	132.9176	117.1923	113.4237	99.3113	93.4468	105.2094	105.8650	121.6256	131.0694	141.6425 (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	145.8092	127.9104	132.9176	117.1923	113.4237	99.3113	93.4468	105.2094	105.8650	121.6256	131.0694	141.6425 (64)
Heat gains from water heating, kWh/month	47.3235	41.4856	43.0408	37.8519	36.5635	31.9103	29.9247	33.8335	34.0873	39.2880	42.4623	45.9388 (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	98.0603	98.0603	98.0603	98.0603	98.0603	98.0603	98.0603	98.0603	98.0603	98.0603	98.0603	98.0603 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	15.8223	14.0532	11.4288	8.6524	6.4677	5.4603	5.9001	7.6692	10.2935	13.0700	15.2546	16.2620 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	171.1275	172.9032	168.4284	158.9019	146.8764	135.5742	128.0236	126.2478	130.7227	140.2492	152.2746	163.5769 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	32.8060	32.8060	32.8060	32.8060	32.8060	32.8060	32.8060	32.8060	32.8060	32.8060	32.8060	32.8060 (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)	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482 (71)
Water heating gains (Table 5)	63.6068	61.7345	57.8505	52.5720	49.1445	44.3199	40.2214	45.4751	47.3435	52.8065	58.9755	61.7456 (72)
Total internal gains	305.9746	304.1090	293.1258	275.5444	257.9067	240.7725	229.5631	234.8101	243.7778	261.5437	281.9228	297.0026 (73)

6. Solar gains

[Jan]					Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d		Gains W	
North					0.4400	10.6334	0.4500	0.0000	0.7700		1.6212 (74)	
East					5.6900	19.6403	0.4500	0.0000	0.7700		38.7224 (76)	
West					3.6500	19.6403	0.4500	0.0000	0.7700		24.8395 (80)	
Solar gains	65.1831	127.4389	210.0359	307.1031	377.3942	386.8638	368.0856	315.4331	244.4873	151.2287	81.2542	53.6218 (83)
Total gains	371.1578	431.5479	503.1618	582.6475	635.3009	627.6363	597.6487	550.2432	488.2651	412.7724	363.1770	350.6244 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Thl (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	20.5486	20.5907	20.6321	20.8288	20.8661	21.0411	21.0411	21.0738	20.9733	20.8661	20.7909	20.7129
alpha	2.3699	2.3727	2.3755	2.3886	2.3911	2.4027	2.4027	2.4049	2.3982	2.3911	2.3861	2.3809
util living area	0.9649	0.9490	0.9168	0.8530	0.7541	0.6231	0.4995	0.5469	0.7414	0.8936	0.9513	0.9691 (86)
MIT	18.2392	18.5246	19.0362	19.6977	20.2773	20.6876	20.8696	20.8335	20.4892	19.7186	18.8613	18.1852 (87)
Th 2	19.8005	19.8026	19.8047	19.8146	19.8164	19.8251	19.8251	19.8267	19.8217	19.8164	19.8127	19.8088 (88)
util rest of house	0.9593	0.9408	0.9030	0.8272	0.7080	0.5458	0.3898	0.4383	0.6758	0.8692	0.9421	0.9641 (89)
MIT 2	16.1448	16.5578	17.2938	18.2338	19.0243	19.5485	19.7442	19.7157	19.3253	18.2858	17.0562	16.0709 (90)
Living area fraction	16.6062	16.9912	17.6777	18.5563	19.3003	19.7995	19.9921	19.9619	19.5817	18.6015	17.4539	16.5368 (92)
Temperature adjustment	16.4562	16.8412	17.5277	18.4063	19.1503	19.6495	19.8421	19.8119	19.4317	18.4515	17.3039	16.3868 (93)

8. Space heating requirement

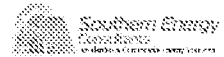
Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	0.9346	0.9106	0.8663	0.7883	0.6773	0.5328	0.3916	0.4367	0.6497	0.8310	0.9125	0.9414 (94)
Ext temp.	346.8778	392.9739	435.8738	459.2939	430.3169	334.4295	234.0216	240.3141	317.2432	343.0053	331.4047	330.0654 (95)
Heat loss rate W	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	974.1363	954.9498	880.1279	751.5424	587.9501	395.1709	253.7259	266.6026	418.6076	619.6069	808.1602	968.8418 (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 per m2	466.6803	377.6478	330.5251	210.4190	117.2791	0.0000	0.0000	0.0000	0.0000	205.7916	343.2640	475.2496 (98)
												2526.8565 (98)
												42.6258 (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													2792.1067 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	466.6803	377.6478	330.5251	210.4190	117.2791	0.0000	0.0000	0.0000	0.0000	205.7916	343.2640	475.2496	(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)	515.6689	417.2904	365.2211	232.5071	129.5902	0.0000	0.0000	0.0000	0.0000	227.3940	379.2972	525.1377	(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	145.8092	127.9104	132.9176	117.1923	113.4237	99.3113	93.4468	105.2094	105.8650	121.6256	131.0694	141.6425	(64)
Efficiency of water heater (217)m	89.7171	89.6684	89.5585	89.3287	88.8979	87.3000	87.3000	87.3000	87.3000	89.2843	89.5925	89.7447	(217)
Fuel for water heating, kWh/month	162.5210	142.6482	148.4143	131.1922	127.5886	113.7586	107.0410	120.5147	121.2657	136.2228	146.2949	157.8282	(219)
Water heating fuel used												1615.2905	(219)
Annual totals kWh/year													
Space heating fuel - main system												2792.1067	(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)												279.4265	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.00 * 1080 * 0.80) =									-1381.7915			-1381.7915	(233)
Total delivered energy for all uses												3380.0322	(238)

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

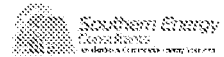
	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	2792.1067	0.2160	603.0950 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1615.2905	0.2160	348.9028 (264)
Space and water heating			951.9978 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	279.4265	0.5190	145.0224 (268)
Energy saving/generation technologies			
PV Unit	-1381.7915	0.5190	-717.1498 (269)
Total CO2, kg/year			418.7954 (272)
Dwelling Carbon Dioxide Emission Rate (DER)			7.0600 (273)

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

DER			7.0600 ZC1
Total Floor Area		TFA	59.2800
Assumed number of occupants		N	1.9612
CO2 emission factor in Table 12 for electricity displaced from grid		EF	0.5190
CO2 emissions from appliances, equation (L14)			17.1064 ZC2
CO2 emissions from cooking, equation (L16)			2.8014 ZC3
Total CO2 emissions			26.9678 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			26.9678 ZC8

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF STANDARD ENE7 CO2 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF STANDARD ENE7 CO2 09 Jan 2014

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	30.6900 (1b)	x 2.3100 (2b)	= 70.8939 (1b) - (3b)
First floor	28.5900 (1c)	x 2.5400 (2c)	= 72.6186 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	59.2800		(3a) + (3b) + (3c) + (3d) + (3e) ... (3n) = 143.5125 (5)
Dwelling volume			

2. Ventilation rate

	main heating	+	secondary heating	+	other	=	total	m3 per hour				
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000 (6a)				
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000 (6b)				
Number of intermittent fans							2 * 10 =	20.0000 (7a)				
Number of passive vents							0 * 10 =	0.0000 (7b)				
Number of flueless gas fires							0 * 40 =	0.0000 (7c)				
Air changes per hour												
Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(7a)+(7b)+(7c) =						20.0000 / (5) =	0.1394 (8)				
Pressure test							Yes					
Measured/design q50							5.0000					
Infiltration rate							0.3894 (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) =	0.3310 (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	0.4220	0.4137	0.4054	0.3641	0.3558	0.3144	0.3144	0.3061	0.3310	0.3558	0.3723	0.3889 (22b)
Effective ac	0.5890	0.5856	0.5822	0.5663	0.5633	0.5494	0.5494	0.5469	0.5548	0.5633	0.5693	0.5756 (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			1.9500	1.3000	2.5350			(26)					
Opening Type 2 (Uw = 1.40)			9.7800	1.3258	12.9659			(27)					
Heat Loss Floor 1			30.6900	0.1800	5.5242			(28a)					
External Wall 1	84.8800	11.7300	73.1500	0.2800	20.4820			(29a)					
External Roof 1	30.6900		30.6900	0.1400	4.2966			(30)					
Total net area of external elements Aum(A, m2)			146.2600					(31)					
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	45.8037			(33)					
Party Wall 1			36.3800	0.0000	0.0000			(32)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K								100.0000 (35)					
Thermal bridges (User defined value 0.044 * total exposed area)								6.4354 (36)					
Total fabric heat loss						(33) + (36) =	52.2391	(37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)													
(38)m	Jan 27.8959	Feb 27.7322	Mar 27.5717	Apr 26.8179	May 26.6769	Jun 26.0204	Jul 26.0204	Aug 25.8988	Sep 26.2732	Oct 26.6769	Nov 26.9622	Dec 27.2605	(38)
Heat transfer coeff	80.1351	79.9713	79.8108	79.0571	78.9160	78.2595	78.2595	78.1379	78.5124	78.9160	79.2013	79.4996	(39)
Average = Sum(39)m / 12 =												79.0564	(39)
HLP	Jan 1.3518	Feb 1.3490	Mar 1.3463	Apr 1.3336	May 1.3312	Jun 1.3202	Jul 1.3202	Aug 1.3181	Sep 1.3244	Oct 1.3312	Nov 1.3361	Dec 1.3411	(40)
HLP (average)												1.3336	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												1.9612 (42)
Average daily hot water use (litres/day)												80.7786 (43)
Daily hot water use	Jan 88.8565	Feb 85.6253	Mar 82.3942	Apr 79.1631	May 75.9319	Jun 72.7008	Jul 72.7008	Aug 75.9319	Sep 79.1631	Oct 82.3942	Nov 85.6253	Dec 88.8565 (44)
Energy conte	131.7716	115.2483	118.9259	103.6825	99.4858	85.8487	79.5514	91.2864	92.3767	107.6561	117.5151	127.6138 (45)
Energy content (annual)										Total = Sum(45)m =		1270.9623 (45)
Distribution loss (46)m = 0.15 x (45)m	19.7657	17.2872	17.8389	15.5524	14.9229	12.8773	11.9327	13.6930	13.8565	16.1484	17.6273	19.1421 (46)
Water storage loss:												150.0000 (47)
Store volume												
b) If manufacturer declared loss factor is not known :												

Regs Region: England

Elmhurst Energy Systems

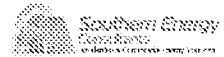
SAP2012 Calculator (Design

System) version 4.04r08



FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF STANDARD ENE7 CO2 09 Jan 2014

Hot water storage loss factor from Table 2 (kWh/litre/day)													0.0191 (51)
Volume factor from Table 2a													0.9283 (52)
Temperature factor from Table 2b													0.5400 (53)
Enter (49) or (54) in (55)													1.4364 (55)
Total storage loss	44.5282	40.2190	44.5282	43.0918	44.5282	43.0918	44.5282	44.5282	43.0918	44.5282	43.0918	44.5282	(56)
If cylinder contains dedicated solar storage	44.5282	40.2190	44.5282	43.0918	44.5282	43.0918	44.5282	44.5282	43.0918	44.5282	43.0918	44.5282	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month	199.5622	176.4785	186.7165	169.2863	167.2764	151.4525	147.3420	159.0770	157.9805	175.4467	183.1189	195.4044	(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 =													(63)
Output from w/h	199.5622	176.4785	186.7165	169.2863	167.2764	151.4525	147.3420	159.0770	157.9805	175.4467	183.1189	195.4044	(64)
Heat gains from water heating, kWh/month	98.0465	87.3042	93.7753	86.9575	87.3115	81.0277	80.6833	84.5852	83.1983	90.0281	91.5568	96.6640	(65)
Total per year (kWh/year) = Sum(64)m =													(64)

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

Metabolic gains (Table 5), Watts													
(66)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	98.0603	98.0603	98.0603	98.0603	98.0603	98.0603	98.0603	98.0603	98.0603	98.0603	98.0603	98.0603	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	15.8223	14.0532	11.4288	8.6524	6.4677	5.4603	5.9001	7.6692	10.2935	13.0700	15.2546	16.2620	(67)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	171.1275	172.9032	168.4284	158.9019	146.8764	135.5742	128.0236	126.2478	130.7227	140.2492	152.2746	163.5769	(68)
Pumps, fans	32.8060	32.8060	32.8060	32.8060	32.8060	32.8060	32.8060	32.8060	32.8060	32.8060	32.8060	32.8060	(69)
Losses e.g. evaporation (negative values) (Table 5)	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)
Water heating gains (Table 5)	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	(71)
Total internal gains	131.7830	129.9170	126.0421	120.7743	117.3542	112.5385	108.4453	113.6898	115.5532	121.0056	127.1622	129.9248	(72)
	374.1508	372.2915	361.3174	343.7466	326.1164	308.9911	297.7871	303.0248	311.9875	329.7428	350.1096	365.1818	(73)

6. Solar gains

[Jan]					Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d		Gains W		
North					0.4400	10.6334	0.4500	0.0000	0.7700		1.6212 (74)		
East					5.6900	19.6403	0.4500	0.0000	0.7700		38.7224 (76)		
West					3.6500	19.6403	0.4500	0.0000	0.7700		24.8395 (80)		
Solar gains	65.1831	127.4389	210.0359	307.1031	377.3942	386.8638	368.0856	315.4331	244.4873	151.2287	81.2542	53.6218	(83)
Total gains	439.3340	499.7304	571.3534	650.8497	703.5106	695.8549	665.8727	618.4579	556.4748	480.9715	431.3638	418.8036	(84)

7. Mean internal temperature (heating season)

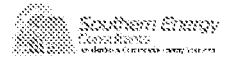
Temperature during heating periods in the living area from Table 9, Thl (C)													21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
tau	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
alpha	20.5486	20.5907	20.6321	20.8288	20.8661	21.0411	21.0411	21.0738	20.9733	20.8661	20.7909	20.7129	
util living area	2.3699	2.3727	2.3755	2.3886	2.3911	2.4027	2.4027	2.4049	2.3982	2.3911	2.3861	2.3809	
	0.9509	0.9324	0.8957	0.8252	0.7199	0.5838	0.4599	0.5028	0.6962	0.8621	0.9321	0.9557	(86)
MIT	18.4071	18.6837	19.1785	19.8113	20.3549	20.7308	20.8915	20.8620	20.5614	19.8485	19.0215	18.3562	(87)
Th 2	19.8005	19.8026	19.8047	19.8146	19.8164	19.8251	19.8251	19.8267	19.8217	19.8164	19.8127	19.8088	(88)
util rest of house	0.9432	0.9220	0.8791	0.7964	0.6714	0.5069	0.3553	0.3981	0.6272	0.8329	0.9198	0.9488	(89)
MIT 2	17.4689	17.7416	18.2257	18.8384	19.3395	19.6651	19.7801	19.7654	19.5369	18.8899	18.0854	17.4244	(90)
Living area fraction	17.6756	17.9491	18.4356	19.0527	19.5632	19.8999	20.0249	20.0070	19.7626	19.1011	18.2916	17.6297	(91)
MIT	17.6756	17.9491	18.4356	19.0527	19.5632	19.8999	20.0249	20.0070	19.7626	19.1011	18.2916	17.6297	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.6756	17.9491	18.4356	19.0527	19.5632	19.8999	20.0249	20.0070	19.7626	19.1011	18.2916	17.6297	(93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	0.9250	0.9009	0.8554	0.7746	0.6597	0.5122	0.3742	0.4155	0.6232	0.8112	0.8991	0.9316	(94)
Ext temp.	406.3864	450.2104	488.7474	504.1487	464.1183	356.4040	249.1943	256.9535	346.8083	390.1477	387.8526	390.1719	(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	1071.8545	1043.5571	952.5900	802.6432	620.5324	414.7654	268.0316	281.8420	444.5838	670.8745	886.3908	1067.6558	(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	495.1083	398.7290	345.0988	214.9160	116.3720	0.0000	0.0000	0.0000	0.0000	208.8608	358.9476	504.0481	(98)
Space heating per m2												2642.0805	(98)
												44.5695	(99)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF STANDARD ENE7 CO2 09 Jan 2014

8c. Space cooling requirement

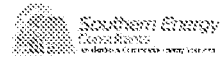
Not applicable

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

DER		10.9300	ZC1
Total Floor Area	TFA	59.2800	
Assumed number of occupants	N	1.9612	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		17.1064	ZC2
CO2 emissions from cooking, equation (L16)		2.8014	ZC3
Total CO2 emissions		30.8378	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m ² /year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		30.8378	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	30.6900 (1b)	x 2.3100 (2b)	= 70.8939 (1b) - (3b)
First floor	28.5900 (1c)	x 2.5400 (2c)	= 72.6186 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	59.2800		(3a) + (3b) + (3c) + (3d) + (3e) ... (3n) = 143.5125 (5)
Dwelling volume			

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					2 * 10 = 20.0000 (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) =					20.0000 / (5) = 0.1394 (8)
Pressure test					Yes
Measured/design q50					5.0000
Infiltration rate					0.3894 (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) =	0.3310 (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												
Effective ac	0.4220	0.4137	0.4054	0.3641	0.3558	0.3144	0.3144	0.3061	0.3310	0.3558	0.3723	0.3889 (22b)
	0.5890	0.5856	0.5822	0.5663	0.5633	0.5494	0.5494	0.5469	0.5548	0.5633	0.5693	0.5756 (25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K					
TER Opaque door			1.9500	1.0000	1.9500		(26)					
TER Opening Type (Uw = 1.40)			9.7800	1.3258	12.9659		(27)					
Heat Loss Floor 1			30.6900	0.1300	3.9897		(28a)					
External Wall 1	84.8800	11.7300	73.1500	0.1800	13.1670		(29a)					
External Roof 1	30.6900		30.6900	0.1300	3.9897		(30)					
Total net area of external elements Aum(A, m2)			146.2600				(31)					
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	36.0623		(33)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							6.4629 (36)					
Total fabric heat loss						(33) + (36) =	42.5252 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	27.8959	27.7322	27.5717	26.8179	26.6769	26.0204	26.0204	25.8988	26.2732	26.6769	26.9622	27.2605 (38)
Heat transfer coeff	70.4211	70.2574	70.0969	69.3431	69.2021	68.5456	68.5456	68.4240	68.7984	69.2021	69.4874	69.7857 (39)
Average = Sum(39)m / 12 =												69.3424 (39)
HLP	Jan 1.1879	Feb 1.1852	Mar 1.1825	Apr 1.1698	May 1.1674	Jun 1.1563	Jul 1.1563	Aug 1.1543	Sep 1.1606	Oct 1.1674	Nov 1.1722	Dec 1.1772 (40)
HLP (average)												1.1697 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												1.9612 (42)
Average daily hot water use (litres/day)												80.7786 (43)
Daily hot water use	88.8565	85.6253	82.3942	79.1631	75.9319	72.7008	72.7008	75.9319	79.1631	82.3942	85.6253	88.8565 (44)
Energy conte	131.7716	115.2483	118.9259	103.6825	99.4858	85.8487	79.5514	91.2864	92.3767	107.6561	117.5151	127.6138 (45)
Energy content (annual)												Total = Sum(45)m = 1270.9623 (45)
Distribution loss (46)m = 0.15 x (45)m												
	19.7657	17.2872	17.8389	15.5524	14.9229	12.8773	11.9327	13.6930	13.8565	16.1484	17.6273	19.1421 (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

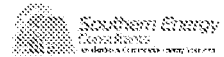
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System) version 4.04r08



FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	45.2803	39.4111	41.9872	39.0393	38.6941	35.8524	37.0475	38.6941	39.0393	41.9872	42.2262	45.2803 (61)
Total heat required for water heating calculated for each month												
Solar input	177.0519	154.6594	160.9131	142.7218	138.1799	121.7011	116.5989	129.9805	131.4160	149.6433	159.7413	172.8941 (62)
	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	177.0519	154.6594	160.9131	142.7218	138.1799	121.7011	116.5989	129.9805	131.4160	149.6433	159.7413	172.8941 (64)
Total per year (kWh/year) = Sum(63)m =												1755.5013 (64)
Heat gains from water heating, kWh/month	55.1341	48.1728	50.0397	44.2343	42.7526	37.5078	35.7127	40.0263	40.4751	46.2925	49.6303	53.7516 (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	98.0603	98.0603	98.0603	98.0603	98.0603	98.0603	98.0603	98.0603	98.0603	98.0603	98.0603	98.0603 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5												
	15.8223	14.0532	11.4288	8.6524	6.4677	5.4603	5.9001	7.6692	10.2935	13.0700	15.2546	16.2620 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5												
	171.1275	172.9032	168.4284	158.9019	146.8764	135.5742	128.0236	126.2478	130.7227	140.2492	152.2746	163.5769 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												
	32.8060	32.8060	32.8060	32.8060	32.8060	32.8060	32.8060	32.8060	32.8060	32.8060	32.8060	32.8060 (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)												
	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482 (71)
Water heating gains (Table 5)												
	74.1050	71.6858	67.2576	61.4365	57.4631	52.0942	48.0010	53.7987	56.2154	62.2210	68.9310	72.2468 (72)
Total internal gains	316.4729	314.0603	302.5329	284.4088	266.2253	248.5467	237.3427	243.1338	252.6497	270.9583	291.8783	307.5038 (73)

6. Solar gains

[Jan]					Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d		Gains W	
North					0.4400	10.6334	0.6300	0.7000	0.7700		1.4299 (74)	
East					5.6900	19.6403	0.6300	0.7000	0.7700		34.1532 (76)	
West					3.6500	19.6403	0.6300	0.7000	0.7700		21.9085 (80)	
Solar gains	57.4915	112.4011	185.2517	270.8649	332.8617	341.2139	324.6515	278.2120	215.6378	133.3837	71.6662	47.2944 (83)
Total gains	373.9644	426.4614	487.7846	555.2737	599.0870	589.7606	561.9942	521.3457	468.2875	404.3420	363.5446	354.7982 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Thl (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	58.4578	58.5941	58.7282	59.3666	59.4876	60.0574	60.0574	60.1641	59.8366	59.4876	59.2434	58.9901
alpha	4.8972	4.9063	4.9152	4.9578	4.9658	5.0038	5.0038	5.0109	4.9891	4.9658	4.9496	4.9327
util living area	0.9975	0.9948	0.9857	0.9522	0.8607	0.6917	0.5253	0.5837	0.8387	0.9742	0.9950	0.9981 (86)
MIT	19.7366	19.8872	20.1565	20.5102	20.7980	20.9513	20.9899	20.9835	20.8704	20.4855	20.0467	19.7100 (87)
Th 2	19.9297	19.9319	19.9340	19.9443	19.9462	19.9551	19.9551	19.9568	19.9517	19.9462	19.9423	19.9383 (88)
util rest of house	0.9967	0.9930	0.9806	0.9345	0.8115	0.5991	0.4064	0.4613	0.7644	0.9613	0.9930	0.9974 (89)
MIT 2	18.2521	18.4733	18.8652	19.3733	19.7508	19.9233	19.9515	19.9501	19.8484	19.3492	18.7143	18.2194 (90)
Living area fraction									fLA = Living area / (4) =			0.2203 (91)
MIT	18.5792	18.7848	19.1497	19.6238	19.9815	20.1498	20.1803	20.1778	20.0735	19.5995	19.0078	18.5478 (92)
Temperature adjustment												0.0000
adjusted MIT	18.5792	18.7848	19.1497	19.6238	19.9815	20.1498	20.1803	20.1778	20.0735	19.5995	19.0078	18.5478 (93)

8. Space heating requirement

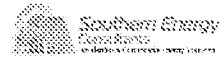
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9950	0.9902	0.9754	0.9278	0.8134	0.6175	0.4328	0.4883	0.7744	0.9556	0.9904	0.9961 (94)
Useful gains	372.1091	422.2881	475.8050	515.1815	487.2935	364.1949	243.2087	254.5558	362.6303	386.3723	360.0401	353.4230 (95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000 (96)
Heat loss rate W	1005.5543	975.5080	886.7022	743.6210	573.0951	380.4141	245.4122	258.4888	410.9693	622.7863	827.4436	1001.2722 (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	471.2832	371.7638	305.7075	164.4764	63.8364	0.0000	0.0000	0.0000	0.0000	175.8920	336.5306	481.9998 (98)
Space heating												2371.4896 (98)
Space heating per m2												(98) / (4) = 40.0049 (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

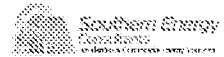
Fraction of space heat from secondary/supplementary system (Table 11)													0.0000 (201)
Fraction of space heat from main system(s)													1.0000 (202)
Efficiency of main space heating system 1 (in %)													93.4000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													2539.0681 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	471.2832	371.7638	305.7075	164.4764	63.8364	0.0000	0.0000	0.0000	0.0000	175.8920	336.5306	481.9998	(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)	504.5859	398.0340	327.3099	176.0990	68.3473	0.0000	0.0000	0.0000	0.0000	188.3212	360.3111	516.0598	(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	177.0519	154.6594	160.9131	142.7218	138.1799	121.7011	116.5989	129.9805	131.4160	149.6433	159.7413	172.8941	(64)
Efficiency of water heater	87.3980	87.1785	86.6420	85.4091	83.2387	80.3000	80.3000	80.3000	80.3000	85.4589	86.8825	80.3000	(216)
Fuel for water heating, kWh/month	202.5811	177.4054	185.7219	167.1038	166.0043	151.5581	145.2042	161.8686	163.6563	175.1055	183.8590	197.6053	(219)
Water heating fuel used													2077.6735 (219)
Annual totals kWh/year													
Space heating fuel - main system													2539.0681 (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)													279.4265 (232)
Total delivered energy for all uses													4971.1681 (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	2539.0681	0.2160	548.4387 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2077.6735	0.2160	448.7775 (264)
Space and water heating			997.2162 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	279.4265	0.5190	145.0224 (268)
Total CO2, kg/m2/year			1161.1635 (272)
Emissions per m2 for space and water heating			16.8221 (272a)
Fuel factor (mains gas)			1.0000
Emissions per m2 for lighting			2.4464 (272b)
Emissions per m2 for pumps and fans			0.6566 (272c)
Target Carbon Dioxide Emission Rate (TER) = (16.8221 * 1.00) + 2.4464 + 0.6566, rounded to 2 d.p.			19.9300 (273)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	30.6900 (1b)	x 2.3100 (2b)	= 70.8939 (1b) - (3b)
First floor	28.5900 (1c)	x 2.5400 (2c)	= 72.6186 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	59.2800		(3a) + (3b) + (3c) + (3d) + (3e) ... (3n) = 143.5125 (5)
Dwelling volume			

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					2 * 10 = 20.0000 (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) =					20.0000 / (5) = 0.1394 (8)
Pressure test					Yes
Measured/design q50					5.0000
Infiltration rate					0.3894 (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) =	0.3310 (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	0.4220	0.4137	0.4054	0.3641	0.3558	0.3144	0.3144	0.3061	0.3310	0.3558	0.3723	0.3889 (22b)
Effective ac	0.5890	0.5856	0.5822	0.5663	0.5633	0.5494	0.5494	0.5469	0.5548	0.5633	0.5693	0.5756 (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
Opening Type 1			1.9500	1.3000	2.5350		(26)
Opening Type 2 (Uw = 1.40)			9.7800	1.3258	12.9659		(27)
Heat Loss Floor 1			30.6900	0.1800	5.5242		(28a)
External Wall 1	84.8800	11.7300	73.1500	0.2800	20.4820		(29a)
External Roof 1	30.6900		30.6900	0.1400	4.2966		(30)
Total net area of external elements Aum(A, m ²)			146.2600				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	45.8037		(33)
Party Wall 1			36.3800	0.0000	0.0000		(32)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							100.0000 (35)
Thermal bridges (User defined value 0.044 * total exposed area)							6.4354 (36)
Total fabric heat loss						(33) + (36) =	52.2391 (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	27.8959	27.7322	27.5717	26.8179	26.6769	26.0204	26.0204	25.8988	26.2732	26.6769	26.9622	27.2605 (38)
Heat transfer coeff	80.1351	79.9713	79.8108	79.0571	78.9160	78.2595	78.2595	78.1379	78.5124	78.9160	79.2013	79.4996 (39)
Average = Sum(39)m / 12 =												79.0564 (39)
HLP	1.3518	1.3490	1.3463	1.3336	1.3312	1.3202	1.3202	1.3181	1.3244	1.3312	1.3361	1.3411 (40)
HLP (average)												1.3336 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												1.9612 (42)
Average daily hot water use (litres/day)												80.7786 (43)
Daily hot water use	88.8565	85.6253	82.3942	79.1631	75.9319	72.7008	72.7008	75.9319	79.1631	82.3942	85.6253	88.8565 (44)
Energy conte	131.7716	115.2483	118.9259	103.6825	99.4858	85.8487	79.5514	91.2864	92.3767	107.6561	117.5151	127.6138 (45)
Energy content (annual)										Total = Sum(45)m =		1270.9623 (45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

Regs Region: England

Elmhurst Energy Systems

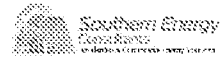
SAP2012 Calculator (Design

System) version 4.04r08



FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (59)
Heat gains from water heating, kWh/month	28.0015	24.4903	25.2718	22.0325	21.1407	18.2428	16.9047	19.3984	19.6300	22.8769	24.9720	27.1179 (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	98.0603	98.0603	98.0603	98.0603	98.0603	98.0603	98.0603	98.0603	98.0603	98.0603	98.0603	98.0603	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	15.8223	14.0532	11.4288	8.6524	6.4677	5.4603	5.9001	7.6692	10.2935	13.0700	15.2546	16.2620	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	171.1275	172.9032	168.4284	158.9019	146.8764	135.5742	128.0236	126.2478	130.7227	140.2492	152.2746	163.5769	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	32.8060	32.8060	32.8060	32.8060	32.8060	32.8060	32.8060	32.8060	32.8060	32.8060	32.8060	32.8060	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	(71)
Water heating gains (Table 5)	37.6364	36.4438	33.9674	30.6007	28.4150	25.3373	22.7213	26.0731	27.2640	30.7486	34.6833	36.4488	(72)
Total internal gains	277.0042	275.8184	266.2427	250.5731	234.1772	218.7899	209.0631	212.4081	220.6982	236.4858	254.6306	268.7058	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
North	0.4400	10.6334	0.4500	0.0000	0.7700	1.6212 (74)
East	5.6900	19.6403	0.4500	0.0000	0.7700	38.7224 (76)
West	3.6500	19.6403	0.4500	0.0000	0.7700	24.8395 (80)

Solar gains	65.1831	127.4389	210.0359	307.1031	377.3942	386.8638	368.0856	315.4331	244.4873	151.2287	81.2542	53.6218	(83)
Total gains	342.1874	403.2572	476.2786	557.6761	611.5714	605.6537	577.1487	527.8412	465.1855	387.7145	335.8848	322.3276	(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	20.5486	20.5907	20.6321	20.8288	20.8661	21.0411	21.0411	21.0738	20.9733	20.8661	20.7909	20.7129	
alpha	2.3699	2.3727	2.3755	2.3886	2.3911	2.4027	2.4027	2.4049	2.3982	2.3911	2.3861	2.3809	
util living area	0.9703	0.9554	0.9248	0.8631	0.7663	0.6366	0.5125	0.5628	0.7573	0.9047	0.9583	0.9741	(86)
MIT	18.1656	18.4562	18.9774	19.6533	20.2477	20.6718	20.8619	20.8224	20.4616	19.6673	18.7944	18.1122	(87)
Th 2	19.8005	19.8026	19.8047	19.8146	19.8164	19.8251	19.8251	19.8267	19.8217	19.8164	19.8127	19.8088	(88)
util rest of house	0.9654	0.9481	0.9120	0.8385	0.7212	0.5594	0.4014	0.4530	0.6933	0.8823	0.9502	0.9698	(89)
MIT 2	17.2322	17.5205	18.0341	18.6946	19.2509	19.6255	19.7661	19.7451	19.4616	18.7240	17.8657	17.1848	(90)
Living area fraction										fLA = Living area / (4) =		0.2203	(91)
MIT	17.4378	17.7266	18.2419	18.9058	19.4705	19.8560	20.0075	19.9825	19.6819	18.9318	18.0703	17.3891	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.4378	17.7266	18.2419	18.9058	19.4705	19.8560	20.0075	19.9825	19.6819	18.9318	18.0703	17.3891	(93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	0.9519	0.9308	0.8903	0.8156	0.7061	0.5617	0.4201	0.4691	0.6844	0.8607	0.9338	0.9574	(94)
Ext temp.	325.7135	375.3529	424.0374	454.8355	431.8034	340.1672	242.4824	247.5953	318.3756	333.7155	313.6610	308.6117	(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	1052.7995	1025.7611	937.1297	791.0319	613.2186	411.3354	266.6728	279.9264	438.2520	657.5153	868.8611	1048.5312	(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	540.9520	437.0743	381.7406	242.0614	134.9729	0.0000	0.0000	0.0000	0.0000	240.9071	399.7441	550.5001	(98)
Space heating per m2												2927.9526	(98)
												(98) / (4) =	49.3919 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	735.6393	579.1203	593.8482	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7271	0.7895	0.7574	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	534.9126	457.2142	449.7605	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	781.4687	746.7340	690.3161	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	177.5204	215.4027	178.9734	0.0000	0.0000	0.0000	0.0000	(104)

Regs Region: England

Elmhurst Energy Systems

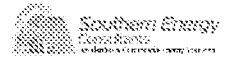
SAP2012 Calculator (Design

System) version 4.04r08



FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

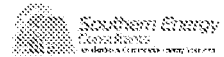


CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Space cooling											571.8965 (104)
Cooled fraction											1.0000 (105)
Intermittency factor (Table 10b)											
	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000 (106)
Space cooling kWh											
	0.0000	0.0000	0.0000	0.0000	44.3801	53.8507	44.7433	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling											142.9741 (107)
Space cooling per m2											2.4118 (108)
Energy for space heating											49.3919 (99)
Energy for space cooling											2.4118 (108)
Total											51.8038 (109)
Dwelling Fabric Energy Efficiency (DFEE)											51.8 (109)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	30.6900 (1b)	x 2.3100 (2b)	= 70.8939 (1b) - (3b)
First floor	28.5900 (1c)	x 2.5400 (2c)	= 72.6186 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	59.2800		(3a) + (3b) + (3c) + (3d) + (3e) ... (3n) = 143.5125 (5)
Dwelling volume			

2. Ventilation rate

	main heating	+	secondary heating	+	other	=	total	m3 per hour				
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000 (6a)				
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000 (6b)				
Number of intermittent fans							2 * 10 =	20.0000 (7a)				
Number of passive vents							0 * 10 =	0.0000 (7b)				
Number of flueless gas fires							0 * 40 =	0.0000 (7c)				
								Air changes per hour				
Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(7a)+(7b)+(7c) =						20.0000 / (5) =	0.1394 (8)				
Pressure test							Yes					
Measured/design q50								5.0000				
Infiltration rate								0.3894 (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) =	0.3310 (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	0.4220	0.4137	0.4054	0.3641	0.3558	0.3144	0.3144	0.3061	0.3310	0.3558	0.3723	0.3889 (22b)
Effective ac	0.5890	0.5856	0.5822	0.5663	0.5633	0.5494	0.5494	0.5469	0.5548	0.5633	0.5693	0.5756 (25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K					
TER Opaque door			1.9500	1.0000	1.9500		(26)					
TER Opening Type (Uw = 1.40)			9.7800	1.3258	12.9659		(27)					
Heat Loss Floor 1			30.6900	0.1300	3.9897		(28a)					
External Wall 1	84.8800	11.7300	73.1500	0.1800	13.1670		(29a)					
External Roof 1	30.6900		30.6900	0.1300	3.9897		(30)					
Total net area of external elements Aum(A, m2)			146.2600				(31)					
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	36.0623		(33)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							6.4629 (36)					
Total fabric heat loss						(33) + (36) =	42.5252 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 27.8959	Feb 27.7322	Mar 27.5717	Apr 26.8179	May 26.6769	Jun 26.0204	Jul 26.0204	Aug 25.8988	Sep 26.2732	Oct 26.6769	Nov 26.9622	Dec 27.2605 (38)
Heat transfer coeff	70.4211	70.2574	70.0969	69.3431	69.2021	68.5456	68.5456	68.4240	68.7984	69.2021	69.4874	69.7857 (39)
Average = Sum(39)m / 12 =												69.3424 (39)
HLP	Jan 1.1879	Feb 1.1852	Mar 1.1825	Apr 1.1698	May 1.1674	Jun 1.1563	Jul 1.1563	Aug 1.1543	Sep 1.1606	Oct 1.1674	Nov 1.1722	Dec 1.1772 (40)
HLP (average)												1.1697 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												1.9612 (42)
Average daily hot water use (litres/day)												80.7786 (43)
Daily hot water use	Jan 88.8565	Feb 85.6253	Mar 82.3942	Apr 79.1631	May 75.9319	Jun 72.7008	Jul 72.7008	Aug 75.9319	Sep 79.1631	Oct 82.3942	Nov 85.6253	Dec 88.8565 (44)
Energy conte	131.7716	115.2483	118.9259	103.6825	99.4858	85.8487	79.5514	91.2864	92.3767	107.6561	117.5151	127.6138 (45)
Energy content (annual)												Total = Sum(45)m = 1270.9623 (45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage												

Regs Region: England

Elmhurst Energy Systems

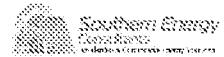
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System) version 4.04r08



FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Heat gains from water heating, kWh/month	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (59)
	28.0015	24.4903	25.2718	22.0325	21.1407	18.2428	16.9047	19.3984	19.6300	22.8769	24.9720	27.1179 (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	98.0603	98.0603	98.0603	98.0603	98.0603	98.0603	98.0603	98.0603	98.0603	98.0603	98.0603	98.0603	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	15.8223	14.0532	11.4288	8.6524	6.4677	5.4603	5.9001	7.6692	10.2935	13.0700	15.2546	16.2620	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	171.1275	172.9032	168.4284	158.9019	146.8764	135.5742	128.0236	126.2478	130.7227	140.2492	152.2746	163.5769	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	32.8060	32.8060	32.8060	32.8060	32.8060	32.8060	32.8060	32.8060	32.8060	32.8060	32.8060	32.8060	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	(71)
Water heating gains (Table 5)	37.6364	36.4438	33.9674	30.6007	28.4150	25.3373	22.7213	26.0731	27.2640	30.7486	34.6833	36.4488	(72)
Total internal gains	277.0042	275.8184	266.2427	250.5731	234.1772	218.7899	209.0631	212.4081	220.6982	236.4858	254.6306	268.7058	(73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W			
North				0.4400	10.6334	0.6300	0.7000	0.7700	1.4299 (74)			
East				5.6900	19.6403	0.6300	0.7000	0.7700	34.1532 (76)			
West				3.6500	19.6403	0.6300	0.7000	0.7700	21.9085 (80)			
Solar gains	57.4915	112.4011	185.2517	270.8649	332.8617	341.2139	324.6515	278.2120	215.6378	133.3837	71.6662	47.2944 (83)
Total gains	334.4958	388.2194	451.4944	521.4380	567.0389	560.0038	533.7146	490.6201	436.3360	369.8695	326.2968	316.0002 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Thl (C)													21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	58.4578	58.5941	58.7282	59.3666	59.4876	60.0574	60.0574	60.1641	59.8366	59.4876	59.2434	58.9901	
alpha	4.8972	4.9063	4.9152	4.9578	4.9658	5.0038	5.0038	5.0109	4.9891	4.9658	4.9496	4.9327	
util living area	0.9985	0.9965	0.9896	0.9620	0.8804	0.7183	0.5505	0.6148	0.8661	0.9818	0.9969	0.9989	(86)
MIT	19.6751	19.8284	20.1029	20.4673	20.7720	20.9424	20.9877	20.9792	20.8469	20.4369	19.9892	19.6494	(87)
Th 2	19.9297	19.9319	19.9340	19.9443	19.9462	19.9551	19.9551	19.9568	19.9517	19.9462	19.9423	19.9383	(88)
util rest of house	0.9980	0.9953	0.9858	0.9472	0.8350	0.6258	0.4272	0.4885	0.7978	0.9723	0.9956	0.9985	(89)
MIT 2	18.7231	18.8776	19.1519	19.5150	19.7927	19.9289	19.9520	19.9509	19.8655	19.4927	19.0468	18.7042	(90)
Living area fraction									fLA = Living area / (4) =			0.2203	(91)
MIT	18.9328	19.0871	19.3614	19.7248	20.0085	20.1521	20.1802	20.1775	20.0817	19.7007	19.2545	18.9125	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9328	19.0871	19.3614	19.7248	20.0085	20.1521	20.1802	20.1775	20.0817	19.7007	19.2545	18.9125	(93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	0.9973	0.9940	0.9830	0.9434	0.8381	0.6446	0.4547	0.5166	0.8077	0.9694	0.9944	0.9979	(94)
Ext temp.	333.5805	385.8899	443.8377	491.9141	475.2364	360.9994	242.6638	253.4333	352.4484	358.5353	324.4824	315.3456	(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	1030.4611	996.7488	901.5457	750.6247	574.9637	380.5752	245.4063	258.4686	411.5349	629.7891	844.5815	1026.7182	(97)
Space heating kWh	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	(97a)
Space heating	518.4791	410.4972	340.5347	186.2717	74.1971	0.0000	0.0000	0.0000	0.0000	201.8129	374.4714	529.2612	(98)
Space heating per m2												2635.5253	(98)
										(98) / (4) =		44.4589	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	644.3283	507.2372	520.0223	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8800	0.9345	0.9101	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	566.9860	474.0114	473.2656	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	728.1116	695.9669	646.8109	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	116.0104	165.1349	129.1177	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												410.2631	(104)

Regs Region: England

Elmhurst Energy Systems

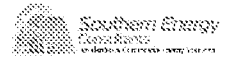
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FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

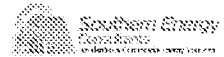


CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Cooled fraction											FC = cooled area / (4) =	1.0000 (105)
Intermittency factor (Table 10b)	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000 (106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	29.0026	41.2837	32.2794	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												102.5658 (107)
Space cooling per m2												1.7302 (108)
Energy for space heating												44.4589 (99)
Energy for space cooling												1.7302 (108)
Total												46.1891 (109)
Target Fabric Energy Efficiency (TFEE)												53.1 (109)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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 (m ²)	Storey height (m)	Volume (m ³)
Ground floor	30.6900 (1b)	x 2.3100 (2b)	= 70.8939 (1b) - (3b)
First floor	28.5900 (1c)	x 2.5400 (2c)	= 72.6186 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	59.2800		(3a) + (3b) + (3c) + (3d) + (3e) ... (3n) = 143.5125 (5)
Dwelling volume			

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					2 * 10 = 20.0000 (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) =					20.0000 / (5) = 0.1394 (8)
Pressure test					Yes
Measured/design q50					5.0000
Infiltration rate					0.3894 (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) =	0.3310 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.3000	4.8000	4.6000	4.3000	4.4000	4.1000	4.2000	4.0000	4.2000	4.6000	4.6000	4.9000 (22)
Wind factor	1.3250	1.2000	1.1500	1.0750	1.1000	1.0250	1.0500	1.0000	1.0500	1.1500	1.1500	1.2250 (22a)
Adj infilt rate	0.4385	0.3971	0.3806	0.3558	0.3641	0.3392	0.3475	0.3310	0.3475	0.3806	0.3806	0.4054 (22b)
Effective ac	0.5961	0.5789	0.5724	0.5633	0.5663	0.5575	0.5604	0.5548	0.5604	0.5724	0.5724	0.5822 (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
Opening Type 1			1.9500	1.3000	2.5350		(26)
Opening Type 2 (Uw = 1.40)			9.7800	1.3258	12.9659		(27)
Heat Loss Floor 1			30.6900	0.1800	5.5242		(28a)
External Wall 1	84.8800	11.7300	73.1500	0.2800	20.4820		(29a)
External Roof 1	30.6900		30.6900	0.1400	4.2966		(30)
Total net area of external elements Aum(A, m ²)			146.2600				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	45.8037		(33)
Party Wall 1			36.3800	0.0000	0.0000		(32)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							100.0000 (35)
Thermal bridges (User defined value 0.044 * total exposed area)							6.4354 (36)
Total fabric heat loss						(33) + (36) =	52.2391 (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	28.2331	27.4145	27.1097	26.6769	26.8179	26.4045	26.5391	26.2732	26.5391	27.1097	27.1097	27.5717 (38)
Heat transfer coeff	80.4722	79.6536	79.3488	78.9160	79.0571	78.6437	78.7782	78.5124	78.7782	79.3488	79.3488	79.8108 (39)
Average = Sum(39)m / 12 =												79.2224 (39)
HLP	1.3575	1.3437	1.3385	1.3312	1.3336	1.3266	1.3289	1.3244	1.3289	1.3385	1.3385	1.3463 (40)
HLP (average)												1.3364 (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

Average daily hot water use (litres/day)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	88.8565	85.6253	82.3942	79.1631	75.9319	72.7008	72.7008	75.9319	79.1631	82.3942	85.6253	88.8565 (44)
Energy conte	131.7716	115.2483	118.9259	103.6825	99.4858	85.8487	79.5514	91.2864	92.3767	107.6561	117.5151	127.6138 (45)
Energy content (annual)										Total = Sum(45)m =		1270.9623 (45)
Distribution loss (46)m = 0.15 x (45)m	19.7657	17.2872	17.8389	15.5524	14.9229	12.8773	11.9327	13.6930	13.8565	16.1484	17.6273	19.1421 (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)

Regs Region: England

Elmhurst Energy Systems

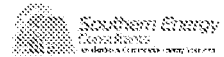
SAP2012 Calculator (Design

System) version 4.04r08



FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF HEAT DEMAND 09 Jan 2014

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	14.0376	12.6621	13.9917	13.5098	13.9379	13.4626	13.8954	13.9229	13.4883	13.9694	13.5543	14.0287 (61)
Total heat required for water heating calculated for each month	145.8092	127.9104	132.9176	117.1923	113.4237	99.3113	93.4468	105.2094	105.8650	121.6256	131.0694	141.6425 (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	145.8092	127.9104	132.9176	117.1923	113.4237	99.3113	93.4468	105.2094	105.8650	121.6256	131.0694	141.6425 (64)
RHI water heating demand	47.3235	41.4856	43.0408	37.8519	36.5635	31.9103	29.9247	33.8335	34.0873	39.2880	42.4623	45.9388 (65)
Heat gains from water heating, kWh/month												1435 (64)
												1435 (64)

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	117.6723	117.6723	117.6723	117.6723	117.6723	117.6723	117.6723	117.6723	117.6723	117.6723	117.6723	117.6723	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	39.5557	35.1330	28.5721	21.6309	16.1694	13.6509	14.7502	19.1729	25.7338	32.6750	38.1366	40.6551	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	255.4141	258.0645	251.3856	237.1670	219.2185	202.3495	191.0799	188.4295	195.1085	209.3271	227.2756	244.1446	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	48.7284	48.7284	48.7284	48.7284	48.7284	48.7284	48.7284	48.7284	48.7284	48.7284	48.7284	48.7284	(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)	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	(71)
Water heating gains (Table 5)	63.6068	61.7345	57.8505	52.5720	49.1445	44.3199	40.2214	45.4751	47.3435	52.8065	58.9755	61.7456	(72)
Total internal gains	449.5292	445.8846	428.7608	402.3225	375.4849	351.2728	337.0041	344.0301	359.1384	385.7611	415.3402	437.4979	(73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2		g Specific data or Table 6b		FF Specific data or Table 6c		Access factor Table 6d		Gains W
North				0.4400	14.2444		0.4500		0.0000		0.7700		2.1717 (74)
East				5.6900	26.6336		0.4500		0.0000		0.7700		52.5105 (76)
West				3.6500	26.6336		0.4500		0.0000		0.7700		33.6842 (80)
Solar gains	88.3664	145.7934	238.8138	361.6560	427.9864	471.6086	445.6055	385.1268	297.2774	186.6718	106.1159	69.9759	(83)
Total gains	537.8956	591.6780	667.5746	763.9785	803.4713	822.8814	782.6096	729.1569	656.4157	572.4329	521.4560	507.4738	(84)

7. Mean internal temperature (heating season)

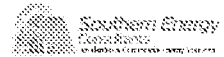
Temperature during heating periods in the living area from Table 9, Th1 (C)													21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	20.4625	20.6728	20.7522	20.8661	20.8288	20.9383	20.9026	20.9733	20.9026	20.7522	20.7522	20.6321	(86)
alpha	2.3642	2.3782	2.3835	2.3911	2.3886	2.3959	2.3935	2.3982	2.3935	2.3835	2.3835	2.3755	(87)
util living area	0.9153	0.8966	0.8488	0.7574	0.6308	0.4720	0.3579	0.3622	0.5770	0.7707	0.8812	0.9225	(88)
MIT	18.9225	19.1013	19.5502	20.1122	20.5768	20.8523	20.9453	20.9472	20.7558	20.2727	19.5389	18.8978	(89)
Th 2	19.7961	19.8068	19.8108	19.8164	19.8146	19.8200	19.8183	19.8217	19.8183	19.8108	19.8108	19.8047	(90)
util rest of house	0.9019	0.8808	0.8257	0.7205	0.5723	0.3897	0.2555	0.2530	0.4926	0.7231	0.8594	0.9101	(91)
MIT 2	17.1226	17.3804	18.0143	18.7867	19.3887	19.7081	19.7920	19.7982	19.6173	19.0235	18.0145	17.0939	(92)
Living area fraction	17.5192	17.7596	18.3527	19.0787	19.6504	19.9602	20.0461	20.0513	19.8681	19.2987	18.3504	17.4914	(93)
MIT	17.3692	17.6096	18.2027	18.9287	19.5004	19.8102	19.8961	19.9013	19.7181	19.1487	18.2004	17.3414	(94)
Temperature adjustment													(95)
adjusted MIT													(96)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	0.8648	0.8422	0.7864	0.6881	0.5551	0.3890	0.2626	0.2608	0.4847	0.6911	0.8203	0.8742	(97)
Ext temp.	465.1922	498.3222	525.0124	525.6660	446.0121	320.0898	205.4889	190.1405	318.1540	395.6272	427.7492	443.6431	(98)
Heat loss rate W	5.7000	5.9000	7.4000	9.7000	12.7000	15.4000	17.2000	17.4000	15.1000	12.2000	8.7000	5.8000	(99)
Month fracti	939.0428	932.7089	857.1815	728.2929	537.6210	346.8313	212.3941	196.3865	363.8073	551.3720	753.8435	921.1254	(100)
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	(101)
RHI space heating demand	352.5449	291.9078	247.1338	145.8914	68.1570	0.0000	0.0000	0.0000	0.0000	115.8742	234.7879	355.2468	(102)
												1811.5438	(103)
												1812	(104)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	30.6900 (1b)	x 2.3100 (2b)	= 70.8939 (1b) - (3b)
First floor	28.5900 (1c)	x 2.5400 (2c)	= 72.6186 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	59.2800		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 143.5125 (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					2 * 10 = 20.0000 (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)					20.0000 / (5) = 0.1394 (8)
Pressure test					Yes
Measured/design q50					5.0000
Infiltration rate					0.3894 (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) =	0.3310 (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	0.4220	0.4137	0.4054	0.3641	0.3558	0.3144	0.3144	0.3061	0.3310	0.3558	0.3723	0.3889 (22b)
Effective ac	0.5890	0.5856	0.5822	0.5663	0.5633	0.5494	0.5494	0.5469	0.5548	0.5633	0.5693	0.5756 (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			1.9500	1.3000	2.5350		(26)					
Opening Type 2 (Uw = 1.40)			9.7800	1.3258	12.9659		(27)					
Heat Loss Floor 1			30.6900	0.1800	5.5242		(28a)					
External Wall 1	84.8800	11.7300	73.1500	0.2800	20.4820		(29a)					
External Roof 1	30.6900		30.6900	0.1400	4.2966		(30)					
Total net area of external elements Aum(A, m2)			146.2600				(31)					
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		45.8037		(33)					
Party Wall 1			36.3800	0.0000	0.0000		(32)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							100.0000 (35)					
Thermal bridges (User defined value 0.044 * total exposed area)							6.4354 (36)					
Total fabric heat loss						(33) + (36) =	52.2391 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 27.8959	Feb 27.7322	Mar 27.5717	Apr 26.8179	May 26.6769	Jun 26.0204	Jul 26.0204	Aug 25.8988	Sep 26.2732	Oct 26.6769	Nov 26.9622	Dec 27.2605 (38)
Heat transfer coeff	80.1351	79.9713	79.8108	79.0571	78.9160	78.2595	78.2595	78.1379	78.5124	78.9160	79.2013	79.4996 (39)
Average = Sum(39)m / 12 =												79.0564 (39)
HLP	Jan 1.3518	Feb 1.3490	Mar 1.3463	Apr 1.3336	May 1.3312	Jun 1.3202	Jul 1.3202	Aug 1.3181	Sep 1.3244	Oct 1.3312	Nov 1.3361	Dec 1.3411 (40)
HLP (average)												1.3336 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												1.9612 (42)
Average daily hot water use (litres/day)												80.7786 (43)
Daily hot water use	88.8565	85.6253	82.3942	79.1631	75.9319	72.7008	72.7008	75.9319	79.1631	82.3942	85.6253	88.8565 (44)
Energy conte	131.7716	115.2483	118.9259	103.6825	99.4858	85.8487	79.5514	91.2864	92.3767	107.6561	117.5151	127.6138 (45)
Energy content (annual)										Total = Sum(45)m =		1270.9623 (45)
Distribution loss (46)m = 0.15 x (45)m	19.7657	17.2872	17.8389	15.5524	14.9229	12.8773	11.9327	13.6930	13.8565	16.1484	17.6273	19.1421 (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)

Regs Region: England

Elmhurst Energy Systems

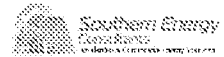
SAP2012 Calculator (Design

System) version 4.04r08



FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS 09 Jan 2014

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	14.0376	12.6621	13.9917	13.5098	13.9379	13.4626	13.8954	13.9229	13.4883	13.9694	13.5543	14.0287 (61)
Total heat required for water heating calculated for each month	145.8092	127.9104	132.9176	117.1923	113.4237	99.3113	93.4468	105.2094	105.8650	121.6256	131.0694	141.6425 (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	145.8092	127.9104	132.9176	117.1923	113.4237	99.3113	93.4468	105.2094	105.8650	121.6256	131.0694	141.6425 (64)
Heat gains from water heating, kWh/month	47.3235	41.4856	43.0408	37.8519	36.5635	31.9103	29.9247	33.8335	34.0873	39.2880	42.4623	45.9388 (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	117.6723	117.6723	117.6723	117.6723	117.6723	117.6723	117.6723	117.6723	117.6723	117.6723	117.6723	117.6723 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	39.5557	35.1330	28.5721	21.6309	16.1694	13.6509	14.7502	19.1729	25.7338	32.6750	38.1366	40.6551 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	255.4141	258.0645	251.3856	237.1670	219.2185	202.3495	191.0799	188.4295	195.1085	209.3271	227.2756	244.1446 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	48.7284	48.7284	48.7284	48.7284	48.7284	48.7284	48.7284	48.7284	48.7284	48.7284	48.7284	48.7284 (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)	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482 (71)
Water heating gains (Table 5)	63.6068	61.7345	57.8505	52.5720	49.1445	44.3199	40.2214	45.4751	47.3435	52.8065	58.9755	61.7456 (72)
Total internal gains	449.5292	445.8846	428.7608	402.3225	375.4849	351.2728	337.0041	344.0301	359.1384	385.7611	415.3402	437.4979 (73)

6. Solar gains

[Jan]					Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d		Gains W	
North					0.4400	10.6334	0.4500	0.0000	0.7700		1.6212 (74)	
East					5.6900	19.6403	0.4500	0.0000	0.7700		38.7224 (76)	
West					3.6500	19.6403	0.4500	0.0000	0.7700		24.8395 (80)	
Solar gains	65.1831	127.4389	210.0359	307.1031	377.3942	386.8638	368.0856	315.4331	244.4873	151.2287	81.2542	53.6218 (83)
Total gains	514.7123	573.3235	638.7967	709.4256	752.8791	738.1366	705.0897	659.4632	603.6257	536.9898	496.5944	491.1196 (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	20.5486	20.5907	20.6321	20.6288	20.8661	21.0411	21.0411	21.0738	20.9733	20.8661	20.7909	20.7129
alpha	2.3699	2.3727	2.3755	2.3886	2.3911	2.4027	2.4027	2.4049	2.3982	2.3911	2.3861	2.3809
util living area	0.9334	0.9130	0.8738	0.8013	0.6961	0.5613	0.4394	0.4791	0.6667	0.8356	0.9119	0.9395 (86)
MIT	18.5837	18.8457	19.3095	19.9003	20.4049	20.7537	20.9018	20.8761	20.6041	19.9451	19.1652	18.5290 (87)
Th 2	19.8005	19.8026	19.8047	19.8146	19.8164	19.8251	19.8251	19.8267	19.8217	19.8164	19.8127	19.8088 (88)
util rest of house	0.9235	0.9001	0.8547	0.7703	0.6463	0.4850	0.3379	0.3771	0.5963	0.8028	0.8967	0.9305 (89)
MIT 2	16.6369	17.0123	17.6727	18.5015	19.1771	19.6127	19.7661	19.7471	19.4500	18.5862	17.4841	16.5634 (90)
Living area fraction	17.0658	17.4162	18.0333	18.8096	19.4476	19.8641	20.0163	19.9958	19.7043	18.8856	17.8544	16.9964 (92)
Temperature adjustment	16.9158	17.2662	17.8833	18.6596	19.2976	19.7141	19.8663	19.8458	19.5543	18.7356	17.7044	-0.1500
adjusted MIT												16.8464 (93)

8. Space heating requirement

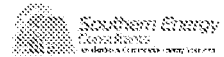
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.8895	0.8629	0.8151	0.7339	0.6215	0.4771	0.3417	0.3789	0.5780	0.7651	0.8597	0.8980 (94)
Useful gains	457.8460	494.7374	520.6823	520.6271	467.9020	352.1376	240.9198	249.8507	348.9011	410.8575	426.9045	441.0469 (95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000 (96)
Heat loss rate W	1010.9674	988.9422	908.5092	771.5682	599.5731	400.2243	255.6174	269.2472	428.2281	642.0278	839.8849	1005.3850 (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	411.5224	332.1056	288.5432	180.6776	97.9632	0.0000	0.0000	0.0000	0.0000	171.9907	297.3459	419.8675 (98)
Space heating	2200.0161 (98)											
Space heating per m2	(98) / (4) = 37.1123 (99)											

8c. Space cooling requirement

Not applicable

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS 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												2430.9570	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	411.5224	332.1056	288.5432	180.6776	97.9632	0.0000	0.0000	0.0000	0.0000	171.9907	297.3459	419.8675	(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)	454.7208	366.9675	318.8322	199.6438	108.2467	0.0000	0.0000	0.0000	0.0000	190.0450	328.5590	463.9420	(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	145.8092	127.9104	132.9176	117.1923	113.4237	99.3113	93.4468	105.2094	105.8650	121.6256	131.0694	141.6425	(64)
Efficiency of water heater (217)m	89.6404	89.5869	89.4658	89.2134	88.7544	87.3000	87.3000	87.3000	87.3000	89.1464	89.4964	89.6709	(216)
Fuel for water heating, kWh/month	162.6602	142.7780	148.5682	131.3617	127.7950	113.7586	107.0410	120.5147	121.2657	136.4335	146.4522	157.9582	(217)
Water heating fuel used												1616.5870	(219)
Annual totals kWh/year													
Space heating fuel - main system												2430.9570	(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)												279.4265	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.00 * 1080 * 0.80) =										-1381.7915		-1381.7915	(233)
Total delivered energy for all uses												3020.1790	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	2430.9570	3.4800	84.5973 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	1616.5870	3.4800	56.2572 (247)
Pumps and fans for heating	75.0000	13.1900	9.8925 (249)
Energy for lighting	279.4265	13.1900	36.8564 (250)
Additional standing charges			120.0000 (251)
Energy saving/generation technologies			
PV Unit	-1381.7915	13.1900	-182.2583 (252)
Total energy cost			125.3451 (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] = 0.5048 (257)
SAP value	92.9575
SAP rating (Section 12)	93 (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	2430.9570	0.2160	525.0867 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1616.5870	0.2160	349.1828 (264)
Space and water heating			874.2695 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	279.4265	0.5190	145.0224 (268)
Energy saving/generation technologies			
PV Unit	-1381.7915	0.5190	-717.1498 (269)
Total kg/year			341.0671 (272)
CO2 emissions per m2			5.7500 (273)
EI value			95.6173
EI rating			96 (274)
EI band			A

Calculation of stars for heating and DHW

Main heating energy efficiency	$3.48 \times (1 + 0.29 \times 0.00) / 0.9050 = 3.845$, stars = 4
Main heating environmental impact	$0.216 \times (1 + 0.29 \times 0.00) / 0.9050 = 0.2387$, stars = 4
Water heating energy efficiency	$3.48 / 0.8868 = 3.924$, stars = 4
Water heating environmental impact	$0.216 / 0.8868 = 0.2436$, stars = 4

Regs Region: England

Elmhurst Energy Systems

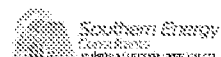
SAP2012 Calculator (Design

System) version 4.04r08



FULL SAP CALCULATION PRINTOUT

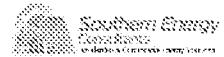
Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS 09 Jan 2014

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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 (m ²)	Storey height (m)	Volume (m ³)
Ground floor	30.6900 (1b)	x 2.3100 (2b)	= 70.8939 (1b) - (3b)
First floor	28.5900 (1c)	x 2.5400 (2c)	= 72.6186 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	59.2800		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 143.5125 (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					2 * 10 = 20.0000 (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) =					20.0000 / (5) = 0.1394 (8)
Pressure test					Yes
Measured/design q50					5.0000
Infiltration rate					0.3894 (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) =	0.3310 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.3000	4.8000	4.6000	4.3000	4.4000	4.1000	4.2000	4.0000	4.2000	4.6000	4.6000	4.9000 (22)
Wind factor	1.3250	1.2000	1.1500	1.0750	1.1000	1.0250	1.0500	1.0000	1.0500	1.1500	1.1500	1.2250 (22a)
Adj infilt rate	0.4385	0.3971	0.3806	0.3558	0.3641	0.3392	0.3475	0.3310	0.3475	0.3806	0.3806	0.4054 (22b)
Effective ac	0.5961	0.5789	0.5724	0.5633	0.5663	0.5575	0.5604	0.5548	0.5604	0.5724	0.5724	0.5822 (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
Opening Type 1			1.9500	1.3000	2.5350		(26)
Opening Type 2 (Uw = 1.40)			9.7800	1.3258	12.9659		(27)
Heat Loss Floor 1			30.6900	0.1800	5.5242		(28a)
External Wall 1	84.8800	11.7300	73.1500	0.2800	20.4820		(29a)
External Roof 1	30.6900		30.6900	0.1400	4.2966		(30)
Total net area of external elements Aum(A, m ²)			146.2600				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	45.8037		(33)
Party Wall 1			36.3800	0.0000	0.0000		(32)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							100.0000 (35)
Thermal bridges (User defined value 0.044 * total exposed area)							6.4354 (36)
Total fabric heat loss						(33) + (36) =	52.2391 (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	28.2331	27.4145	27.1097	26.6769	26.8179	26.4045	26.5391	26.2732	26.5391	27.1097	27.1097	27.5717 (38)
Heat transfer coeff	80.4722	79.6536	79.3488	78.9160	79.0571	78.6437	78.7782	78.5124	78.7782	79.3488	79.3488	79.8108 (39)
Average = Sum(39)m / 12 =												79.2224 (39)
HLP	1.3575	1.3437	1.3385	1.3312	1.3336	1.3266	1.3289	1.3244	1.3289	1.3385	1.3385	1.3463 (40)
HLP (average)												1.3364 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												1.9612 (42)
Average daily hot water use (litres/day)												80.7786 (43)
Daily hot water use	88.8565	85.6253	82.3942	79.1631	75.9319	72.7008	72.7008	75.9319	79.1631	82.3942	85.6253	88.8565 (44)
Energy conte	131.7716	115.2483	118.9259	103.6825	99.4858	85.8487	79.5514	91.2864	92.3767	107.6561	117.5151	127.6138 (45)
Energy content (annual)										Total = Sum(45)m =		1270.9623 (45)
Distribution loss (46)m = 0.15 x (45)m	19.7657	17.2872	17.8389	15.5524	14.9229	12.8773	11.9327	13.6930	13.8565	16.1484	17.6273	19.1421 (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)

Regs Region: England

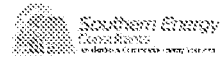
Elmhurst Energy Systems

SAP2012 Calculator (Design
System) version 4.04r08



FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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

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	14.0376	12.6621	13.9917	13.5098	13.9379	13.4626	13.8954	13.9229	13.4883	13.9694	13.5543	14.0287 (61)
Total heat required for water heating calculated for each month	145.8092	127.9104	132.9176	117.1923	113.4237	99.3113	93.4468	105.2094	105.8650	121.6256	131.0694	141.6425 (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	145.8092	127.9104	132.9176	117.1923	113.4237	99.3113	93.4468	105.2094	105.8650	121.6256	131.0694	141.6425 (64)
Heat gains from water heating, kWh/month	47.3235	41.4856	43.0408	37.8519	36.5635	31.9103	29.9247	33.8335	34.0873	39.2880	42.4623	45.9388 (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	117.6723	117.6723	117.6723	117.6723	117.6723	117.6723	117.6723	117.6723	117.6723	117.6723	117.6723	117.6723 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	39.5557	35.1330	28.5721	21.6309	16.1694	13.6509	14.7502	19.1729	25.7338	32.6750	38.1366	40.6551 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	255.4141	258.0645	251.3856	237.1670	219.2185	202.3495	191.0799	188.4295	195.1085	209.3271	227.2756	244.1446 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	48.7284	48.7284	48.7284	48.7284	48.7284	48.7284	48.7284	48.7284	48.7284	48.7284	48.7284	48.7284 (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)	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482 (71)
Water heating gains (Table 5)	63.6068	61.7345	57.8505	52.5720	49.1445	44.3199	40.2214	45.4751	47.3435	52.8065	58.9755	61.7456 (72)
Total internal gains	449.5292	445.8846	428.7608	402.3225	375.4849	351.2728	337.0041	344.0301	359.1384	385.7611	415.3402	437.4979 (73)

6. Solar gains

[Jan]					Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d		Gains W	
North					0.4400	14.2444	0.4500	0.0000	0.7700		2.1717 (74)	
East					5.6900	26.6336	0.4500	0.0000	0.7700		52.5105 (76)	
West					3.6500	26.6336	0.4500	0.0000	0.7700		33.6842 (80)	
Solar gains	88.3664	145.7934	238.8138	361.6560	427.9864	471.6086	445.6055	385.1268	297.2774	186.6718	106.1159	69.9759 (83)
Total gains	537.8956	591.6780	667.5746	763.9785	803.4713	822.8814	782.6096	729.1569	656.4157	572.4329	521.4560	507.4738 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Thl (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	20.4625	20.6728	20.7522	20.8661	20.8288	20.9383	20.9026	20.9733	20.9026	20.7522	20.7522	20.6321
alpha	2.3642	2.3782	2.3835	2.3911	2.3886	2.3959	2.3935	2.3982	2.3935	2.3835	2.3835	2.3755
util living area	0.9153	0.8966	0.8488	0.7574	0.6308	0.4720	0.3579	0.3622	0.5770	0.7707	0.8812	0.9225 (86)
MIT	18.9225	19.1013	19.5502	20.1122	20.5768	20.8523	20.9453	20.9472	20.7558	20.2727	19.5389	18.8978 (87)
Th 2	19.7961	19.8068	19.8108	19.8164	19.8146	19.8200	19.8183	19.8217	19.8183	19.8108	19.8108	19.8047 (88)
util rest of house	0.9019	0.8808	0.8257	0.7205	0.5723	0.3897	0.2555	0.2530	0.4926	0.7231	0.8594	0.9101 (89)
MIT 2	17.1226	17.3804	18.0143	18.7867	19.3887	19.7081	19.7920	19.7982	19.6173	19.0235	18.0145	17.0939 (90)
Living area fraction	17.5192	17.7596	18.3527	19.0787	19.6504	19.9602	20.0461	20.0513	19.8681	19.2987	18.3504	17.4914 (92)
Temperature adjustment	17.3692	17.6096	18.2027	18.9287	19.5004	19.8102	19.8961	19.9013	19.7181	19.1487	18.2004	17.3414 (93)

8. Space heating requirement

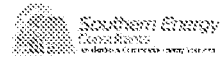
Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	465.1922	498.3222	525.0124	525.6660	446.0121	320.0898	205.4889	190.1405	318.1540	395.6272	427.7492	443.6431 (95)
Ext temp.	5.7000	5.9000	7.4000	9.7000	12.7000	15.4000	17.2000	17.4000	15.1000	12.2000	8.7000	5.8000 (96)
Heat loss rate W	939.0428	932.7089	857.1815	728.2929	537.6210	346.8313	212.3941	196.3865	363.8073	551.3720	753.8435	921.1254 (97)
Month fracti	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 kWh	352.5449	291.9078	247.1338	145.8914	68.1570	0.0000	0.0000	0.0000	0.0000	115.8742	234.7879	355.2468 (98)
Space heating	1811.5438 (98)											
Space heating per m2	(98) / (4) = 30.5591 (99)											

8c. Space cooling requirement

Not applicable

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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													2001.7058 (211)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Space heating requirement	352.5449	291.9078	247.1338	145.8914	68.1570	0.0000	0.0000	0.0000	0.0000	115.8742	234.7879	355.2468	(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)	389.5523	322.5501	273.0760	161.2060	75.3116	0.0000	0.0000	0.0000	0.0000	128.0377	259.4341	392.5379	(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	145.8092	127.9104	132.9176	117.1923	113.4237	99.3113	93.4468	105.2094	105.8650	121.6256	131.0694	141.6425	(64)
Efficiency of water heater (217)m	89.5397	89.5004	89.3545	89.0460	88.4742	87.3000	87.3000	87.3000	87.3000	88.8325	89.3270	89.5642	(217)
Fuel for water heating, kWh/month	162.8430	142.9159	148.7531	131.6086	128.1997	113.7586	107.0410	120.5147	121.2657	136.9156	146.7299	158.1464	(219)
Water heating fuel used												1618.6924	(219)
Annual totals kWh/year													
Space heating fuel - main system												2001.7058	(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)												279.4265	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.00 * 1284 * 0.80) =										-1643.2472		-1643.2472	(233)
Total delivered energy for all uses												2331.5775	(238)

10a. Fuel costs - using BEDF prices (417)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	2001.7058	4.1000	82.0699 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	1618.6924	4.1000	66.3664 (247)
Pumps and fans for heating	75.0000	15.7000	11.7750 (249)
Energy for lighting	279.4265	15.7000	43.8700 (250)
Additional standing charges			89.0000 (251)
Energy saving/generation technologies			
PV Unit	-1643.2472	15.7000	-257.9898 (252)
Total energy cost			35.0915 (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	2001.7058	0.2160	432.3685 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1618.6924	0.2160	349.6376 (264)
Space and water heating			782.0060 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	279.4265	0.5190	145.0224 (268)
Energy saving/generation technologies			
PV Unit	-1643.2472	0.5190	-852.8453 (269)
Total kg/year			113.1081 (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	2001.7058	1.2200	2442.0811 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1618.6924	1.2200	1974.8047 (264)
Space and water heating			4416.8858 (265)
Pumps and fans	75.0000	3.0700	230.2500 (267)
Energy for lighting	279.4265	3.0700	857.8394 (268)
Energy saving/generation technologies			
PV Unit	-1643.2472	3.0700	-5044.7688 (269)
Primary energy kWh/year			460.2063 (272)
Primary energy kWh/m2/year			7.7633 (273)

SAP 2012 EPC IMPROVEMENTS

Regs Region: England

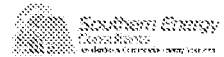
Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.04r08

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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

Current energy efficiency rating: A 93
Current environmental impact rating: A 96

(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	+ 1.3	-£ 29	-170 kg (150.4%)

Recommended measures	Typical annual savings	Energy efficiency	Environmental impact
Solar water heating	£29 2.87 kg/m²	A 94	A 98
Total Savings	£29 2.87 kg/m²		

Potential energy efficiency rating: A 94
Potential environmental impact rating: A 98

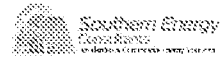
Fuel prices for cost data on this page from database revision number 417 TEST (24 Aug 2017)
Recommendation texts revision number 4.9c (22 Feb 2014)

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

	Current	Potential	Saving
Electricity	£56	£63	-£8
Mains gas	£237	£200	£37
Space heating	£183	£183	£0
Water heating	£66	£37	£29
Lighting	£44	£44	£0
Generated (PV)	-£258	-£258	£0
Total cost of fuels	£35	£5	£29
Total cost of uses	£35	£6	£29
Delivered energy	39 kWh/m²	25 kWh/m²	14 kWh/m²
Carbon dioxide emissions	0.1 tonnes	-0.1 tonnes	0.2 tonnes
CO2 emissions per m²	2 kg/m²	-1 kg/m²	3 kg/m²
Primary energy	8 kWh/m²	-8 kWh/m²	16 kWh/m²

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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 (m ²)	Storey height (m)	Volume (m ³)
Ground floor	30.6900 (1b)	x 2.3100 (2b)	= 70.8939 (1b) - (3b)
First floor	28.5900 (1c)	x 2.5400 (2c)	= 72.6186 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	59.2800		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 143.5125 (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					2 * 10 = 20.0000 (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)					20.0000 / (5) = 0.1394 (8)
Pressure test					Yes
Measured/design q50					5.0000
Infiltration rate					0.3894 (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) =	0.3310 (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	0.4220	0.4137	0.4054	0.3641	0.3558	0.3144	0.3144	0.3061	0.3310	0.3558	0.3723	0.3889 (22b)
Effective ac	0.5890	0.5856	0.5822	0.5663	0.5633	0.5494	0.5494	0.5469	0.5548	0.5633	0.5693	0.5756 (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			1.9500	1.3000	2.5350		(26)					
Opening Type 2 (Uw = 1.40)			9.7800	1.3258	12.9659		(27)					
Heat Loss Floor 1			30.6900	0.1800	5.5242		(28a)					
External Wall 1	84.8800	11.7300	73.1500	0.2800	20.4820		(29a)					
External Roof 1	30.6900		30.6900	0.1400	4.2966		(30)					
Total net area of external elements Aum(A, m2)			146.2600				(31)					
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		45.8037		(33)					
Party Wall 1			36.3800	0.0000	0.0000		(32)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							100.0000 (35)					
Thermal bridges (User defined value 0.044 * total exposed area)							6.4354 (36)					
Total fabric heat loss						(33) + (36) =	52.2391 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 27.8959	Feb 27.7322	Mar 27.5717	Apr 26.8179	May 26.6769	Jun 26.0204	Jul 26.0204	Aug 25.8988	Sep 26.2732	Oct 26.6769	Nov 26.9622	Dec 27.2605 (38)
Heat transfer coeff	80.1351	79.9713	79.8108	79.0571	78.9160	78.2595	78.2595	78.1379	78.5124	78.9160	79.2013	79.4996 (39)
Average = Sum(39)m / 12 =												79.0564 (39)
HLP	Jan 1.3518	Feb 1.3490	Mar 1.3463	Apr 1.3336	May 1.3312	Jun 1.3202	Jul 1.3202	Aug 1.3181	Sep 1.3244	Oct 1.3312	Nov 1.3361	Dec 1.3411 (40)
HLP (average)												1.3336 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												1.9612 (42)
Average daily hot water use (litres/day)												80.7786 (43)
Daily hot water use	88.8565	85.6253	82.3942	79.1631	75.9319	72.7008	72.7008	75.9319	79.1631	82.3942	85.6253	88.8565 (44)
Energy conte	131.7716	115.2483	118.9259	103.6825	99.4858	85.8487	79.5514	91.2864	92.3767	107.6561	117.5151	127.6138 (45)
Energy content (annual)										Total = Sum(45)m =		1270.9623 (45)
Distribution loss (46)m = 0.15 x (45)m	19.7657	17.2872	17.8389	15.5524	14.9229	12.8773	11.9327	13.6930	13.8565	16.1484	17.6273	19.1421 (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)

Regs Region: England

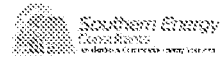
Elmhurst Energy Systems

SAP2012 Calculator (Design
System) version 4.04r08



FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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	14.0376	12.6621	13.9917	13.5098	13.9379	13.4626	13.8954	13.9229	13.4883	13.9694	13.5543	14.0287 (61)
Total heat required for water heating calculated for each month	145.8092	127.9104	132.9176	117.1923	113.4237	99.3113	93.4468	105.2094	105.8650	121.6256	131.0694	141.6425 (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												1.4270 (H8)
Utilisation factor												0.5038 (H9)
Collector performance factor												0.8793 (H10)
Dedicated solar storage volume												75.0000 (H11)
Effective solar volume												75.0000 (H13)
Daily hot water demand												80.7786 (H14)
Volume ratio Veff/V												0.9285 (H15)
Solar storage volume factor												0.9852 (H16)
Solar input												-791.4917 (H17)
Solar input	-22.9517	-38.2998	-65.2289	-87.4196	-107.9995	-106.1807	-104.7775	-91.5446	-71.6978	-48.9612	-27.2240	-19.2066 (63)
												-791.4917 (63)
Solar input (sum of months) = Sum(63)m =												
Output from w/h	122.8575	89.6106	67.6888	29.7727	5.4242	0.0000	0.0000	13.6647	34.1672	72.6644	103.8454	122.4358 (64)
Total per year (kWh/year) = Sum(64)m =												662.1313 (64)
Heat gains from water heating, kWh/month	47.3235	41.4856	43.0408	37.8519	36.5635	31.9103	29.9247	33.8335	34.0873	39.2880	42.4623	45.9388 (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	117.6723	117.6723	117.6723	117.6723	117.6723	117.6723	117.6723	117.6723	117.6723	117.6723	117.6723	117.6723 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	39.5557	35.1330	28.5721	21.6309	16.1694	13.6509	14.7502	19.1729	25.7338	32.6750	38.1366	40.6551 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	255.4141	258.0645	251.3856	237.1670	219.2185	202.3495	191.0799	188.4295	195.1085	209.3271	227.2756	244.1446 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	48.7284	48.7284	48.7284	48.7284	48.7284	48.7284	48.7284	48.7284	48.7284	48.7284	48.7284	48.7284 (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)	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482 (71)
Water heating gains (Table 5)	63.6068	61.7345	57.8505	52.5720	49.1445	44.3199	40.2214	45.4751	47.3435	52.8065	58.9755	61.7456 (72)
Total internal gains	449.5292	445.8846	428.7608	402.3225	375.4849	351.2728	337.0041	344.0301	359.1384	385.7611	415.3402	437.4979 (73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2		g Specific data or Table 6b		FF Specific data or Table 6c		Access factor Table 6d		Gains W
North				0.4400	10.6334		0.4500		0.0000		0.7700		1.6212 (74)
East				5.6900	19.6403		0.4500		0.0000		0.7700		38.7224 (76)
West				3.6500	19.6403		0.4500		0.0000		0.7700		24.8395 (80)
Solar gains	65.1831	127.4389	210.0359	307.1031	377.3942	386.8638	368.0856	315.4331	244.4873	151.2287	81.2542	53.6218	(83)
Total gains	514.7123	573.3235	638.7967	709.4256	752.8791	738.1366	705.0897	659.4632	603.6257	536.9898	496.5944	491.1196	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Thl (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
tau	20.5486	20.5907	20.6321	20.8288	20.8661	21.0411	21.0411	21.0738	20.9733	20.8661	20.7909	20.7129
alpha	2.3699	2.3727	2.3755	2.3886	2.3911	2.4027	2.4027	2.4049	2.3982	2.3911	2.3861	2.3809
util living area	0.9334	0.9130	0.8738	0.8013	0.6961	0.5613	0.4394	0.4791	0.6667	0.8356	0.9119	0.9395 (86)
MIT	18.5837	18.8457	19.3095	19.9003	20.4049	20.7537	20.9018	20.8761	20.6041	19.9451	19.1652	18.5290 (87)
Th 2	19.8005	19.8026	19.8047	19.8146	19.8164	19.8251	19.8251	19.8267	19.8217	19.8164	19.8127	19.8088 (88)
util rest of house	0.9235	0.9001	0.8547	0.7703	0.6463	0.4850	0.3379	0.3771	0.5963	0.8028	0.8967	0.9305 (89)
MIT 2	16.6369	17.0123	17.6727	18.5015	19.1771	19.6127	19.7661	19.7471	19.4500	18.5862	17.4841	16.5634 (90)
Living area fraction									fLA = Living area / (4) =			0.2203 (91)
MIT	17.0658	17.4162	18.0333	18.8096	19.4476	19.8641	20.0163	19.9958	19.7043	18.8856	17.8544	16.9964 (92)
Temperature adjustment												-0.1500
adjusted MIT	16.9158	17.2662	17.8833	18.6596	19.2976	19.7141	19.8663	19.8458	19.5543	18.7356	17.7044	16.8464 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	0.8895	0.8629	0.8151	0.7339	0.6215	0.4771	0.3417	0.3789	0.5780	0.7651	0.8597	0.8980 (94)

Regs Region: England

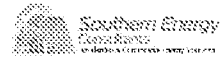
Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.04r08

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Useful gains	457.8460	494.7374	520.6823	520.6271	467.9020	352.1376	240.9198	249.8507	348.9011	410.8575	426.9045	441.0469 (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												
Month fracti	1010.9674	988.9422	908.5092	771.5682	599.5731	400.2243	255.6174	269.2472	428.2281	642.0278	839.8849	1005.3850 (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	411.5224	332.1056	288.5432	180.6776	97.9632	0.0000	0.0000	0.0000	0.0000	171.9907	297.3459	419.8675 (98)
Space heating per m2												2200.0161 (98)
											(98) / (4) =	37.1123 (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												2430.9570 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	411.5224	332.1056	288.5432	180.6776	97.9632	0.0000	0.0000	0.0000	0.0000	171.9907	297.3459	419.8675 (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)	454.7208	366.9675	318.8322	199.6438	108.2467	0.0000	0.0000	0.0000	0.0000	190.0450	328.5590	463.9420 (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	122.8575	89.6106	67.6888	29.7727	5.4242	0.0000	0.0000	13.6647	34.1672	72.6644	103.8454	122.4358 (64)
Efficiency of water heater	89.7437	89.8006	89.8740	90.0331	90.3263	87.3000	87.3000	87.3000	87.3000	89.5253	89.6494	87.3000 (216)
Fuel for water heating, kWh/month	136.8982	99.7885	75.3152	33.0686	6.0051	0.0000	0.0000	15.6526	39.1377	81.1663	115.8350	89.7572 (217)
Water heating fuel used												136.4078 (219)
Annual totals kWh/year												739.2749 (219)
Space heating fuel - main system												2430.9570 (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)												279.4265 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV Unit 0 (0.80 * 2.00 * 1080 * 0.80) =									-1381.7915			-1381.7915 (233)
Total delivered energy for all uses												2192.8670 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	2430.9570	3.4800	84.5973 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	739.2749	3.4800	25.7268 (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	279.4265	13.1900	36.8564 (250)
Additional standing charges			120.0000 (251)
Energy saving/generation technologies			
PV Unit	-1381.7915	13.1900	-182.2583 (252)
Total energy cost			101.4096 (255)

11a. SAP rating - Individual heating systems

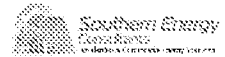
Energy cost deflator (Table 12):		0.4200 (256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.4084 (257)
SAP value		94.3023
SAP rating (Section 12)		94 (258)
SAP band		A

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	2430.9570	0.2160	525.0867 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	739.2749	0.2160	159.6834 (264)
Space and water heating			684.7701 (265)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

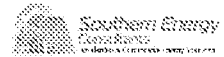


CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Pumps and fans	125.0000	0.5190	64.8750 (267)
Energy for lighting	279.4265	0.5190	145.0224 (268)
Energy saving/generation technologies			
PV Unit			
Total kg/year	-1381.7915	0.5190	-717.1498 (269)
CO2 emissions per m2			177.5177 (272)
EI value			2.9900 (273)
EI rating			97.7189
EI band			98 (274)
			A

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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 (m ²)	Storey height (m)	Volume (m ³)
Ground floor	30.6900 (1b)	x 2.3100 (2b)	= 70.8939 (1b) - (3b)
First floor	28.5900 (1c)	x 2.5400 (2c)	= 72.6186 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	59.2800		(4)
Dwelling volume		(3a) + (3b) + (3c) + (3d) + (3e) ... (3n) =	143.5125 (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					2 * 10 = 20.0000 (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) =					20.0000 / (5) = 0.1394 (8)
Pressure test					Yes
Measured/design q50					5.0000
Infiltration rate					0.3894 (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) =	0.3310 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.3000	4.8000	4.6000	4.3000	4.4000	4.1000	4.2000	4.0000	4.2000	4.6000	4.6000	4.9000 (22)
Wind factor	1.3250	1.2000	1.1500	1.0750	1.1000	1.0250	1.0500	1.0000	1.0500	1.1500	1.1500	1.2250 (22a)
Adj infilt rate	0.4385	0.3971	0.3806	0.3558	0.3641	0.3392	0.3475	0.3310	0.3475	0.3806	0.3806	0.4054 (22b)
Effective ac	0.5961	0.5789	0.5724	0.5633	0.5663	0.5575	0.5604	0.5548	0.5604	0.5724	0.5724	0.5822 (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
Opening Type 1			1.9500	1.3000	2.5350		(26)
Opening Type 2 (Uw = 1.40)			9.7800	1.3258	12.9659		(27)
Heat Loss Floor 1			30.6900	0.1800	5.5242		(28a)
External Wall 1	84.8800	11.7300	73.1500	0.2800	20.4820		(29a)
External Roof 1	30.6900		30.6900	0.1400	4.2966		(30)
Total net area of external elements Aum(A, m ²)			146.2600				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	45.8037		(33)
Party Wall 1			36.3800	0.0000	0.0000		(32)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							100.0000 (35)
Thermal bridges (User defined value 0.044 * total exposed area)							6.4354 (36)
Total fabric heat loss						(33) + (36) =	52.2391 (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	28.2331	27.4145	27.1097	26.6769	26.8179	26.4045	26.5391	26.2732	26.5391	27.1097	27.1097	27.5717 (38)
Heat transfer coeff	80.4722	79.6536	79.3488	78.9160	79.0571	78.6437	78.7782	78.5124	78.7782	79.3488	79.3488	79.8108 (39)
Average = Sum(39)m / 12 =												79.2224 (39)
HLP	1.3575	1.3437	1.3385	1.3312	1.3336	1.3266	1.3289	1.3244	1.3289	1.3385	1.3385	1.3463 (40)
HLP (average)												1.3364 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												1.9612 (42)
Average daily hot water use (litres/day)												80.7786 (43)
Daily hot water use	88.8565	85.6253	82.3942	79.1631	75.9319	72.7008	72.7008	75.9319	79.1631	82.3942	85.6253	88.8565 (44)
Energy conte	131.7716	115.2483	118.9259	103.6825	99.4858	85.8487	79.5514	91.2864	92.3767	107.6561	117.5151	127.6138 (45)
Energy content (annual)										Total = Sum(45)m =		1270.9623 (45)
Distribution loss (46)m = 0.15 x (45)m	19.7657	17.2872	17.8389	15.5524	14.9229	12.8773	11.9327	13.6930	13.8565	16.1484	17.6273	19.1421 (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)

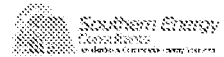
Regs Region: England

Elmhurst Energy Systems

SAP2012 Calculator (Design
System) version 4.04r08

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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

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	0.0000 (57)
Combi loss	14.0376	12.6621	13.9917	13.5098	13.9379	13.4626	13.8954	13.9229	13.4883	13.9694	13.5543	14.0287	(61)
Total heat required for water heating calculated for each month	145.8092	127.9104	132.9176	117.1923	113.4237	99.3113	93.4468	105.2094	105.8650	121.6256	131.0694	141.6425	(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													1283.7868 (H5)
Overshading factor													0.8000 (H6)
Solar energy available													2156.7619 (H7)
Adjustment factor for showers													1.0000 (H7a)
Solar-to-load ratio													1.6970 (H8)
Utilisation factor													0.4453 (H9)
Collector performance factor													0.8793 (H10)
Dedicated solar storage volume													75.0000 (H11)
Effective solar volume													75.0000 (H13)
Daily hot water demand													80.7786 (H14)
Volume ratio Veff/V													0.9285 (H15)
Solar storage volume factor													0.9852 (H16)
Solar input													-831.9053 (H17)
Solar input	-26.9611	-38.0270	-64.6062	-90.1225	-107.6097	-113.8954	-111.5410	-98.0071	-76.0898	-52.5143	-30.8186	-21.7126	(63)
													-831.9053 (63)
Solar input (sum of months) = Sum(63)m =													
Output from w/h	118.8481	89.8834	68.3114	27.0698	5.8139	0.0000	0.0000	7.2022	29.7752	69.1113	100.2508	119.9299	(64)
Total per year (kWh/year) = Sum(64)m =													636.1960 (64)
Heat gains from water heating, kWh/month	47.3235	41.4856	43.0408	37.8519	36.5635	31.9103	29.9247	33.8335	34.0873	39.2880	42.4623	45.9388	(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	117.6723	117.6723	117.6723	117.6723	117.6723	117.6723	117.6723	117.6723	117.6723	117.6723	117.6723	117.6723	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	39.5557	35.1330	28.5721	21.6309	16.1694	13.6509	14.7502	19.1729	25.7338	32.6750	38.1366	40.6551	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	255.4141	258.0645	251.3856	237.1670	219.2185	202.3495	191.0799	188.4295	195.1085	209.3271	227.2756	244.1446	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	48.7284	48.7284	48.7284	48.7284	48.7284	48.7284	48.7284	48.7284	48.7284	48.7284	48.7284	48.7284	(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)	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	(71)
Water heating gains (Table 5)	63.6068	61.7345	57.8505	52.5720	49.1445	44.3199	40.2214	45.4751	47.3435	52.8065	58.9755	61.7456	(72)
Total internal gains	449.5292	445.8846	428.7608	402.3225	375.4849	351.2728	337.0041	344.0301	359.1384	385.7611	415.3402	437.4979	(73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2		g Specific data or Table 6b		FF Specific data or Table 6c		Access factor Table 6d		Gains W
North				0.4400	14.2444		0.4500		0.0000		0.7700		2.1717 (74)
East				5.6900	26.6336		0.4500		0.0000		0.7700		52.5105 (76)
West				3.6500	26.6336		0.4500		0.0000		0.7700		33.6842 (80)
Solar gains	88.3664	145.7934	238.8138	361.6560	427.9864	471.6086	445.6055	385.1268	297.2774	186.6718	106.1159		69.9759 (83)
Total gains	537.8956	591.6780	667.5746	763.9785	803.4713	822.8814	782.6096	729.1569	656.4157	572.4329	521.4560		507.4738 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Thl (C)													21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
tau	20.4625	20.6728	20.7522	20.8661	20.8288	20.9383	20.9026	20.9733	20.9026	20.7522	20.7522	20.6321	
alpha	2.3642	2.3782	2.3835	2.3911	2.3886	2.3959	2.3935	2.3982	2.3935	2.3835	2.3835	2.3755	
util living area	0.9153	0.8966	0.8488	0.7574	0.6308	0.4720	0.3579	0.3622	0.5770	0.7707	0.8812	0.9225	(86)
MIT	18.9225	19.1013	19.5502	20.1122	20.5768	20.8523	20.9453	20.9472	20.7558	20.2727	19.5389	18.8978	(87)
Th 2	19.7961	19.8068	19.8108	19.8164	19.8146	19.8200	19.8183	19.8217	19.8183	19.8108	19.8108	19.8047	(88)
util rest of house	0.9019	0.8808	0.8257	0.7205	0.5723	0.3897	0.2555	0.2530	0.4926	0.7231	0.8594	0.9101	(89)
MIT 2	17.1226	17.3804	18.0143	18.7867	19.3887	19.7081	19.7920	19.7982	19.6173	19.0235	18.0145	17.0939	(90)
Living area fraction									fLA = Living area / (4) =			0.2203	(91)
MIT	17.5192	17.7596	18.3527	19.0787	19.6504	19.9602	20.0461	20.0513	19.8681	19.2987	18.3504	17.4914	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.3692	17.6096	18.2027	18.9287	19.5004	19.8102	19.8961	19.9013	19.7181	19.1487	18.2004	17.3414	(93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	0.8648	0.8422	0.7864	0.6881	0.5551	0.3890	0.2626	0.2608	0.4847	0.6911	0.8203	0.8742	(94)

Regs Region: England

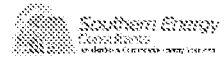
Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.04r08

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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

Useful gains	465.1922	498.3222	525.0124	525.6660	446.0121	320.0898	205.4889	190.1405	318.1540	395.6272	427.7492	443.6431 (95)
Ext temp.	5.7000	5.9000	7.4000	9.7000	12.7000	15.4000	17.2000	17.4000	15.1000	12.2000	8.7000	5.8000 (96)
Heat loss rate W												
Month fracti	939.0428	932.7089	857.1815	728.2929	537.6210	346.8313	212.3941	196.3865	363.8073	551.3720	753.8435	921.1254 (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	352.5449	291.9078	247.1338	145.8914	68.1570	0.0000	0.0000	0.0000	0.0000	115.8742	234.7879	355.2468 (98)
Space heating per m2											(98) / (4) =	30.5591 (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												2001.7058 (211)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	352.5449	291.9078	247.1338	145.8914	68.1570	0.0000	0.0000	0.0000	0.0000	115.8742	234.7879	355.2468 (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)	389.5523	322.5501	273.0760	161.2060	75.3116	0.0000	0.0000	0.0000	0.0000	128.0377	259.4341	392.5379 (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	118.8481	89.8834	68.3114	27.0698	5.8139	0.0000	0.0000	7.2022	29.7752	69.1113	100.2508	119.9299 (64)
Efficiency of water heater (217)m	89.6713	89.7257	89.7873	89.9838	90.2400	87.3000	87.3000	87.3000	87.3000	89.2774	89.5182	87.3000 (216)
Fuel for water heating, kWh/month	132.5375	100.1758	76.0814	30.0830	6.4427	0.0000	0.0000	8.2500	34.1068	77.4119	111.9893	133.7452 (219)
Water heating fuel used												710.8234 (219)
Annual totals kWh/year												
Space heating fuel - main system												2001.7058 (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)												279.4265 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV Unit 0 (0.80 * 2.00 * 1284 * 0.80) =									-1643.2472			-1643.2472 (233)
Total delivered energy for all uses												1473.7086 (238)

10a. Fuel costs - using BEDF prices (417)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	2001.7058	4.1000	82.0699 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	710.8234	4.1000	29.1438 (247)
Pumps and fans for heating	75.0000	15.7000	11.7750 (249)
Pump for solar water heating	50.0000	15.7000	7.8500 (249)
Energy for lighting	279.4265	15.7000	43.8700 (250)
Additional standing charges			89.0000 (251)
Energy saving/generation technologies			
PV Unit	-1643.2472	15.7000	-257.9898 (252)
Total energy cost			5.7189 (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	2001.7058	0.2160	432.3685 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	710.8234	0.2160	153.5379 (264)
Space and water heating			585.9063 (265)
Pumps and fans	125.0000	0.5190	64.8750 (267)
Energy for lighting	279.4265	0.5190	145.0224 (268)
Energy saving/generation technologies			
PV Unit	-1643.2472	0.5190	-852.8453 (269)
Total kg/year			-57.0416 (272)

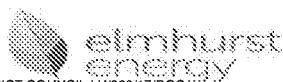
13a. Primary energy - Individual heating systems including micro-CHP

Regs Region: England

Elmhurst Energy Systems

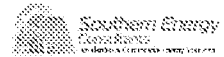
SAP2012 Calculator (Design

System) version 4.04r08



FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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	2001.7058	1.2200	2442.0811 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	710.8234	1.2200	867.2046 (264)
Space and water heating			3309.2857 (265)
Pumps and fans	125.0000	3.0700	383.7500 (267)
Energy for lighting	279.4265	3.0700	857.8394 (268)
Energy saving/generation technologies			
PV Unit	-1643.2472	3.0700	-5044.7688 (269)
Primary energy kWh/year			-493.8938 (272)
Primary energy kWh/m2/year			-8.3315 (273)

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

Overheating Calculation Input Data

Dwelling type	EndTerrace House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	South East England
Front of dwelling faces	West
Overshading	Average or unknown
Thermal mass parameter	100.0
Night ventilation	Yes
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	189.44 (P1)
Transmission heat loss coefficient	52.24 (37)
Summer heat loss coefficient	241.68 (P2)

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

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

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North	0.4400	86.6589	0.4500	0.0000	0.9000	15.4426
East	5.6900	124.7972	0.4500	0.0000	0.9000	287.5890
West	3.6500	124.7972	0.4500	0.0000	0.9000	184.4815

total: 487.5131

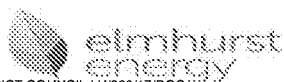
Solar gains	Jun	Jul	Aug	(P4)
Internal gains	518	488	423	
Total summer gains	348	334	341	
	866	822	764	(P5)
Summer gain/loss ratio	3.58	3.40	3.16	(P6)
Summer external temperature	15.40	17.40	17.50	
Thermal mass temperature increment (TMP = 100.0)	1.30	1.30	1.30	
Threshold temperature	20.28	22.10	21.96	(P7)
Likelihood of high internal temperature	Not significant	Medium	Slight	
Assessment of likelihood of high internal temperature:	Medium			

Regs Region: England

Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.04r08



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